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KEY TO PRONUNCIATION.

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

′ (prime), ″ (secondary) accents, to indicate syllabic stress

THE ENCYCLOPEDIA AMERICANA

Great-crested Flycatcher, a large flycatcher (*Myiarchus crinitus*), which is a summer visitor to all parts of temperate North America, and is noted for its shrill, yet musical scream, and for its habit of entwining one or more cast-off snake-skins in its large tree-lodged nest. It is olive-brown above, with an ashy head surmounted by a tall brownish crest, and the lower parts delicate yellow. Several other species belong to the southwestern States and Mexico, and are often called crested kingbirds.

Great Dane, a breed of large, smooth-coated dogs, the modern equivalent of the ancient boar-hound. See DOG.

Great Divide, The. See DIVIDE, THE GREAT.

Great Eastern, a British iron steamship, before the Celtic the largest vessel constructed, built (1854–8) at Milwall, on the Thames, for the Eastern Steam Navigation Company, by Scott Russell, from plans by I. K. Brunel; length 680 feet; breadth, 82½, or, including paddle-boxes, 118 feet; height, 58 feet (70 to top of bulwarks). She had 6 masts, 5 of iron and 1 of wood, and could spread 7,000 yards of sail, besides having 8 engines, divided between her screws and paddles, and capable of working at 11,000 horse-power. From the first her career was unfortunate, the launching process alone lasting three months and costing $300,000. After several unremunerative trips to New York she was employed first as a troop-ship, and then as a cable-laying ship, for which her size and steadiness specially qualified her. Various attempts were afterward made to utilize her, but she at last came to be a mere holiday spectacle, and was broken up in 1888.

Great Expectations, a novel by Charles Dickens, published in 1861. As in 'David Copperfield,' the hero tells his own story from boyhood. Owing to the simplicity of the plot, and to the small number of characters, it possesses great unity of design. These characters, each drawn with marvelous distinctness of outline, are subordinated throughout to the central personage "Pip," whose great expectations form the pivot of the narrative.

Great Falls, Mont., city, county seat of Cascade County; on the Missouri River, the Great Northern, and the G. F. & C. Railways; 120 miles northeast of Butte. South and nearby is a great mining region and north is an agricultural and grazing section. It has large gold, silver, and copper smelters, and bituminous coal, lead, iron, and sandstone are found in the vicinity. The excellent water power which the city possesses is an inducement to manufacturers to establish works in Great Falls. The water-power, at medium low water, is equal to over 350,000 horse-power, and this, together with the unusual wealth of minerals, has largely aided the rapid growth of the city. There are a number of falls here; one, Great Falls, gives name to the city. Its rapid growth has been largely the result of its natural resources. Its chief manufactures are flour, furniture, mining and agricultural instruments, wagons, carriages, and woolen goods. The first settlement was made in 1884, and in 1888 Great Falls was incorporated. Municipal affairs are administered by a mayor, elected biennially, and a city council of two chambers. Minor officials are nominated by the executive and confirmed by the council. The water-works are owned and operated by the city. The population increased from (1890), 3,979 to (1900) 14,930.

Great Fish, or **Black River**, a river in Mackenzie and Keewatin territories, Dominion of Canada. It rises in a small lake near the northern shore of Lake Aylmer, flows in a northeasterly direction through lakes Beechy, Pelley and Garry, and enters the Arctic Ocean by a wide estuary. King William Land is near its mouth. The Great Fish River is about 500 miles in length. Sir George Back, the Arctic explorer (1796–1878), explored the river in 1834-5 and followed it to the ocean. He described Ah-hel-Dessy, or Parry Falls, on one of the tributaries, as more grand than Niagara in splendor of effect. See Back 'Narrative of the Arctic Land Expedition to the Mouth of the Great Fish River' (1833-5).

Great Fish River, a river in Cape Colony, South Africa, which rises in the Sneeuwberg, or Snowy Mountains, and after a southeasterly course of 230 miles, enters the Indian Ocean at lat. 33° 25′ 5″, and long. 27° 8′, about five miles northeast of Port Alfred.

Great Horned Owl. See EAGLE OWL.

Great Island. (1) A small island at the entrance to Portsmouth Harbor, N. H. It has a lighthouse 90 feet high. (2) An island in Bass Strait, between Tasmania and Australia. It is about 40 miles long and 12 miles broad. Pop. 42,100.

Great Kanawha, ka-nä'wa, a tributary of the Ohio River, has its rise between the Blue Ridge and Iron Mountains in the northwestern part of North Carolina, flows northeast by north through the southwestern part of Virginia, then changes its course northwest and west into West Virginia, and flows into the Ohio River at Point Pleasant. It receives the Gauley River in Fayette County, West Virginia, and from thence to its mouth is known by the name of Great Kanawha. The river, at a cost of over $4,000,000, has been made navigable from the Ohio to Great Kanawha Falls, about three miles from the mouth of the Gauley River. It is about 450 miles in length.

Great Kanawha, Battle of. See POINT PLEASANT.

Great Lakes, the name given to the chain of lakes on the northern border of the United States. They include Lakes Superior, Michigan, Huron, Saint Clair, Erie, and Ontario; Michigan only lying wholly within the United States, and no one of the lakes wholly within the territory of the Dominion of Canada. Their area is about 90,000 square miles; elevation, Lake Superior 600 feet above the sea, and Lake Ontario 250 feet. The fall of Lake Superior to Lake Erie is about 40 feet. No large river flows into the Great Lakes; the Saint Lawrence River is the outlet. The basin of the Great Lakes averages in width about 100 miles north and south of the north and south shores respectively. The combined coast lines in the United States have a shore line of about 3,075 miles. These great inland seas constitute the largest body of fresh water in the world. Like all large bodies of water they affect the climate of the surrounding country. Good farms, extensive forests, and valuable minerals are found along the coast. On the southern shore of Lake Superior (q.v.) are found masses of ore and low mountains apparently of eruptive origin. The Great Lakes have been the means of developing to a considerable extent the Northwest, as they are the main thoroughfares by which the products of the large farms, the cattle ranches, the mines, and the forests have been brought to eastern markets. Coal and manufactured products of the east pass over the lakes to western markets. The bituminous coal tonnage of the lakes for [illegible] was 9,000,000 tons. In the same year the net freight tonnage of Sault Ste. Marie's Falls canal was over 25,000,000 tons, or three times the amount which passed through the Suez Canal. The iron ore tonnage for 1900 was 20,[illegible] tons. There are 20 individual ports on the Great Lakes which have a registered tonnage ranging from 1,000,000 to over 5,000,000 tons. Cleveland's tonnage alone, in 1902, was 5,037,[illegible]82 tons; and the same year New York's tonnage was 8,[illegible]2,707 tons. The line of cities around the Great Lakes are (1903) increasing in commercial importance and population with more rapidity than any group of cities in any other part of the world. Some of these lake ports, all terminals of railroad trunk lines, are Toledo, which increased [illegible] per cent from 1890 to 1900; Chicago, which increased in the same time 54 per cent; Cleveland, 46 per cent; Milwaukee, 39 per cent; and Buffalo, 37 per cent. The question of locating a dam at the outlet of Lake Erie so as to benefit navigation has been under consideration, and efforts are being made (1903) to have commissioners appointed by the governments of the United States and Great Britain who will work together, and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada. In June 1903, the Congress of the United States took action regarding the matter, and empowered the President to appoint three American Commissioners; one to be an engineer officer of the army; another, a civil engineer, "well versed in the hydraulics of the Great Lakes;" the third, a lawyer "of experience in questions of international and riparian law." The necessity of such a commission to examine even the variations in the levels of the waters of this great thoroughfare is manifest when the levels of Detroit River, Lake Saint Clair, Saint Clair River, and Saint Mary's River have been lowered by the Government twenty-one-foot channels from Duluth and Chicago to Buffalo. The Chicago Drainage Canal (see Chicago) has helped to lower Lake Michigan. The Consolidated Lake Superior Company is taking water out of Saint Marys River. Other causes are making a change of level, and the increased transportation on all the lakes, will mean better channels to the ocean. For canals connecting the Great Lakes with rivers and the two around water-falls, see articles on the respective lakes.

Great Meadows, Pa., Engagement at, 28 May 1754; Washington's first fight. When the French built Fort Duquesne (now Pittsburg), driving off an English force which had begun to fortify the same spot, it was evident that the decisive struggle for mastery of the American "hinterland" was to begin; and the commander of the nearest English force, a Virginia militia officer of 22, named George Washington, at once sent a messenger to Gov. Dinwiddie and wrote letters to the governors of Pennsylvania and Maryland, urging all to send troops and expel the French. Meantime he set out with his force to build a fort on the Monongahela where Brownsville, Pa., now stands. Constructing a road as he went, he halted at the Great Meadows of the Youghiogheny, a bushy field at the foot of Laurel Hill,— a good camping-place and defensible position. Hearing from his scouts that the French had learned of the English activity, and sent out a party to engage any English band they met, he cleared the field of bushes and threw up an intrenchment behind a ravine crossing the field, but instead of waiting an attack, took 40 men for a night surprise of the French, guided by Indian allies. It was raining hard, the path was often lost, and he did not reach the French camp till morning. They were an advance party of 32, sent out to reconnoitre and, hearing of Washington's advance, they had hidden in a rocky hollow and sent back for reinforcements, but attempting defense when surprised, the commandant — Ensign Jumonville — and nine men were killed, and the rest captured and taken to the camp at Great Meadows. Washington lost one killed and three wounded. The sequel is told under FORT NECESSITY.

Great Pacificator, a name given Henry Clay (q.v.), on account of his efforts to reconcile the conflicting interests of North and South, especially in connection with the Missouri Compromise.

Great Pedee, a river which has its rise in the mountains of the northwestern part of North Carolina, flows south and east across the State, and enters South Carolina at Marlboro County, in the northeastern part of the State, then flows southeast into Winyaw Bay, an inlet of the Atlantic. In North Carolina the river is called Yadkin. About where the Little Pedee joins the Great Pedee, and south to its mouth, there are several quite large islands. The river is navigable for a distance of about 150 miles from Winyaw Bay.

Great Salt Lake, a body of water in the northwestern part of Utah, the principal drainage centre of the Great Basin (q.v.); bounded on the east by the Wasatch Mountains, on the west by the Great Salt Lake Desert. It is about 4,200 feet above sea-level, 80 miles long and from 20 to 32 miles wide. Its chief inlets are the Bear, Ogden, and Weber, and the Jordan which brings the fresh waters of Lake Utah. Great Salt Lake has no apparent outlet save evaporation. In 1850 the amount of saline matter held in solution was 22.4 per cent, in 1869 only 14.8 per cent. Between these dates the amount of water flowing in annually exceeded the evaporation, and the lake increased in area from 1,700 to 2,360 square miles. Since 1869–70 the lake has been receding. One cause of the water diminishing in volume is the amount used for irrigation; but the amount of water contributed by the inlets has decreased since 1870. At one time Great Salt Lake was much larger than it is now. The bars, cliffs, and beaches formed by the waters of the ancient lake (called Lake Bonneville) are plainly visible along the base of the mountains. Lake Bonneville had an area of 19,800 square miles and a depth of 1,100 feet. Its depth near where the great Mormon Temple now is was about 850 feet. Its dry bed is now occupied by nearly 200,000 people. The waters of Lake Bonneville reached the ocean through Columbia River. Geological investigations show that there have been at least two moist periods with intervening and subsequent periods of dryness. A change from the present dry climate and scant rainfall to a moist climate would result in a great increase in area of the waters in the lakes and rivers and a return to former water areas. Great Salt Lake has several islands, the largest of which Antelope, is 18 miles long. No fishes seem to exist, but several species of insects and brine-shrimps have been found in the waters; and water-fowls in large numbers frequent the shore. The first mention of Great Salt Lake appeared in a report made by the Franciscans, in 1776. Father Escalante and companions seem to have traveled from Mexico to this region. A report made also by the Franciscans early in the 17th century mentions the large rivers and lakes and the mineral wealth of this section. In 1843 Fremont explored and described this region, and a thorough survey was made in 1849–59 by Howard Stansbury, captain in the United States Army. (See UTAH.) Consult: 'Jesuit Relations'; Bancroft, 'Utah'; U. S. Reports and Surveys.

Great Slave Lake, a body of water in the Canadian Northwest Territory, lat. 62° N.; greatest length about 300 miles, greatest breadth 50 miles. Estimated area, 10,100 square miles. By the Great Slave River it receives the waters of Lake Athabasca; and the outlet is the Mackenzie River which flows into the Arctic Ocean.

Great Slave River, in Canada, is the outlet of Athabasca Lake and flows into Great Slave Lake (q.v.), by two mouths, near Fort Resolution. A number of falls and rapids are in its upper course, but the descent becomes more gradual near its mouth. Length about 300 miles.

Great South Bay, an arm of the Atlantic Ocean on the southern coast of Suffolk County, Long Island, N. Y.; 50 miles long, from one and one-half to five miles wide. Great South Beach, which is about 35 miles long, has Fire Island lighthouse on the western extremity, and separates the bay from the ocean.

Great Stone Face, one of Hawthorne's short stories relating to the "Old Man of the Mountain" in the White Mountains, in 'Snow Image and Other Twice Told Tales' (1852).

Greatorex, grāt'ō-rěks, **Eliza Pratt,** American artist: b. Manor Hamilton, Ireland, 25 Dec. 1819; d. Paris, 9 Feb. 1897. She studied art in New York and Paris. Her work began in landscape painting, but pen and ink work and etching subsequently absorbed her efforts. In 1868 she was elected associate of the National Academy. In 1870 she visited Germany and in 1871 published 'The Homes of Oberammergau.' Her principal works are 'Summer Etchings in Colorado' (1873) and 'Old New York from the Battery to Bloomingdale' (1876).

Grebes, grēbz, a well-defined group of water-bird (*Colymbidæ* or *Podicipidæ*) comprising 25 species, spread over practically the whole world. The grebes are peculiar in having the legs placed very far back, in their flattened tarsi and lobed (not webbed) toes, each digit being flattened and bordered by an extension of horny skin. They are expert swimmers and preeminent as divers. They nest in secluded ponds and bogs, piling up a mass of vegetable matter upon some floating foundation, and deposit chalky white eggs. When the female leaves the nest she usually covers the eggs over with vegetable matter. The little grebes are expert swimmers and divers from the time they are hatched, and in their soft downy plumage are exceedingly beautiful. During migrations grebes are found frequently along our rivers and sea coasts, and are often shot by duck hunters in the autumn and winter. Though they have no stiffened tail feathers, and have relatively very small wings, they are able to fly long distances. The body plumage is soft and compact, and that of the under surface is a beautiful silvery white, which makes "grebe-breasts" a very desirable article in the millinery trade. The best-known species in eastern North America are the horned grebe (*Colymbus auritus*) which has a peculiar ruff of black and rusty feathers about the head; and the pied-billed grebe (*Podilymbus podiceps*) a rather more heavily built bird without a ruff and with a thicker and shorter bill. Both are popularly known as "hell-divers." In Europe the common species are the horned grebe, the great crested grebe (*C. cristatus*) and the dabchick (*C. fluviatilis*).

Greece, Ancient, the European peninsula which was bounded on the north by Macedonia and Illyria; on the east and southeast by the Ægean and Myrtoan, and on the west, and southwest, by the Ionian seas. Its length from the borders of Macedonia to Cape Tænarum was about 250 miles. The name of Græcia originated in Italy, and was probably derived from Pelasgian colonists, who, coming from Epirus to Magna Græcia, in southern Italy, and calling themselves Græci, occasioned the application of this name to all the people who spoke the same language with them. In earlier times, for example in the time of Homer, Greece had no general name among the natives. Aristotle was the first Greek to call his countrymen Γραικοί, Greeks. It afterward received the name of *Hellas*, and still later, after the country was conquered by the Romans, it was divided into two provinces: the Peloponnesus being known as Achaia, and the remaining regions to the north as Macedonia. The Greek tribes were so widely dispersed that it is difficult to determine with precision the limits of Greece, properly so called. The name perhaps is properly applied only to the country lying to the south of Macedonia, with the adjacent islands; but it has sometimes been given in a modern sense by geographers to the whole territory lying to the south of Mount Hæmus, Mount Scomius, and the Illyrian Alps, or the whole series of mountains now called the Balkan, so as to include regions inhabited by some Thracian, Macedonian, and Illyrian tribes. The area of the mainland of the more limited region to which the name of Hellas is properly confined is above 55,000 square miles. The whole of Greece naturally divides itself into three parts: Northern Greece, including Epirus and Thessaly; Central Greece, which comprises what was known as Hellas; and the Peloponnesus.

Physical Features.— The first thing which strikes the eye on looking at a map of Greece is the comparatively great extent of its coast-line, formed by numerous gulfs which penetrate into it in all directions, and give it a remarkably broken and rugged appearance. Proceeding round the coast from the northwest to the northeast we are presented in succession with the Ambracian Gulf (now Gulf of Arta), Corinthian Gulf (the mouth of which is now called the Gulf of Patras, while the name of Gulf of Corinth is reserved for the inner part of it), the Cyparissian (now Arcadia) Gulf, and the Messenian, Laconian, Argolic, Saronic, Malian, and Pagasæan gulfs, now called respectively Koron, Marathon, Nauplia, Athens, Lamia, and Volo. The Corinthian Gulf on the west, and the Saronic Gulf on the east, which nearly meet at the Isthmus of Corinth, divide Greece into a continental and a peninsular portion, the latter called the Peloponnesus (now Morea). Another striking feature is the mountainous character of the interior. The whole country was bounded on the north by a range of mountains, the western half of which was called Mount Lingon and the eastern half the Cambunian Mountains, with Mount Olympus at their eastern extremity. From about the middle of this range a lofty chain called Mount Pindus strikes southward and runs almost parallel to the eastern and western coasts of Greece. At a point in this chain called Mount Tymphrestus (or Typhrestus, now Mount Velukhi), two chains proceed in an easterly direction, the northernmost of which, Mount Othrys, runs almost due east, and attains at some points a height of from 7,000 to 8,000 feet, while the southern one runs rather in a southeasterly direction, attaining at one point a height of [illegible] feet, and terminates at the celebrated pass of Thermopylæ. The Cambunian Mountains on the north, the range of Pindus on the west, and Othrys on the south, enclose the large and fertile vale of Thessaly, forming the basin of the Peneus (now Salambria), and the ranges of Othrys and Œta enclose the smaller basin of the Spercheus (Hellada). Another range of mountains branches off from Mount Œta and runs still more to the south. This is the celebrated Parnassus, which, at its highest point, exceeds 8,000 feet. The peaks of Cithæron, Parnes, Pentelicus, and Hymettus lie in the same direction, but are more distinguished for their classic celebrity than for their height. The range in which these peaks are found is continued to the southeast point of continental Greece, and the islands of Ceos, Cythnos, Seriphos, and Siphnos (now Kea, Thermia, Serpho, and Siphanto) may be regarded as continuations of it. This range on the south and that of Œta on the north enclose the basin of the Cephissus, with Lake Copais (now Topolia). Another chain of mountains strikes southwestward from the central range of continental Greece, under the names of Corax and Taphiassus. The chief rivers on the west side of the Pindus chain are the Arachthus (now Arta) and the Achelous (now Aspropotamo).

The chief feature in the mountain system of the Peloponnesus is a range or series of ranges forming a circle round the valley of Arcadia in the interior, having a number of branches proceeding outward from it in different directions, dividing the rest of the Peloponnesus into several other valleys. The loftiest part of the mountainous circle round Arcadia is that lying to the north, with the peak of Cyllene (Ziria), 7,789 feet high, at its eastern extremity, and Erymanthus (Olonos), 7,297 feet high, at its western. The southern part consists rather of a series of heights than a chain of mountains. The highest range which branches off from the circle around Arcadia, and, indeed, the highest range in the Peloponnesus, is Mount Taygetus (Pentedactylon), which strikes southward, separating the ancient divisions of Messenia and Laconia, and terminating in the promontory of Tænarum (now Cape Matapan). The other ranges are of no importance. The only rivers in the Peloponnesus of any consequence are the Eurotas (Iri), draining Laconia on the southeast, the Pamisus (Pirnatza), draining Messenia on the southwest, the Alpheus (Ruphia), draining Arcadia and Elis, and the Peneus (Gastuni) draining Elis on the west.

The rock most largely developed in the mountains of Greece is limestone, which often assumes the form of the finest marble. Granite and gneiss are found only in the north, in the central ramifications of the Pindus. Tertiary formations prevail in the northeast of the Peloponnesus, and in the northwest, along the shores of Elis, are considerable tracts of alluvium. Volcanic rocks are not seen on the


GREECE
AND PART OF
TURKEY.
IN EUROPE.
SCALE OF MILES.
0 10 20 40 60 80 100
Population of places is indicated by
different lettering, thus :
50,000 and over ATHENS
25,000 to 50,000 Patras
10,000 to 25,000 Corfu
1,000 to 10,000 Kosmos
Smaller Places Rikhia
Railroads
ATHENS
and Vicinity.
SCALE OF MILES.
Mt. Lycabettus
ACROPOLIS
Copyright, 1904, by The Americana Company.
Longitude East from Greenwich
ADRIATIC SEA
ITALY
GULF OF TARANTO
IONIAN SEA
MEDITERRANEAN SEA
SEA OF CANDIA
CRETE OR CANDIA
TURKEY
GREECE
ASIA MINOR
BLACK SEA
SEA OF MARMARA
AEGEAN SEA
CONSTANTINOPLE
ADRIANOPLE
SALONIKI
SMYRNA
ATHENS
Patras
Corfu
NORTHERN SPORADES
CYCLADES
SPORADES
Canea
Rhodes
Karpathos

mainland, but form considerable masses in some of the islands. Attica was rich in silver and marble. The quarries of Pentelicus and the mines of Laureium were famous. Gold and serpentine were found in Siphnos; there was tin in Ceos, and copper near Chalcis in Eubœa. In many of the islands iron abounded.

Divisions.— On the northwest of the mainland of Greece was the mountainous region of Epirus, which was never more than half Greek; and to the east of that district, separated from it by the chain of Pindus, lay Thessaly, a region of fertile plains. To the south, lay a series of small independent states. Reckoned from west to east, there were Acarnania, Ætolia, Doris and Locris, Phocis with Mount Parnassus, the seat of the Muses, and the sacred Delphi, regarded by the Greeks as the navel of the earth; Bœotia, with Helicon, another mountain sacred to the Muses, and with the cities of Thebes and Platæa; Megaris, containing the city of Megara; and Attica with its capital Athens, Piræus, the port of Athens, and the city of Eleusis, the seat of the mysterious worship of Demeter. In the middle of the Peloponnesus was Arcadia, with the towns of Mantinea, Tegea, and Megalopolis, the last founded by Epaminondas. In the north lay Sicyon and Corinth, the latter situated on the isthmus connecting the Peloponnesus with the rest of Greece; and to the west of that Achaia. To the southwest of Achaia lay the rich province of Elis, with the plain and sacred grove of Olympia, celebrated on account of the Olympic games, which were held here every fourth year. To the south of Elis, in the southwest corner of the Peloponnesus, lay the province of Messenia, with the famous stronghold of Ithome, "one of the horns of the Peloponnesus," the fort of Pylos, and later the capital town of Messene, founded by Epaminondas 369. Separated from Messenia by the range of Taygetus was the province of Laconia, occupying the southeast corner of the Peloponnesus, and containing the renowned city of Sparta, long the rival and ultimately the conqueror of Athens. Lastly, to the north of Laconia, the east of Arcadia, and the south of Sicyon, lay the province of Argolis, with the capital Argos, and the cities of Mycenæ and Tiryns, all remarkable for the remains of gigantic works of masonry, commonly known as Cyclopean works.

The islands of Greece are partly scattered over the Ægean Sea and partly contained in the Ionian Sea on the southwest of the mainland. The Greeks applied the names Cyclades and Sporades to two groups of islands in the Ægean, the former name (from *kuklos*, a circle) to those which they believed to form a circle round the sacred island of Delos, and the latter (from a Greek root meaning scattered, sporadic) to those which were scattered over various parts of the sea. Some islands were sometimes said to be in the one group and sometimes in the other, and several were sometimes excluded from both. The following, however, are the principal of those which may most properly be considered as belonging to the Cyclades: Andros, Tenos, Myconos, Naxos (now Naxia), Paros (celebrated for its marble), Amorgos, Anaphe, Thera (now Santorin), Pholegandros (now Polykandro), Sicinos, Ios (now Nio), Melos, Syros, and Gyaros (Jura), Siphnos, Seriphos, Cythnos, and Ceos. The name Sporades may be applied to all the other islands in the Ægean. The Sporades will thus include the following islands on the northeast of the mainland of Greece: Eubœa (Negropont), the largest of all the Greek islands, separated from the continent only by the narrow strait of Euripus, and containing the ports of Chalcis and Eretria; Sciathos, Scopelos, Halonesus (Kilidromi), Eudemia (Sarakino), and Scyros; the following off the coasts of Thrace and Asia Minor: Lemnos, Thasos, Imbros, and Samothrace (in very remote times the seats of a mysterious religious worship) Lesbos (with the flourishing and luxurious town of Mitylene), Chios, Samos, Cos, etc.; and the following in the Saronic Gulf, or between it and the Argolic Gulf: Salamis (now Salamis or Koluri), Ægina, Calauria (Poros), Hydrea (Hydra), and Pityussa (Spetsæ). The islands in the Ionian Sea are Corcyra (Corfu), celebrated in the most ancient times for its wealth and culture, and at a later period colonized by Corinthians; Paxos, Leucas or Leucadia (Santa Maura), at one time connected with the mainland; the "rocky" Ithaca (now vulgarly called Ithaki), the home of Ulysses; Cephallenia (Cephalonia), Zacynthus (Zante), and Cythera (Cerigo), one of the seats of the worship of the goddess Aphrodite.

Soil, Productions, Etc.— Greece was in ancient times more fertile than it is now, which is accounted for by the fact that the forests have been to a large extent cleared away, the springs thus dried up, and the soil deprived of moisture. The most fertile districts were Thessaly, Bœotia, and some parts of the Peloponnesus; the least fertile Attica and Arcadia. The principal objects of cultivation were the vine and the olive, but flax and the commoner cereals were also cultivated more or less. Among the domestic animals were horses, asses, mules, oxen, swine, sheep, goats, and dogs. Swine were very numerous everywhere, and mules were much used in the Peloponnesus; but there were comparatively few horses, as the mountainous character of the country was not conducive to their being reared; the best horses of Greece were reared in Thessaly. Bears, boars, and wolves are mentioned among the wild animals anciently found in Greece, and it may perhaps be inferred from the legend of the Nemean lion that even lions at one time existed in this country. Herodotus, indeed, expressly states that lions were found between the Nestus in Thrace and the Achelous in Acarnania.

Climate.— The climate of ancient Greece is highly commended by ancient Greek writers, as by Herodotus, Hippocrates, and Aristotle, on which account it seems fair to infer that the malaria which now infests the air in summer did not then prevail to the same extent, a circumstance that is easily accounted for by the fact that in those times the country was more thickly populated and better cultivated. In respect of temperature the same differences resulting from the inequalities of the surface must have existed then as exist now, long and severe winters being experienced in the highlands of the interior, while the lowlands, exposed to the sea, enjoyed warm and genial weather all the year round.

History.— Greece has never at any period formed a single and independent state. As long as it remained independent it was divided into a number of separate states, and during the only period when it was administered as a single territory it was subject to a foreign power. A general sketch of the history of ancient Greece must therefore touch only upon those leading events which belong to the common history of the Greek states, or which at least affected the Greek people as a whole, even although they may belong more especially to the history of an individual state.

The earliest inhabitants of Greece of whom anything is known are called by Greek writers Pelasgians. The ethnological affinities of these have often been discussed, but the most recent authorities believe that they were an Indo-Germanic or Aryan people. They occupied Greece before the influx of Ionians, Æolians and Dorians. They seem to have been agricultural in pursuits, dwelt along the fertile valleys, built strong cities, walls of the so-called cyclopean masonry, and among their most famous seats were Dodona in Epirus, Thessaly, Orchomenos in Bœotia, Mycenæ in Argolis, Sicyon, etc.

In religion they abhorred both polytheism and anthropomorphism. Their name afterward became changed to Hellenes and under this appellation they amalgamated with the Ionians, the Achæans, the Æolians and the Dorians. The early relations of Greece with the East are perhaps reflected in the legends of Oriental colonists — Cadmus, Pelops, Cecrops, etc. — who settled in Greece in very remote times. The reality of an early connection between Greece and the East is established by the fact that the Greeks derived the greater part of their alphabet from the Phœnicians.

The Hellenes, or Greeks properly so called, entering the country probably from the northwest, subdued and partly displaced the Pelasgians. They are usually represented as having been divided into four chief tribes — the Æolians, occupying the northern parts of Greece (Thessaly, Bœotia, etc.); the Dorians, occupying originally only the small region in the neighborhood of Mount Œta; the Achæans, occupying the greater part of the Peloponnesus; and the Ionians, occupying the northern strip of the Peloponnesus and Attica. The middle part of the Peloponnesus was still mostly inhabited by a Pelasgic population. The warlike and enterprising character of these Hellenic invaders is evidenced by the poetic legends of their achievements in the heroic ages, such as the tale of the Trojan War, of Theseus, of Jason and the Argonauts, etc. From all these we may gather at least that the Hellenes early distinguished themselves by building towns, making long voyages, planting distant settlements, and carrying on foreign wars. As in later times, they were divided into numerous states, each consisting of a single city with the surrounding territory. These states were governed by kings who were the heads of the supreme families, and who traced their descent from Zeus. By the side of the kings stood the heads of the other leading families of the state, who in Homer are also called kings, and likewise boasted of a descent from Zeus. In the public market place (agora), where all the affairs of the state were transacted, these subordinate kings gave their opinions on every subject of deliberation, and advised the supreme ruler as to the course he should pursue, but beyond that they had no authority. Their influence, however, was very great, especially where the rightful head of the state did not possess the abilities of a ruler.

The distribution of the Hellenic tribes which we have just indicated is not that which continued throughout the main period of Greek history. It was entirely altered by an event called the Dorian migration, or sometimes the return of the Heracleids, which is placed by Thucydides about 80 years after the fall of Troy, and thus about the year 1104 B.C., according to the ordinary system of chronology. Before the great migration several smaller ones had taken place. One tribe, finding its territory too circumscribed, would move to another, expelling the inhabitants already settled there, who thus found themselves compelled to remove to some other district, where they treated the original inhabitants in the same way that they had been treated themselves. In this way there arose a general disturbance, till at last the hardy Dorian inhabitants of the mountainous region about Mount Œta began a migration on a greater scale than had hitherto been attempted, and thus brought about a series of changes which resulted in an entirely new settlement of the Greek territory. They first conquered a large part of northern Greece, and then entered and subdued the greater part of the Peloponnesus, driving out or subjugating the Achæans, as the Achæans had driven out or subjugated the Pelasgians. The Dorians are also said to have invaded Attica, where, however, they were baffled, according to the legend, by the self-devotion of Codrus, the king of that territory. It is said that an oracle had pronounced that in this war whichever side lost its king would be victorious, on which account strict orders were given to the Dorian soldiers to spare the life of the king of the enemy. But Codrus disguised himself in the dress of a common herdsman, and going into the enemy's camp provoked a quarrel in which he met his death, on learning which the Dorians despaired of success and withdrew. In the legend in which this series of events has come down to us the Dorians are represented as having entered the Peloponnesus under Temenus, Cresphontes, and Aristodemus, three descendants of Heracles, who had come to recover the territory of which their ancestors had been unjustly deprived by Eurystheus. Hence the name of the Return of the Heracleids, sometimes given to this event.

The Achæan inhabitants of the Peloponnesus whom the Dorians found there had a threefold fate. One part of them sought for new homes, and turned their steps toward the part of the Peloponnesus occupied by the Ionians, whom they expelled, keeping for themselves their territory, which hence received the name of Achaia. Another part voluntarily submitted to the invaders, who imposed tribute upon them and excluded them from all share in the government; while a third part resisted to the last, and were in the end reduced to the condition of slavery. In Laconia the former received the name Periœci (dwellers round), and the latter were called Helots.

The Ionians who were driven out of the Peloponnesus found at first a refuge among their kindred in Attica, but when this district did not suffice for all the inhabitants, old and new, large numbers of them left it and founded

GREECE.

1. Parthenon, on the Acropolis, Athens.
2. Temple of Victory, on the Acropolis, Athens.

Ionic colonies on several of the islands of the Ægean Sea and on the middle part of the coast of Asia Minor, where they built 12 cities, which formed an Ionic Confederacy. The principal of these were Ephesus and Miletus. About the same time as the Ionians are said to have colonized the middle part of the seaboard of Asia Minor, another body of Greeks, proceeding from Thessaly and Bœotia, are said to have founded the Æolian colonies on some of the northern islands of the Ægean, and on the northern part of the western coast of Asia Minor. The Æolic colonies of Asia Minor also formed a confederacy of 12 cities, but the number was afterward reduced to 11 by the accession of Smyrna to the Ionic Confederacy. While Ionians and Æolians thus colonized the middle and northern islands of the Ægean and coasts of Asia, the southern islands and the southern part of the west coast of Asia Minor were in like manner colonized by Dorian settlers. The six Doric towns in Asia Minor, along with the island of Rhodes, formed a confederacy similar to the Ionic and Æolic ones.

In considering the subject of Greek colonization we are brought face to face with the fact that in settling in foreign lands, the Greek races kept distinct from each other. One of the great keys to an understanding of Greek history is a right understanding of the relation between the two great races of the Greek name, the Dorians and Ionians. The Dorians were inland mountaineers, the Ionians were of the seacoast. The former, as represented in the institutions of Sparta, were a practical, and conservative race, living in public, simple and unimaginative. Their poetry was the public ode, accompanied with the dance in the market-place, often carried on under arms. The Ionians were versatile, imaginative, impressible. They were devoted to the maritime life, were travelers, and fond of welcoming strangers to their cities. They were traders. Moreover, they were keenly intellectual and reached the summit of excellence in art, literature, and philosophy. Their poetry was the epic narrative; and they invented the drama, in which the Ionian tale of personal adventure was united with the Doric ode. These two contrasted races between them swayed the fate of Greece. Their relations were complicated by the different colonies which they established at different points on the Mediterranean and Euxine coasts. In the course of time new Greek settlements were made on the coasts of the Hellespont, the Propontis (Sea of Marmora), and the Black Sea by both Dorians and Ionians. The most important of these were Byzantium (Constantinople) (Dorian), Sinope (Ionian), Cerasus (Ionian), and Trapezus (Trebizonde) (Ionian). Further, there were flourishing Greek colonies on the coasts of Thrace and Macedonia; for example, Abdera, Amphipolis, Olynthus, Potidæa, etc., which were all Ionian; and the Greek colonies in Lower Italy were so numerous that the inhabitants of the interior spoke Greek, and the whole region received the name of Greater Greece. The most famous of the Greek colonies in this quarter were Tarentum, Sybaris, Croton, Cumæ, and Naples. The island of Sicily also came to a great extent into the hands of the Greeks, who founded on it or enlarged many towns. By far the largest, most powerful, and most highly cultured of the Greek colonies was the Dorian colony of Syracuse, founded in the 8th century B.C. On the north coast of Africa the Dorian colony of Cyrene rivaled in wealth and commerce the city of Carthage; and on the south coast of Gaul Ionian Massilia (Marseilles) presented a model of civilized government to the inhabitants of the surrounding districts. All these towns kept up a commerce in the products of the land in which they were planted. They exerted a most important and beneficent influence on the manners of the neighboring inhabitants. They preserved the customs and institutions of their mother city, which they regarded with filial reverence; but otherwise they were perfectly free and independent.

Although ancient Greece never formed a single state, the various Greek tribes always looked upon themselves as one people, and classed all other nations under the general name of *Barbaroi* (foreigners). There were four chief bonds of union between the Greek tribes. First and chiefly they had a common language, which, though it had considerable dialectic peculiarities when spoken by different tribes, was yet understood throughout every part of Greece and in all the Greek colonies. Secondly, they had common religious ideas and institutions, and especially in the oracle of Delphi (q.v.) they had a common religious sanctuary, which was held by all the states in equal reverence, and was resorted to from all parts of Greece, alike by communities and individuals, for advice in circumstances of difficulty, and not unfrequently for indications as to the future. Thirdly, there was a general assembly of the Greeks called the Amphictyonic League (q.v.) in which the whole nation was represented by tribes (not by states), and the chief functions of which were to guard the interests of the sanctuary of Delphi, and to see that the wars between the separate states of Greece were not carried on in too merciless a manner. When any of the ordinances of the league were violated it was its duty to see that the violators were punished, and to entrust the infliction of the punishment to some one of its members. The fourth bond of union between the tribes of Greece consisted in the four great national festivals or games, the Olympian, Isthmian, Nemean, and Pythian (qq.v.) which were held at different intervals in four different parts of Greece, in which all Greeks, and none but Greeks, were allowed to participate, and which slaves were not allowed even to witness. At these games contests took place in foot-racing and chariot-racing, boxing, wrestling, and throwing with the quoit (or discus), and prizes were also awarded for works of art, poems, dramas, histories, etc. The prize was a simple wreath of olive or pine branches, or of parsley; but such a prize brought glory not only on the winner himself, but on his whole family and kindred, and even on the state to which he belonged. The victor was welcomed home by a triumphal procession, and his victory was celebrated in odes sung on the occasion, and sometimes composed by such poets as Simonides and Pindar. The Olympic games were the most celebrated of these festivals. They were held in the summer once every four years at Olympia, in Elis; the month in which they were held was considered as sacred, and during it no acts of hostility were allowed to take place between any of the Greek states. Originally, the only contest was a foot-race, and so high was the honor of a victory in this race esteemed, that from that of Corœbus in 776 B.C. the whole of Greece reckoned the time. The year in which any event happened was styled the first, second, third, or fourth year of a certain Olympiad, the name given to the interval elapsing between each celebration.

The various small states of Greece may be divided, according to the form of their constitution, into the two great classes of aristocratic and democratic. Sparta or Lacedæmon, the chief town of Laconia and of the Dorians, was the leading aristocratic state; and Athens, the capital of Attica and the chief town of the Ionians, was the leading democratic state; and as a rule all the Doric states, and subsequently all those under the influence of Sparta, resembled that city in their constitution; and all the Ionic states, and those under the influence of Athens, resembled it. These two races are the only ones that come into prominence during the earlier part of Greek history subsequent to the Doric migration. Sparta is said to have derived its form of government, and all its institutions, near the close of the 9th century B.C., from Lycurgus, who made minute regulations as to the course of education and the mode of life among the Spartans. He had but one object, that of training the Spartan youth for war, and developing a hardy and warlike spirit among the people. The immediate results of this training were seen in the conquests which the Spartans effected over the surrounding states, especially over the Messenians in the 8th and 7th centuries B.C. Many of the vanquished Messenians left their native country and founded the city of Messana in Sicily. Those who remained were reduced to the condition of Helots (q.v.).

The constitution of Athens was not originally democratical, but monarchical. Afterward it became aristocratic, and first received a more or less democratic constitution from Solon at the beginning of the 6th century B.C. This was followed about 50 years later by a despotic monarchy under the celebrated "tyrant" Pisistratus, and his sons, Hippias and Hipparchus, the last survivor of whom, Hippias, reigned in Athens till 510 B.C. Hipparchus had been assassinated four years before, and the last four years of the reign of Hippias were distinguished by violence and cruelty. His enemies drove him from Athens, after which the republic was restored in a more purely democratic form than at first.

Hippias found refuge at the court of the king of Persia, with whose aid he hoped to be able to return and rule once more in Athens. The Persian monarchy had been established about 30 or 40 years before by Cyrus the Great, and its sway extended not only over the whole of Persia, Media, and Babylonia, but also over Egypt and Asia Minor. With the rest of this last-mentioned territory the Greek colonies on the coast had been brought under the yoke of this empire, and although they chafed under the foreign dominion, they were kept in subjection by the native princes or tyrants whom the Persian monarch imposed on them as governors. One of the most powerful of these governors was Histiæus of Miletus, whose behavior had excited the distrust of Darius, the Persian king, for the latter, on the pretence of rewarding him for a signal service invited him to his court and kept him at Susa in practical captivity. Histiæus secretly incited his relative, Aristagoras of Miletus, to get up a rising among the Greek colonies of Asia Minor, in the hope that he might, during the disturbance, find an opportunity of returning to his home. The endeavors of Aristagoras were successful; all the Greek towns on the coast were soon in arms, and assistance was asked from the mother country. Only Athens, which feared lest Darius should re-establish Histiæus, and the small Ionian town of Eretria in Eubœa, furnished any aid. The Greeks, in 496 B.C., conquered and burned the town of Sardis, the capital of Asia Minor, whereupon the rebellion extended over the whole of Ionia. But the superior forces of the enemy, and the want of union among the insurgents, led in the following year (495) to the loss of a naval battle, and soon after to the destruction of Miletus, the inhabitants of which were partly put to death and partly made captives.

Darius now determined to avenge himself on the Athenians and Eretrians for the part that they had taken in the rising. In 492 he sent out an expedition against them under his son-in-law Mardonius, but the Persian fleet was wrecked off the promontory of Mount Athos. Darius had at the same time despatched heralds to the islands and states of Greece to demand earth and water in token of submission. Most of the islands and many of the smaller states yielded, but Athens and Sparta indignantly refused the demand, and even went the length of putting the heralds to death. Enraged at this insult Darius equipped a second fleet and placed it under the command of Datis and Artaphernes. But this met with no better fate than the first. The Persians landed on the island of Eubœa, and after destroying Eretria, crossed the Euripus into Attica; but here they were met (490 B.C.) on the plain of Marathon by 10,000 Athenians and 1,000 Platæans, under Miltiades, and, although 10 times as numerous, were totally defeated and pursued to their ships. This battle put an end to the second Persian expedition, but Darius at once began to make preparations for a third expedition, and this time on a far greater scale than before. In the midst of these preparations he died, but his son Xerxes, collected an army of 1,700,000 men and a fleet of 1,200 large ships besides a number of smaller ones, crossed the Hellespont in 481 by means of two bridges of boats, and led his army through Thrace, Macedonia, and Thessaly, while his fleet followed the line of coast. Thessaly had surrendered without a stroke, and Xerxes at once pursued his march in the direction of Phocis. But before he could enter this territory he had to make his way through the narrow and difficult pass of Thermopylæ, and this had previously been occupied by 300 Spartans under Leonidas, along with several thousand allies. Here Xerxes in vain attempted to force a passage against a mere handful of Greeks; thousands of his troops were slain; and it was only after Ephialtes had betrayed to the Persians a foot-path which led over the heights of Œta to the rear of the defenders of the pass, that the Persian king effected his purpose. Leonidas allowed all the allies to depart, while he himself and his 300 Spartans, along with 700 Thespians who voluntarily remained with them, held out until they were completely annihilated (480 B.C.).

The way through Phocis and Bœotia was now open to the Persians, who advanced into Attica, and laid the city of Athens in ruins, putting to death the small garrison. The women and children belonging to Athens had by this time, on the advice of Themistocles, been removed to Salamis, Ægina, and Trœzen, while all the men capable of bearing arms served in the fleet. It was to Themistocles that the deliverance of Greece was now chiefly due. The united fleet of the Greeks had already contended with success against that of the Persians off the promontory of Artemisium, in Eubœa, and had then sailed into the Saronic Gulf, whither it was followed by the enemy. In this confined arm of the sea, where there was no room for the manœuvring of the numerous ships of the enemy, a decisive battle between the two fleets took place with the result that Themistocles had anticipated, the total defeat of the Persians. This battle is known as the battle of Salamis, from the name of an island in the Saronic Gulf, and was fought in the same year as Thermopylæ (480 B.C.). Xerxes himself had been an eyewitness of the battle and at once began a speedy retreat with his land army through Thessaly, Macedonia, and Thrace, a retreat which Themistocles had hastened by causing the false report to reach Xerxes, that it was the intention of the Greeks to destroy the bridges of boats over the Hellespont. Xerxes left behind him only 300,000 men in Thessaly. In the spring of the following year (479) these advanced into Attica and compelled the citizens once more to seek refuge in Salamis; but in the battle of Platæa the Greeks, under the command of Pausanias, obtained so complete a victory, that only 40,000 of the Persians reached the Hellespont. On the same day the remnant of the Persian fleet was attacked and defeated by the Greeks off Mount Mycale, near Samos on the Ionian coast of Asia.

By the brilliant part which the Athenians under Themistocles had played against the Persians, the influence of Athens had greatly increased throughout Greece; and this was further strengthened by the fact that the war aginst Persia, which still continued, was chiefly conducted by sea, where Athens was much more powerful than Sparta. From this date then begins the period of the leadership or *hegemony* of Athens in Greece, which continued to the close of the Peloponnesian war, 404 B.C. Athens now exerted her influence to form a confederacy including the Greek islands and maritime towns as well as Athens herself, the object of which was to provide for the continuance of the war by the payment into a common treasury at Delos, of a fixed sum of money, and by furnishing ships for the same purpose. In this confederacy Athens of course had the lead, and gradually was able to render tributary many of the islands and smaller maritime states. In 469 B.C. the victories won by the Athenians over the Persians was crowned by the double victory of Cimon, the son of Miltiades, over the fleet and army of the Persians on the river Eurymedon, in the south of Asia Minor; and this victory was followed by the Peace of Cimon, which secured the freedom and independence of all Greek towns and islands. Shortly after followed the brilliant administration of Pericles, during which Athens reached the height of her political grandeur, while at the same time she flourished in trade, in arts, in science, and in literature.

The position of Athens, however, soon raised up a number of enemies. Sparta regarded her prosperity with jealousy; and the arrogance of Athens had produced a pretty general feeling of indignation and hatred. Two hostile confederacies were formed in Greece. At the head of one of these confederacies was the city of Athens, which was joined by all the Ionian states of Greece, and more or less supported by the democratic party in every state. At the head of the other confederacy stood Sparta, which was similarly joined by all the Dorian states, and supported by the aristocratic party everywhere. At last in 431 war was declared by Sparta on the complaint of Corinth that Athens had furnished assistance to the island of Corcyra in its war against the mother city; and on that of Megara, that the Megarean ships and merchandise were excluded from all the ports and markets of Attica.

In the first part of the Peloponnesian war the Spartans had considerable successes, while a great calamity befell the Athenians, who had collected all the inhabitants of the country districts of Attica within the walls of the city; and in consequence a pestilence broke out which carried off thousands of the inhabitants, and among them Pericles himself. From this blow, however, the city soon recovered, and in 425 the early successes of the Spartans in Attica were compensated by the capture of Pylos in Messenia by the Athenian general Demosthenes, who at the same time succeeded in shutting up 400 Spartans in the small island of Sphacteria, opposite Pylos, where they were ultimately starved into surrender. The person to whom the surrender was made was the demagogue Cleon, who, in consequence of his military successes, obtained the command of an army which was sent to operate against the Spartan general Brasidas in Thrace. But in 422 he was defeated by Brasidas before the town of Amphipolis, and himself slain, after which the opposite party in Athens got the upper hand, and concluded the peace with Sparta known as the Peace of Nicias (421 B.C.).

The effect of this peace was to divide the Spartans and the Corinthians, who had hitherto been allies. The latter united themselves with Argos, Elis and some of the Arcadian towns to wrest from Sparta the hegemony of the Peloponnesus. In this design they were supported by Alcibiades, a nephew of Pericles, a man of handsome figure and great personal accomplishments. The war which was now waged between Sparta and Corinth with her allies resulted, however, in favor of the former, whose arms were victorious at the battle of Mantinea in 418.

Soon after this the Athenians resumed hostilities, fitting out in 415 B.C. a magnificent army and fleet, under the command of Alcibiades, Nicias, and Lamachus, for the reduction of the Dorian city of Syracuse in Sicily. This undertaking, which renewed the race hatred between Sparta and Athens, was a complete failure. Alcibiades was accused in his absence of several offenses against religion and the constitution, and deprived of his command. Thirsting for revenge, he betook himself to Sparta, and exhorted the city to renew the war with Athens. By his advice one Spartan army was despatched to Attica, where it took up such a position as prevented the Athenians from obtaining supplies from Eubœa, while another was sent under Gylippus to assist their kindred in Sicily. These steps were ruinous to Athens. Lamachus fell in the siege of Syracuse, and the Athenian fleet was totally destroyed. The reinforcements sent out under Nicias and Demosthenes were defeated (413 B.C.) by the combined Spartan and Syracusan armies. All the Athenians who escaped death were made captives and compelled to work as slaves in the quarries of Sicily, although it may be mentioned as an interesting fact that many of these captives obtained their liberty by being able to recite fragments of Euripides.

After this disaster many of the allies of Athens joined the Spartans, who now pressed on the war with greater energy. The Athenians recalled Alcibiades, who returned in 407, and was received by his fellow-citizens with enthusiasm as their expected deliverer. A few months later he was again an exile, having been deprived of the command because one of his subordinates had lost a naval battle fought off Ephesus in his absence. During the rest of the war the Athenians had only one success, the naval victory won off the islands of Arginusæ over the Spartan Callicratidas in 406. In the following year (405) the Spartans made themselves masters of the whole of the Athenian fleet except nine vessels, while the majority of the crews were on shore at Ægospotamos on the Hellespont. The Spartans now easily subdued the islands and states that still maintained their allegiance to the Athenians, and laid siege to Athens itself. In 404 B.C. the war was terminated by the Athenians' surrender. Sparta immediately imposed upon Athens an aristocratic form of government, placing the supreme power in the hands of the Thirty Tyrants. Only a year later, however (403), Thrasybulus was able to overthrow this hated rule and re-establish the democracy.

The fall of Athens resulted in Sparta's leadership or hegemony in Greece, which lasted till the battle of Leuctra, 371 B.C. The Spartans now abused their power and speedily roused the hatred and jealousy of the other states. The Greek states which had up to this time been, and still continued to be, leaders, had now lost almost entirely their manliness and independent spirit, and no longer maintained the hereditary war against Persia, but each sought the aid of that power for its own purpose. The Spartans did indeed send an expedition into Asia Minor, but it came to nothing; and the states of Greece, the Spartans included, at last, in 387, agreed to the disgraceful Peace of Antalcidas, by which the whole of the west coast of Asia Minor was ceded to the Persians, and the Greek colonies there thus deprived of the independence that had been secured to them by the Peace of Cimon.

An act of violence committed by a Spartan general in Thebes in 380 in the end led to the complete downfall of that city. The aristocratic party in Thebes, when the Spartan army happened to be in the neighborhood, prevailed upon the general to give his assistance in overthrowing their opponents and establishing an aristocratic government. A number of the less prominent members of the defeated party, among them Pelopidas, made their escape to Athens, where they got the support and assistance of the democratic party there. They soon returned in disguise to their own city, surprised and murdered the leaders of the aristocratic party, expelled the Spartan garrison, and again set up a democratic government. These circumstances give a good idea of the fury of party strife which was then general in the Greek cities. The immediate result of this counter-revolution in Thebes was a war with Sparta, the heroes of which were Epaminondas and Pelopidas, who were then at the head of affairs in Thebes. In the course of the war the Spartans invaded Bœotia, but were so completely defeated at Leuctra in 371 B.C. that they never fully recovered from the blow.

With this victory Thebes won hegemony in Greece, which she maintained during the lifetime of Epaminondas, whose policy it was to keep down the power of Sparta by strengthening the surrounding states. From him the Messenians recovered their freedom, and by his advice the cities of Arcadia formed themselves into a confederacy, and built the city of Megalopolis. This policy was at first successful, but in a few years the confederacy began itself to strive after the supremacy, and joined themselves with this object to the Spartans. Epaminondas then invaded the Peloponnesus, but although the Thebans totally defeated the Spartans and Arcadians in the battle of Mantinea (362), yet the victory being won with the loss of their great general, the Thebans could no longer boast with justice of supremacy in Greece. Pelopidas had died two years before.

Two years after the death of Epaminondas, Philip, the father of Alexander the Great, became king of Macedonia. He was a man of great ability as a soldier and a ruler, an admirer of the Greek character, and a lover of Greek art and literature. He perceived, however, the weakness of the Greeks, arising from their want of unity, and waited for an opportunity of interfering in the affairs of their country, with the view of ultimately making himself master of it. An occasion for interference was furnished him by the Sacred war (355–46). The Phocians having taken possession of some of the land belonging to the sanctuary of Delphi, the Amphictyonic League condemned them to pay a fine and restore the land they had taken. This was refused and the league imposed upon the Thebans the task of forcing the Phocians to submit, but in their rocky strongholds the Phocians were able to resist all the efforts of their assailants, who at last called in the aid of Philip of Macedon. With his help the Phocians were subdued, they themselves expelled from the league, and their place given to Philip.

It was not, however, till the Locrian war (339–8) that Philip acquired a firm hold in Greece. The Locrians had committed the same offense as that of the Phocians, and when they likewise refused to pay the fine imposed upon them by the league, Philip, as one of the members, received the charge of punishing them. The advance of Philip was at first witnessed with comparative indifference by the states of Greece, but when his real designs became apparent the Athenians, on the advice of Demosthenes, hastily concluded an alliance with the Thebans, and an army was sent out to oppose him. The battle of Chæronea (338) turned out, however, disastrously for the Greeks, who saw their whole country laid at the feet of Philip. But the conqueror treated his new subjects with mildness, wishing to reconcile them to the Macedonian yoke, and to win their co-operation in his projected invasion of the rotten empire of Persia. He collected a large army, of which he got himself declared commander-in-chief by the Amphictyonic League in an assembly held at Corinth in 337 B.C.; before he was able to start he was assassinated 336 B.C.

The design of Philip on Persia was taken up and carried out by his son Alexander the Great, during whose absence Antipater was left behind as governor of Macedonia and Greece. Soon after the departure of Alexander, Agis III. of Sparta headed a rising against Antipater. He was defeated, however, in the battle of Megalopolis in 330 B.C., and no other attempt was made by the Greeks to recover their liberty for nearly 100 years. At the close of the wars which followed the death of Alexander, and which resulted in the division of his empire, Greece remained with Macedonia.

The last efforts of the Greeks to recover their independence proceeded from the Achæans, who held the northern strip of the Peloponnesus. This tribe is frequently mentioned by Homer as taking a very prominent part in the Trojan war; but during the historical period of Greece they for the most part kept aloof from the quarrels of the other states, and did not even furnish assistance in repelling the Persian invasion. They had taken part, though reluctantly, in the Peloponnesian war on the side of Sparta, and had shared in the defeat of Megalopolis in 330 B.C. In the course of the first half of the 3d century B.C. several of the Achæan towns expelled the Macedonians, and revived an ancient confederacy, which was now known as the Achæan League. About the middle of this century the league was joined by the town of Sicyon, the native city of Aratus, who soon after became its leading spirit. Through his influence it was joined also by Corinth, and then it began to aim at acquiring the supremacy throughout the Peloponnesus, and even throughout the whole of Greece, as well as at delivering Greece from the Macedonian yoke. In following out the first of these aims Aratus and the league came into collision with Sparta, which at that time happened to be governed in near succession by two kings, Agis IV. (244–240) and Cleomenes (236–220), who had both something of the old Lycurgan spirit in them. These, then, naturally looked with jealousy on the efforts of Aratus, and during the reign of Cleomenes a war broke out between Sparta and the Achæan League. The league was at first worsted, and was only finally successful when Aratus, forgetting the ultimate end of his efforts in the pursuit of that which he had more immediately in view, called in the aid of the Macedonians. In the battle of Sellasia, in 222 B.C., Cleomenes was defeated and compelled to take to flight, and the Macedonians became masters of Sparta. Aratus died in 213, and his place was taken by Philopœmen, "the last of the Greeks," who roused the league once more to vigorous efforts, and gradually succeeded in making it in some degree independent of Macedonia.

About this time the Romans, who had just come out victorious from a second war with Carthage, in which they had had to contend with Hannibal, found an occasion to interfere in the affairs of Greece. Philip V. of Macedon had allied himself during this war with Hannibal, and, accordingly as soon as the war was concluded, the Romans sent over Flamininus to punish him for so doing, and in this war with Philip the Romans were joined by the Achæan League. Philip was defeated at the battle of Cynoscephalæ in 197 B.C., and was in consequence obliged to agree to a peace, in which he recognized the independence of Greece. To gratify the Greek vanity Flamininus proclaimed the deliverance of Greece from the Macedonian yoke at a celebration of the Isthmian games in 196 B.C.; but the Greeks soon felt that they had only exchanged masters, that they were in reality, although not in name, as much in subjection to them as they had ever been to the Macedonians. On this account the Ætolians, who had formed a league similar to that of the Achæans, appealed for assistance against the Romans to Antiochus the Great, king of Syria, one of the kingdoms which had been formed out of the empire of Alexander. The appeal was listened to; but the help afforded was useless, for Antiochus was defeated in a bloody battle at Magnesia in Asia Minor in 190 B.C. The Ætolians were compelled to pay a money indemnity, and to sacrifice some of their art treasures.

By this time the Achæan League was unquestionably supreme over all other powers within Greece, having been joined by all the states of the Peloponnesus. But the league itself was in reality subject to Rome, the senate of which assumed the right of regulating its proceedings; and on one occasion, in 168 B.C., on the conclusion of a war waged by the Romans against Macedonia, the former carried off into Italy 1,000 of the noblest Achæans, on the pretext that they had furnished assistance to the Macedonians. Such was the condition of affairs until 147 B.C., when the league openly resisted a demand made by the Roman senate, that Sparta, Corinth, Argos, and other cities, should be separated from it, in consequence of which a war ensued, which was concluded in 146 B.C. by the capture of Corinth by the rude consul Mummius.

The independence of Greece was virtually gone with the fall of Corinth. From this date the prosperity of her cities rapidly declined, and the last sparks of the ancient Greek patriotism and love of independence became extinguished. The various cities still retained, however, something of the qualities for which they had been remarkable at the height of their glory. Athens was still one of the centres of culture, and the cradle of all kinds of new speculations. Many Athenians left their native city and made a livelihood, although they gained little esteem, among the Romans, as artists and scholars, actors and dancers, poets and wits. The citizens of Sparta continued to gratify their thirst for warfare as well as their covetousness by serving as mercenaries in foreign armies. Corinth was still the home of luxury and vice.

From the date above mentioned Greece remained attached to the Roman empire. On the division of the Roman empire it fell of course to the eastern or Byzantine half. From 1204 to 1261 it formed a part of the Latin Empire of the East, and was divided into a number of feudal principalities. In the latter year it was reannexed to the Byzantine empire, with which it remained till it was conquered by the Turks between 1400 and 1473. In 1099 the Morea was ceded to the Venetians, but was recovered by the Turks in 1715. (For the history of the present kingdom of Greece, see GREECE, MODERN.) Consult: Thirlwall, 'History of Greece'; Grote, 'History of Greece'; Bury, 'History of Greece' (1900).

Cosmogony and Religion.— Nowhere did polytheism develop itself into a brighter and more beautiful system than among the ancient Greeks. It was this circumstance no doubt that led the Romans, when they became acquainted with the literature and religion of the Greeks, to blend the Greek system with that of the ancient Italians, identifying the Greek deities with those of their own pantheon. In this way the Greek and Italian deities came to be confounded.

According to the view of the origin of all things which in course of time grew up among the Greeks, the universe was in the beginning a formless mass, Chaos (confusion), from which arose the "broad-bosomed" Earth (Greek, *Gaia, Gē;* Latin, *Tellus*), the Lower World (Tartarus), the darkness of Night (Greek, *Nux;* Latin, *Nox*), the parent of Light, and the formative principle of Love (Greek, *Erōs;* Latin, *Amor*), all of which were regarded as independent divinities. From the womb of the Earth proceeded the Heaven (Greek *Ouranos;* Latin, *Cœlum*) and the Ocean, and afterward the Titans, creatures of superhuman size and strength, who formed the first dynasty of gods. The Titans were succeeded by a more genial race of divinities endowed with intellectual as well as physical qualities, who subdued the Titans, and subsequently the Giants, another race whom the Earth produced after the loss of her first brood. In this second dynasty of gods the supreme ruler was Zeus (Jupiter or Juppiter), the son of Kronos (Saturn), who after the subjugation of the Titans and Giants ruled in Olympus over "the middle air," while his brother Pluto reigned over the dark kingdom of the lower world (Hades, Tartarus, Orcus), and Poseidōn (Neptune), armed with his trident, ruled in the sea. Like reverence was paid to Hēra (Juno), the sister and wife of Zeus, and the queen of Heaven, the virgin Pallas Athēnē (Minerva), a goddess armed with helmet and shield, and worshipped as the patroness of all intellectual employments and useful inventions, to the two children of Lētō (Latona), Apollo, the leader of the Muses (hence called Musagētēs) and the protector of the fine arts, and his sister, the chaste huntress Artemis (Diana), the goddess of the moon, to the daughter of Zeus, Aphroditē (Venus), the goddess of love, Ares (Mars), the god of war, Hermēs (Mercury), the herald of the gods, and others besides. In addition to these there was an innumerable host of inferior deities (Nymphs, Nereids, Tritons, Horai, Sirens, Dryads and Hamadryads, etc.), who presided over woods and mountains, fields and meadows, rivers and lakes, the seasons, etc. There was also a race of heroes or demigods (Heracles or Hercules, Perseus, etc.) tracing their origin from Zeus, and forming a connecting link between gods and men, while on the other hand the Satyrs formed a connecting link between the race of men and the lower animals. According to a plausible theory, now less generally held than formerly, these gods and demigods are nothing else than the personified objects of nature (the Sky or Upper Air, the Sun, the Ocean, the Air in Motion, etc.), and were originally not conceived as personified, in the strict sense of the term, that is, as clothed in a human form, but simply as the objects themselves, to which the earliest races everywhere attributed a conscious existence like their own, and that the mythological tales relating to these deities and heroes were in their simplest form the natural expression of what human beings in their infancy believed to be done and felt by the very things which they saw. Such is the theory of Max Müller, Mr. Cox, and others; but it will be more appropriately expounded in the article Mythology (q.v.).

With regard to the inculcation of religious beliefs, and the practice of religious duties among the Greeks, the most striking thing to remember is that they had no separate class appointed to perform these functions. The priests were in no sense preachers of doctrines, but merely hierophants, or exhibitors of sacred things, of rites, symbols, and images. They showed how the gods were to be worshipped, or more usually how a particular god was to be worshipped; but it was not their office to teach theological doctrine.

Greek Language and Writing.— The language which we call Greek belongs, as is well known, to the Indo-European or Aryan family of tongues, being akin to the Sanskrit, Persian, Latin, Celtic, Slavonic, and Germanic languages, including of course English. Out of Greece it was spoken in a great part of Asia Minor, of the south of Italy and Sicily, and in other regions which were settled by Grecian colonies. From the great number of Hellenic tribes of the same race it was to be expected that there would be different dialects, the knowledge of which is the more necessary for becoming acquainted with the Greek language, since the writers of this nation have transmitted the peculiarities of the different dialects in the use of single letters, words, forms, terminations, and expressions, and that not merely to characterize more particularly an individual represented as speaking, but even when they speak in their own person. It is customary to distinguish three leading dialects, according to the three leading branches of the Greeks, the Æolic, the Doric, and the Ionic, to which was afterward added the mixed Attic dialect; besides these there are several secondary dialects. Akin to the Ionic is the so-called Epic dialect, that in which the poems of Homer and Hesiod are written, and which was afterward adopted by other epic writers. The Doric was rustic and harsh; the Ionic was the softest and most liquid. The Attic was the neatest, clearest and most precise in sound literation and idiom. The Æolic was spoken on the north of the Isthmus of Corinth (except in Megara, Attica, and Doris), in the Æolian colonies of Asia Minor, and on some of the northern islands of the Ægean Sea. The Doric was spoken in the Peloponnesus, in the Doric Tetrapolis, in the Doric colonies of Asia Minor, of Lower Italy (Tarentum), of Sicily (Syracuse, Agrigentum), and most purely by the Messenians; the Ionic in the Ionian colonies of Asia Minor, and on the islands of the Archipelago; and the Attic in Attica. In each of these dialects there are celebrated authors. The Ionic dialect is found pure in some prose writers, especially Herodotus and Hippocrates. The Doric is used in the poems of Pindar, Theocritus, Bion, and Moschus. Little Doric prose remains, and that is mostly on mathematical or philosophical subjects. In Æolic we have fragments of Alcæus and Sappho. After Athens had obtained the supremacy of Greece, and rendered itself the centre of all literary cultivation, the masterpieces of Æschylus, Sophocles, Euripides, Aristophanes, Thucydides, Xenophon, Plato, Aristotle, Isocrates, Demosthenes, etc., made the Attic the common dialect of literature. Grammarians afterward distinguished the genuine Attic, as it exists in those masters from the Attic of common life, calling the latter the *common Greek* or *Hellenic* dialect: and even the later Attic writers, posterior to the golden age of the literature, were designated *Hellenes* or *common Greeks*. In this latter class are Theophrastus, Apollodorus, Polybius, Plutarch, and others. Many of the later writers, however, wrote genuine Attic, as Lucian, Ælian, and Arrian. Except the dramatists, the poets by no means confined themselves to the Attic; the dramatists themselves assumed the Doric, to a certain degree, in their choruses, for the sake of giving them additional solemnity, because the antique ode was of Doric tradition. They also used the epic or Æolic dialect in narrative passages of the drama where it recalled the recitations of the ancient Ionian rhapsode. Undoubtedly the Greek dialects were not, in the earliest times, so distinct from each other as they afterward became; and on this subject we may quote the words of Prof. Bury (Hist. of Greece, chap. i.): "There can be little doubt that the mixture of the Greeks with the native peoples had a decisive effect upon the differentiation of the Greek dialects. The dialects spoken by the first settlers in Thessaly, in Attica, in Arcadia, have some common characteristics which tempt us to mark them as a group, and distinguish them from another set of dialects spoken by Greek folks which were to appear somewhat later on the stage of history. We may conjecture that the first set of invaders spoke in their old home much the same idiom; that this was differently modified in Thessaly and Bœotia, in Attica and Argolis, and the various countries where they settled; and that many of the local peculiarities were developed in the mouths of the conquered learning the tongue of the conquerors." It results that to have a thorough knowledge of the Greek language we must follow out historically as far as possible the course of its formation, extending our view over all the varied forms of the dialects — a labor which this language, so rich in classic models of every kind, so perfect, so flexible, so expressive, so sweet in its sound, so harmonious in its movements, and so philosophical in its grammatical forms and whole structure, merits, and richly rewards.

When the Greeks became acquainted with the art of writing we do not know. In Egypt hieroglyphics were used more than 3,000 years before the Christian era, and the cuneiform writing of Assyria and Babylonia had a similar antiquity. In Crete writing was practised more than 2,000 years before Christ, it is believed, and among the Asiatic Greeks it was probably introduced 9 or 10 centuries before Christ. According to the writer above quoted: "Perhaps the earliest example of a Greek writing that we possess is on an Attic jar of the 7th century; it says the jar shall be the prize of the dancer who dances more gaily than all the others. But the lack of early inscriptions is what we should expect. The new art was used for ordinary and literary purposes long before it was employed for official records. It was the great gift, which the Semites, who themselves derived it from Egypt, gave to Europe." According to the legend it was Cadmus the Phœnician who introduced the alphabet into Greece; and it is an undoubted fact that the most of the Greek letters are derived from the Phœnician ones. The Greek alphabet possesses the following 24 letters. Α, α (alpha), a; Β β (beta), b; Γ, γ (gamma), g; Δ, δ (delta), d; Ε, ε (epsilon), ĕ; Ζ, ζ (zeta), z; Η, η (eta), ē; Θ, θ (theta), th; Ι, ι (iota), i; Κ, κ (kappa), k; Λ, λ (lambda), l; Μ, μ (mu), m; Ν, ν (nu), n; Ξ, ξ (xi), x; Ο, ο (omicron, i. e. small o), ŏ; Π, π (pi), p; Ρ, ρ (rho), r; Σ, σ, ς (sigma), s; Τ, τ (tau), t; Υ, υ (upsilon), u, commonly transliterated by y; Φ, φ (phi), ph; Χ, χ (chi), ch guttural; Ψ, ψ (psi), ps; Ω, ω (omega, or great *o*), *ō*. There are also marks indicating accent, a rough and a smooth "breathing," the former equivalent to *h* initial before a vowel; but no *j*, *v*, *w*, etc. The alphabet originally introduced into Greece is said to have consisted of but 16 letters; 4 (Θ Ξ Φ Χ) are said to have been invented by Palamedes during the Trojan war, and 4 more (Ζ Η Ω Ψ) by Simonides of Ceos. That the 8 letters mentioned are more modern than the others is certain, partly from historical accounts, partly from the most ancient inscriptions. It remains to remark that the Greeks originally wrote from right to left; then *boustrophedon*, that is, alternately from right to left and left to right; and finally always from left to right.

Greek Literature.— The origin of Greek literature, that is, of the intellectual cultivation of the Greeks as contained in written works, is lost in an almost impenetrable obscurity. Though there existed in Greece, in earlier times, no actual literature, there probably was by no means a want of what we may not improperly call *literary cultivation*, if we free ourselves from the prejudice that a literature must of necessity be embodied in written alphabetical characters. The *first period* of Grecian cultivation which extends to the movement known as the invasion of the Peloponnesus by the Heraclidæ and Dorians, and the great changes produced by it, and which we may designate by the name of the *Ante-Homeric period*, was no doubt utterly destitute of literature; but it may be questioned whether it was also destitute of all that culture which we are accustomed to call *literary*. The fables which are told of the intellectual achievements of this period may have a certain basis of truth. Among the promoters of literary cultivation in this time we must distinguish three classes: (1) Those of whom we have no writings, but who are mentioned as inventors of arts, poets, and sages: Amphion, Demodocus, Melampus, Olen, Phemius, and Prometheus. (2) Those to whom are falsely attributed works no longer extant: Abaris, Aristeas, Chiron, Epimenides, Eumolpus, Corinnus, Linus, and Palamedes. (3) Those to whom writings yet extant, which, however, were productions of later times, are attributed: Dares, Dictys, Horapollo, Musæus, Orpheus, and the authors of the

Sibylline oracles. This is not the place to inquire whether any and how much of these writings is genuine. It is enough that the idea of such a forgery proves a belief in the existence of earlier productions. And how could the next period have been what it was without previous preparation? If we may thus infer what must have been in order that the succeeding period should be what it was, we learn also from the various traditions of the Ante-Homeric period that there existed in it institutions which, through the means of religion, poetry, oracles, and mysteries, had no small influence on the civilization of the nation and the promotion of culture; for the most part, indeed, in Oriental forms, and perhaps of Oriental origin; and that these institutions, generally of a priestly character, obtained principally in the northern parts of Greece, Thrace, and Macedonia. We must here remark that intellectual cultivation did not prosper at once in Greece, nor display itself simultaneously among all the tribes; that the Greeks became Greeks only in the process of time, and some tribes made more rapid progress than others.

About 80 years after the Trojan war new commotions and a new migration began within the borders of Greece. A portion of the inhabitants emigrated from the mother country to the islands and to Asia Minor. This change was in the highest degree favorable to Grecian genius; for the new settlements, abounding in harbors, and destined by nature for commerce and industry, afforded them not only a more tranquil life, but also a wider field for refinement, and gave rise to new modes of life. The ancients ascribed to the colonies in Ionia and the rest of Asia Minor the character of luxury and voluptuousness. The blue sea, the pure sky, the balmy air, the beautiful prospects, the finest fruits, and most delicious vegetables in abundance, all the requisites of luxury, here united to nourish a soft sensuality. Poetry and philosophy, painting and statuary, here attained their highest perfection; but great and heroic deeds were oftener celebrated than performed. Near the scene of the first grand national enterprise of the Greeks — the Trojan war — it was not strange that the interest this event excited should be lively, and that it should take a powerful hold of the imagination. Poetry thus found a subject, in the treatment of which it necessarily assumed a character entirely distinct from that of the former period. Among all nations heroic poetry has flourished with the spirit of heroism. The heroes were here followed by the bards, and thus the epopee was formed. We therefore call this *second period* the *epic age* of the Greeks. The minstrel (*aoidos*) now appears separated from the priest, but highly honored, particularly because the memory of the heroes lived in his verse; and poetry was the guardian of all the knowledge of preceding times, so long as traditions were not committed to writing. From its very nature the epopee must be historical, in an enlarged sense. Under such circumstances it is not strange that regular schools for poets were established; for the imagination of the first poet fired the imagination of others, and it was then, perhaps, believed that poetry must be learned like other arts — a belief to which the schools for priests, on which the schools for minstrels were probably modeled, contributed not a little. But they were minstrels in the strictest sense, for their traditions were sung, and the poet accompanied his verses on a stringed instrument. On every important occasion minstrels were present, who were regarded as standing under the immediate influence of the gods, especially of the Muses, who were acquainted with the present, the past, and the future. The minstrel, with the seer, thus stood at the head of men. But among the many minstrels which this age undoubtedly possessed, Homer alone has survived, whose name has always been associated with the two great epic poems, the 'Iliad' and 'Odyssey,' although in modern times the theory first promulgated by Wolf in 1795, that neither of these poems is the work of one man, has been accepted either entirely or with modifications by many scholars, and many others who contend for the unity of each of the two poems are yet inclined to believe that they were not both composed by the same individual. The latter opinion is not of modern origin, but divided also the Homeric scholars of ancient times. Several hymns, and a mock heroic poem called the 'Batrachomyomachia,' or the 'Battle of the Frogs and Mice,' are also ascribed to Homer, but on altogether insufficient grounds. From him an Ionian school of minstrels takes its name — the *Homeridæ* — who probably constituted at first, at Chios, a distinct family of rhapsodists, and who preserved the old Homeric and epic style, the spirit and tone of the Homeric verse. Much that was attributed to Homer may reasonably be assigned to them. A certain class of the followers of Homer are known by the name of the Cyclic poets, who began, however, to deviate materially from the Ionian epos, the historical element predominating more and more over the poetical. By Cyclus we understand the whole circle of traditions and fables, and not merely the events of the Trojan war. Cyclic poetry comprehended the whole compass of mythology; and we may, therefore, divide it into: (1) a cosmogonical; (2) a genealogical; and (3) a heroic Cyclus; in the latter of which there are two separate periods: (1) that of the heroes before; and (2) that of those after, the expedition of the Argonauts. To the first class belong the battles of the Titans and giants; to the second, the theogonies and herogonies. To the first period of the third class belong the Europia, several Heracleia and Dionysiacs, several Thebaids, Argonautics, Theseids, Danaids, Amazonica, etc. In the second period the poetry generally related to the Trojan war. To this belonged the Nostoi, which treated of the return of the heroes from Troy. The earliest of these Cyclic poets appeared about the time of the first Olympiad. A history of the gradual formation of their poetry cannot be given, because we have only very general accounts respecting them. But what we do know justifies us in concluding that between these historic poets and the Ionian school of minstrels something intervened, making, as it were, the transition. And we actually find this in the *Bœotian-Ascrean* school, which arose in European Greece, it is said, in the 8th century B.C. It derived its name from Ascra in Bœotia, the residence of Hesiod, who stood at its head, and by whom poetry was probably conducted back again from Asia Minor (for he was originally of Cyme in Æolia) to Greece. His works also were at first preserved by rhapsodists. They were not arranged till a later period, when they were augmented by foreign additions; so that, in their present form, their authenticity is as doubtful as that of the poems ascribed to Homer. Of the 16 works attributed to him there have come down to us the 'Theogony,' the 'Shield of Hercules' (the fragment of a larger poem), and 'Works and Days' (a didactic work on agriculture), the 'Choice of Days,' intermixed with moral and prudential maxims, etc. The works of Homer and Hesiod acquired a canonical importance among the Greeks, and constituted, in a certain degree, the foundation of youthful education.

In the *third period*, the age of lyric poetry, of apologues and philosophy, our knowledge of Greek history gradually acquires a greater certainty. About the beginning of the epoch of the Olympiads (776 B.C.) there ensued a true ebb and flood of constitutions among the small states of Greece. After numerous vicissitudes of power, during which the contending parties persecuted each other for a long time with mutual hatred, republics, with democratical constitutions, finally sprang up, which were in some measure united into one whole by national meetings at the sacred games. The spirit prevalent in such a time greatly favored lyric poetry, which now became an art in Greece, and reached the summit of its perfection at the time of the invasion of the Persians. Next to the gods, who were celebrated at their festivals with hymns, their country, with its heroes, was the leading subject of this branch of poetry, on the character of which external circumstances seem to have exercised no slight influence. The mental energies of the nation were roused by the circumstances of the country; and the numerous wars and conflicts, patriotism, the love of freedom, and the hatred of enemies and tyrants, gave birth to the heroic ode. Life, however, was at the same time viewed more on its dark side. Thence there was an intermingling of more sensibility in the elegy, as well as, on the other side, a vigorous reaction, in which the spirit of ridicule gave rise to the iambus (satire). In everything there was a more powerful impulse toward meditation, investigation, and labor for the attainment of a desired condition. The Golden Age, the gift of the gods, was felt to have departed. Whatever man discovered in future was to be the fruit of his own efforts. This feeling showed that the age of manhood had arrived. Philosophy had become necessary, and attained continually a greater development. It first spoke in maxims and gnomes, in fables and in dogmatic precepts. Lyric poetry next gave utterance to the feelings excited by the pleasures of earth. Of those who gained a reputation in this way, as well as by the improvement of music and the invention of various forms of lyric poetry, history presents us the names of Archilochus of Paros, inventor of the iambus; Tyrtæus, author of war songs; Callinus of Ephesus, inventor of the elegiac measure (all of whom flourished in the 7th century B.C.); Terpander of Antissa, in Lesbos (675 B.C.); Simonides of Amorgos (664), the second of the three principal iambic poets of Greece; Alcman the Lydian, and Arion of Methymna, said by Herodotus to have invented the dithyrambus (both flourished about 630 B.C.): Sappho, Alcæus, and Erinna, all natives of Lesbos, the first two of Mitylene, and all of whom flourished about 610 B.C.; Mimnermus of Colophon (flourished from about 634 to 600 B.C.); Stesichorus of Himera (600); Ibycus of Rhegium (lived about 540 B.C. at the court of Polycrates of Samos); Anacreon of Teos (lived first at the court of Polycrates, afterward at that of Hipparchus at Athens); Hipponax of Ephesus (540–520), the third great iambic poet; Lasus of Hermione (520); Simonides of Ceos (fl. 500); his contemporary, Timocreon of Rhodes; Corinna of Tanagra (490), the friend and instructress of Pindar (522–442). As gnomic writers, Theognis of Megara and Phocylides of Miletus deserve to be named (both of whom flourished about 540 B.C.); as a fablist, Æsop (570 B.C.). In the order of time several belong to the following period, but are properly placed here, on account of their connection.

In the period of 550–500 B.C. traditions were first committed to writing in prose, and Cadmus of Miletus (540), Acusilaus the Argive, Hecatæus of Miletus (500), Hellanicus of Mitylene, and Pherceydes of Scyros, are among the oldest historical writers (450). These are known as the logographers (*logographoi*), a name given to them by Thucydides. After them appeared Herodotus (born 484), the Homer of history. His example kindled Thucydides (born 471) to emulation, and his eight books of the history of the Peloponnesian war make him the first philosophical historian, and a model for all his successors. If his conciseness sometimes renders Thucydides obscure, in Xenophon (born about 444), on the contrary, there prevails the greatest perspicuity; and he became the model of quiet, unostentatious historical writing. These three historians are the most distinguished of this period, in which we must, moreover, mention Ctesias (400), Philistus (363), and Theopompus (340).

An entirely new species of poetry was created in this period. From the thanksgiving festivals, which the country people solemnized after the vintage, in honor of Dionysus (Bacchus), with wild songs and comic dances, arose, especially in Attica, the drama. By degrees variety and a degree of art were given to the songs of the village chorus, and by and by an intermediate speaker was introduced, who related popular fables, while the chorus varied the eternal praises of Bacchus by moral reflections, as the narration prompted. These games of the feast of the vintage were soon repeated on other days. Solon's contemporary, Thespis, who smeared his actors, like vintagers, with lees of wine, exhibited at the cross ways or in the villages, on movable stages, stories sometimes serious with solemn choruses, sometimes laughable with dances, in which satyrs and other ridiculous characters excited laughter. Their representations were called tragedies (*tragōdiai*), that is, songs of the goat (so called either because the exhibition of a tragedy was in the earliest times accompanied by the sacrifice of a goat, or because a goat was the prize, or because the actors were clad in goat-skins) comedies (*kōmōdiai*, meaning either village songs, from *kōmē*, a village, or songs of revelry, from *kōmos*, revelry), festive dances and satirical actions (*drama satyricum*). These sports were finally exhibited, with much more splendor, on the stages of the towns, and acquired a more and more distinct character by their peculiar tone and morality. Instead of an intermediate speaker, who related his story extemporaneously, Æschylus (525-456) first substituted actors, who repeated their parts by rote; and he was thus the actual creator of the dramatic art, which was soon carried to perfection; tragedy by Æschylus, Sophocles (495-406) and Euripides (480-406); comedy by Cratinus (519-422), Eupolis (fl. 440), Crates, but especially by Aristophanes (about 444-380). Under the government of the Thirty Tyrants the freedom which comedy had possessed, of holding up living characters to ridicule, was restricted, and the middle comedy was thus gradually formed, in which the chorus was abolished, and, with delineations of general character, characteristic masks were also introduced. The mimes of Sophron of Syracuse (460-420), dramatic dialogues in rhythmical prose, formed a distinct species, in connection with which stands the Sicilian comedy of Epicharmus (about 540-450).

Eloquence, the necessary outcome of the democratic institutions of many of the Greek states, likewise flourished during this period, and was speedily elevated to the rank of a fine art. Antiphon (440), Lysias (458-378), Isocrates (436-338), Isæus (420-348), Demosthenes (about 385-322), Æschines (389-314), were renowned masters of this art. We still possess the admired masterpieces of several of these orators. How near rhetoric was then to triumphing over poetry is manifested in Euripides, and there is no question that it had a considerable influence on Plato and Thucydides. Mathematics was now cultivated, and geography served to illustrate history. Astronomy is indebted to the Ionic school, arithmetic to the Italic, and geometry to the Academic school for many discoveries. As mathematicians, Meton, Euctemon, Archytas of Tarentum, Eudoxus of Cnidus, were celebrated. Geography was particularly enriched by voyages of discovery, which were occasioned by commerce; and in this view Hanno's voyage to the western coast of Africa, the Periplus of Scylax (a description of the coasts of the Mediterranean), and the discoveries of Pytheas of Massilia in the northwest of Europe, deserve mention. The study of nature was likewise pursued by the philosophers; but the healing art, hitherto practised by the Asclepiadæ in the temples, constituted a distinct science, and Hippocrates (about 460-357) became the creator of scientific medicine.

The following period is usually called the *Alexandrine*, and might be characterized as the *systematizing* or *critical period*. Athens did not, indeed, cease to sustain its ancient reputation; but during the greater part of the period Alexandria was in reality the leading Greek city. From this and other causes the spirit of Grecian literature necessarily took another turn. Greece was now under a foreign yoke; great creative geniuses no longer arose either in the home country or in the colonies; and the use of an immense library tended to make erudition triumph over the free action of mind, which, however, could not be immediately overborne. In philosophy, Plato's acute and learned disciple, Aristotle (384-322), appeared as the founder of the Peripatetic school, which gained distinction by enlarging the territory of philosophy, and by its spirit of system. He separated logic and rhetoric, ethics and politics, physics and metaphysics and applied philosophy to several branches of knowledge; thereby producing economics, pedagogics, and poetics. He invented the philosophical syllogism, and gave philosophy the form which it preserved for centuries. His disciple Theophrastus (died 287 B.C.) followed his steps in the investigation of philosophy and natural history. But the more dogmatic was the philosophy of Aristotle, the more caution was requisite to the philosophical inquirer, and the spirit of doubt was salutary. This was particularly exhibited in the system of skepticism which originated with Pyrrho of Elis (330). A similar spirit subsisted in the middle and new academies, of which Arcesilaus (241) and Carneades (155) were the founders. The Stoic school, founded by Zeno of Citium in Cyprus (342-270), and the Epicurean, of which Epicurus (2[illegible]-270) was the founder, were chiefly remarkable for the effect that they had in the development of moral speculation in opposite directions, which gradually brought about a great difference in the practice of the adherents of the opposite schools. Mathematics and astronomy made great progress in the schools at Alexandria, Rhodes, and Pergamus. And to whom are the names of Euclid (323-283), Archimedes (287-212), Eratosthenes (276-196), and Hipparchus (160-145) unknown? The expeditions and achievements of Alexander furnished abundant matter to history; but, on the whole, it gained in extent, not in value, since a preference for the wonderful over the actual had now become prevalent. The more gratifying, therefore, is the appearance of Polybius of Megalopolis (204-122), who is to be regarded as the author of the true method of historical exposition, by which universal history acquired a philosophical spirit and a worthy object. Geography, which Eratosthenes made a science, and Hipparchus united more closely with mathematics, was enriched in various ways. To the knowledge of countries and nations much was added by the accounts of Nearchus Agatharchides and others. With respect to poetry many remarkable changes occurred. In Athens the middle comedy gave place not without the intervention of political causes to the new which approaches to the modern "comedy of manners." (See DRAMA.) Among the many poets of this class Menander (342-291) and Philemon (330) were eminent. To this period also belong the celebrated idyllic poets Theocritus (270), and his contemporary Bion, as well as Moschus, who lived about 20 years later. The other kinds of poetry did not remain uncultivated; we may mention the learned poetry of Callimachus and of Lycophron, the epic of Apollonius Rhodius, the didactic of Aratus and Nicander; but all these others, as well as the criticisms of poetry and the fine arts, point to Alexandria; and we shall therefore pass them over in this place. (See ALEXANDRIAN SCHOOL.) The Septuagint (q.v.) or Greek translation of the Old Testament was a work of scholars of the Alexandrian school. The period subsequent to 146 B.C. is known as the Græco-Roman. Polybius may be placed here as well as the other historians, Diodorus Siculus and Dionysius of Halicarnassus; while in the Christian era we have Josephus, Arrian, Appian, Herodian; the biographies of Plutarch, Diogenes Laertius, and Philostratus, the geographies of Strabo and Pausanias; the astronomy and geography of Ptolemy;

the informatory works of Athenæus, Ælian, and Stobæus; the medical works of Galen; the satirical works of Lucian; and the Greek romances best represented in Heliodorus, Achilles Tatius, and Chariton. See BYZANTINE LITERATURE.

The following are among the best works on Greek literature: K. O. Müller's 'Geschichte der griechischen Litteratur' (4th ed. 1882–4); Bergk's 'Griechische Litteraturgeschichte' (1892–4); Bernhardy's 'Grundriss der griechischen Litteratur' (new ed. 1892); Mure's 'Critical History of the Language and Literature of Ancient Greece' (1854–60); Mahaffy's 'Classical Greek Literature' (1890); Jevons' 'History of Greek Literature' (1890): Croiset's 'Histoire de la littérature grècque (1889–95); Susemihl's 'Geschichte der griechischen Litteratur in der Alexandrinerzeit' (1891–2).

Greece, Modern (Greek *Hellas*), a kingdom in the southeast of Europe, bounded on the north by Turkey, and on all other sides by the sea — the Ionian Sea on the west, the Mediterranean proper on the south, and the Ægean Sea on the east. The mainland forms two chief portions, united by the narrow Isthmus of Corinth; a northern, called Northern Greece or Livadia, and a southern peninsula, called the Peloponnesus or Morea. By far the largest island is Eubœa, only separated from the mainland of Livadia by the narrow channel of Euripo. The other islands form several groups: The northern Sporades on the northeast of Eubœa including Skiathos, Skopelos, Khiliodromia, Pelagonisi, Sarakinon or Peristeri, and Skyros; the western Sporades, chiefly in the Gulf of Egina, or between it and the Gulf of Nauplia, including Hydra, Spetsæ, Poros, Egina, and Salamis or Koluri, the Cyclades; and the Ionian Islands. (See GREECE, ANCIENT.) The capital and largest town is Athens.

Physical Features.— See GREECE, ANCIENT.

Divisions.— Greece is politically divided into 16 nomarchies, which are again subdivided into eparchies, and these again into demes. The following table gives the names of the nomarchies, with the area of each of them, and the population according to the returns for 1896:

NOMARCHIES		Area in sq. m.	Pop. 1896.
Northern Greece:	Attica and Bœotia...	2,472	313,069
	Phocis and Phthiotis.	2,044	147,297
	Acarnania and Ætolia	3,013	170,565
Peloponnesus:	Argolis and Corinth.	1,442	157,578
	Achaia and Elis.....	1,901	236,251
	Arcadia	2,020	167,092
	Messenia	1,221	205,798
	Laconia	1,670	135,462
Islands:	Eubœa and Sporades.	2,216	115,515
	Cyclades	923	134,747
	Corfu	431	124,578
	Zante	277	45,032
	Cephalonia	302	83,363
Thessaly:	Arta	395	39,144
	Trikkala	2,200	176,773
	Larissa	2,478	181,542
	Total..............	25,014	2,433,806

By the law of 17 July 1899 there is a new division into 26 nomarchies, namely: Attica, Bœotia, Phthiotis, Phocis, Ætolia and Acarnania, Eurytania, Larissa, Magnesia, Trikkala, Karditsa, Arta, Achaia, Elis, Eubœa, Cyclades, Kerkyra (Corfu), Leucas, Kephallenia (Cephalonia), Zacynthos (Zante). These are subdivided into 69 districts and 442 communes.

Climate.— In general the first snow falls in October and the last in April. During the summer rain scarcely ever falls, and the channels of almost all the minor streams become dry. The air is then remarkably clear, and a month will sometimes pass away without a cloud being seen. A sudden change, however, takes place toward the end of harvest. Rain becomes frequent and copious; and the streams which had been dried up not only fill their channels, but frequently overflow them, and lay considerable tracts under water. In this way stagnant pools and marshes are occasionally formed, which give rise to intermittent fevers. Compare GREECE, ANCIENT (*Climate*).

Vegetation, Agriculture, etc.— The cultivated land in Greece has recently been estimated at rather more than 5,563,100 acres. There are besides 5,000,000 acres of pasture land, and 3,000,000 acres of waste land. The draining of Lake Copais redeems 60,000 acres of land, which the company divides into holdings of from 5 to 50 acres. English agricultural machinery is being introduced, but still agriculture is in a backward state.

Thessaly is the richest portion of Greece agriculturally. The condition of the agricultural population is said to be very satisfactory. The principal cereal crops are wheat, barley, and maize, but the quantity raised is not sufficient, and much grain is imported. All the fruits of the latitude are grown — figs, almonds, oranges, citrons, melons, etc.— in abundance and of excellent quality, without receiving any great share of attention. The vine also grows vigorously, and considerable quantities of wine are made, some of the sorts being of high quality. But a much more important product of Greece, especially on the coasts of the Peloponnesus, and in the islands of Cephalonia, Zante, Ithaca, and Santa Maura, is the Corinthian grape or currant, the export of which has increased in value from $7,558,350 in 1898 to $8,238,118 in 1900. Another important object of cultivation is the olive, for which both the soil and the climate are alike favorable. The culture of the mulberry for the rearing of silk-worms is carried on to some extent. Some good tobacco is grown. The forests contain, among other trees, the oak (*Quercus Ægilops*) which yields the valonia of commerce. The live stock are neither numerous nor of good breeds. The raising of artificial grasses for their maintenance may be said to be unknown, and the scanty herbage which natural pasture affords must be of little avail. Asses and mules are more numerous than horses; cattle are comparatively few; and the chief animals from which dairy produce is obtained are the sheep and the goat. The quantity of wool produced is considerable, but most of it is of a coarse description.

Manufactures, Trade, Communications, etc.— The manufactures are limited, but with all other branches of industry in Greece are increasing, and are furthered by high duties on imported goods. The employment of the steam-engine in manufacturing industries dates from about 1868, and is yet only developed to a small extent. Piræus is the chief industrial centre, having spinning and weaving factories for cotton, silk, and wool, machine-shops, paper-works, dye-works, etc. Other centres are Syra, Corinth, Nauplia, Patras, Larissa. Still, cottons and other textiles form by far the most important part of the imports of manufactured goods. Leather manufactures form an important branch of industry. Marble has been worked from the most ancient period in the quarries of the island of Paros. In 1871 the working of the ancient argentiferous lead mines of Laurion in Attica was resumed with good success; and quantities of manganese iron ore and zinc ore are also raised in this district. The most important branch of manufacturing industry is ship-building, which is carried on at various places. Much of the trade carried on is merely coasting, but the foreign trade also is of considerable extent. A large part of the foreign shipping of Greece is that which deals with the import of the manufactures of England, Germany, etc., into Greece, Turkey, and the Levant generally. In regard to this branch, the peculiar advantages which the Greeks possess in their knowledge of the languages, and acquaintance with the habits and wants, of the people of these countries, have been greatly in their favor. The chief ports of Greece are Piræus (population 42,169, the port of Athens), Syra, and Patras (population 37,958). The principal export is currants (very largely to Britain); but wine, olive-oil, dried figs, raisins, silver, lead, zinc ore, and manganese iron ore, tobacco, sponges, and other articles are also exported; the principal imports are cereals, coals, and cotton and woolen goods. The imports in 1891 were $27,800,200, the exports $21,497,040; in 1901 the imports were $27,773,010. The greatest hindrance to the development of Greece is the want of good roads, which are peculiarly necessary in so mountainous a country. Attention, however, has been directed to the supplying of this want, and there are now over 2,043 miles of roads. Among other public works which have engaged the energies of the Greeks are the construction and restoration of harbors, the erection of lighthouses, the execution of drainage works, etc. In 1883 there were only 58 miles of railways open, but in 1901 603 miles were open, and 300 were under construction. A ship canal across the isthmus of Corinth (4 miles) was opened in 1893.

Weights, Measures, and Money.— The French metric system of weights and measures has been introduced into Greece by the government, but the people still adhere to the old system. In the latter the standard lineal measure was the *pikē*, equal to three quarters of an English yard; the standard square measure was the *stremma*, nearly equal to .242 of an English acre; the standard weight was the *oke* = 2.80 pounds avoirdupois; 44 *okes* were equal to 1 *cantar*, or about 122 pounds avoirdupois. The weights and measures of the metric system are called royal, to distinguish them from the old weights and measures. In this system the French measures of length, millimetre, centimetre, decimetre, and metre are called respectively *gramma*, *daktylos*, *palamē*, and *pēcheus* (cubit). The kilometre is called a *stadion*, and the myriametre *skoinis*. The new or royal measures of surface are the square *pecheus* = the square metre, and the *stremma* = the are. The measures of capacity are the *kybos*, *mystron*, *kotyle*, *litra*, and *koilon*, respectively equal to the millilitre, centilitre, decilitre, litre, and hectolitre. The weights for gold, silver, and precious stones are the *kokkos*, *obolos*, and *drachmē*, respectively equal to the centigramme, decigramme, and gramme. The commercial unit of weight is the *mna* = 1,500 *drachmēs* = 1½ kilogramme. The *talanton* is equal to the quintal, and the *tonos* equal to the tonneau.

In 1875 Greece entered the monetary league of which the other members are France, Italy, Switzerland, and Belgium, and all the members of which have a monetary unit equal to the franc in value. The name of the Greek unit is the *drachma*, divided into 100 *lepta*, nominally equal to a franc but varying considerably in value.

Government and People.— As settled by the present constitution the throne is hereditary according to the law of primogeniture in the family of King George. The king must be a member of the Greek Orthodox Church. He attains his majority at the age of 18. The legislative authority is vested in a single chamber, called the Boulē, the members of which (proportioned in number to the amount of the population) are elected for four years by ballot by manhood suffrage. It meets every year on 1 November, unless called at an earlier date for special business. The executive power is exercised by the king through a responsible ministry. The Greek Orthodox Church alone is established, but all other forms of religion enjoy toleration. The highest ecclesiastical authority, subject to the king, is vested in a permanent synod, which sits at Athens, and consists of five members appointed by the king from the highest dignitaries of the Church. There is 1 metropolitan, who has his seat at Athens, 21 archbishops, and 29 bishops, who are presented and ordained by the synod, and confirmed and invested by the king. Justice is administered, on the basis of the French civil code, by a supreme court (*Areios Pagos*), which has its seat at Athens; five higher courts, one at Athens, one at Nauplia, one at Patras, one at Larissa, and one at Corfu; and a number of courts of primary resort (*Protodikeia*), in the principal towns. The public revenue, derived chiefly from direct taxes, customs, stamps, excise, monopolies, the rent of national property, etc., was estimated for 1900 at $18,510,755, and the expenditure at $17,687,135. Revenue for 1902 was estimated at $23,021,075, and expenditure at $23,021,080. Greece has a very large public debt. In 1899 the amount of this debt was about $152,500,000. A considerable portion of the debt incurred in recent years has been in the way of raising loans for the making of railways. Of the foreign debt one loan is guaranteed by Great Britain, France, and Russia, which have latterly had to pay the dividends on it, and which are now accordingly heavy claimants on Greece. The payment of the interest on its public debt has long been with Greece a matter of difficulty. Every male Greek on attaining the age of 21 years is liable to military service, his term being 2 years with the colors, 10 with the reserve, 8 in the national guard, and 10 in the national guard reserve. The army in 1900 numbered about 25,000 on a peace footing, expanding easily to 82,000 in time of war. The navy in 1903 consisted of 3 armor-clad ships, 10 torpedo-boats, besides several unprotected gun-vessels and cruisers. The population contains a considerable intermixture of foreign stocks, among which the Albanese, or Arnauts, are the most numerous; but the great

GREECE.

1, The Academy at Athens. 2. The University at Athens.

majority, though not without some taint in their blood, are of genuine Greek extraction, and, both in physical and mental features, bear a marked resemblance to their celebrated forefathers. It is true that the degrading bondage to which they were subjected for centuries has sunk them far below their natural level, and too often substituted sycophancy and low cunning for the intellectual superiority which, in earlier and better times, displayed itself in immortal productions of the chisel and the pen; but that the original elements of greatness still exist has been proved by the noble struggles which they have made for independence. The educational system of Greece, organized in 1834 by George Gennadius, one of the leaders of the war of independence, is very complete. There are three grades of schools, the demotic or primary national schools, the Hellenic or secondary grammar schools, and the gymnasia, in which, it is asserted, the range and the level of the teaching are much the same as in a German gymnasium or in the upper parts of our public schools. In all three grades of schools education is gratuitous, and in the primary schools it is compulsory on all children between 5 and 12. There is a university at Athens, attended by nearly 3,000 students, many of whom come from districts under the rule of the Sultan. Thus far, however, education seems to be actually diffused among the people only to a limited extent, though the numbers that receive a university education are so great that many such young men find themselves without any proper sphere of employment, and are obliged to adopt the career of politician and place-hunter. Many of these are now, however, said to be finding better ways of turning their education to account through the rapid development of trade and industry. The national dress of the Greeks resembles the Albanian costume. In the men it consists of a tight jacket, generally scarlet, a white linen kilt in numerous folds, a bright-colored sash round the waist, and embroidered gaiters; in the women it consists of a vest or jacket fitting close to the shape, and a skirt, on the head a kind of fez or skull-cap.

History.— From the year 1715 (see preceding article) till 1821 the Greeks were subject to the domination of the Turks. In 1770, and again in 1790, they made attempts at insurrection, which, however, were speedily frustrated. In the early years of the 19th century a secret society was formed for the purpose of effecting their liberation from the galling yoke, and in 1821 they found an opportunity of breaking out into another insurrection, which in the end proved successful. In that year Ali, the pasha of Janina, revolted against the Sultan Mahmoud II., and secured the aid of the Greeks by promising them their independence. The rising of the Greeks took place on 6 March, under Alexander Ypsilanti, and on 1 Jan. 1822 they published a declaration of independence. In the same year Ali was assassinated by the Turks, but the Greeks nevertheless continued the struggle that they had begun, and in which they were encouraged by the sympathy of nearly all the nations of Europe. Among the most distinguished of their leaders were Marcos Bozzaris, Capo d'Istria, Constantine Kanaris, Kolocotroni, Miaulis, Mavrocordato, Mavromichaelis, etc. In 1823 they were joined by Lord Byron, who, during the last year of his life, did all in his power to further their cause by his wealth, as well as by his active efforts on their behalf. Unfortunately he died in April of the following year. In 1825, the Turks having called to their aid Mehemet-Ali, the pasha of Egypt, the latter sent his son, Ibrahim Pasha, whose talents secured them the success that they had hitherto been unable to attain. Tripolitza, the capital of the Morea, was taken, as was also Missolonghi, in spite of the valor of the Suliote mountaineers. It was about this time that the Greek patriots received the aid of the English admiral Lord Cochrane, who organized their fleet, and of the French colonel Fabvier, who instructed their army in the system of European tactics. In spite of this, however, the Turks continued to triumph everywhere, and resisted all the pressure that was put upon them by other European powers to make concessions. A treaty was then concluded at London (6 July 1827) between Britain, France, and Russia, for the pacification of Greece, and when the mediation of these three powers was declined by the Sultan, their united fleets, under Admiral Codrington, attacked and annihilated the Turkish fleet off Navarino, 20 Oct. 1827. In the beginning of the following year (1828) Count Capo d'Istria became president of the state, and later on in the same year Ibrahim Pasha was forced to evacuate Greece. At last, on 3 Feb. 1830, a protocol of the allied powers declared the independence of Greece, which was recognized by the Porte on 25 April of this year. The new member of the states of Europe received from the allies a monarchical form of government, and offered the crown to Leopold, Prince of Saxe-Coburg, and when he refused it, to Otho, a young prince of Bavaria. The latter accepted the offer, and was proclaimed king of the Hellenes at Nauplia, on 30 Aug. 1832. The power of the king was at first almost absolute, and his arbitrary measures, and more especially the preponderance which he gave to Germans in the government, soon made him unpopular. At the same time the finances of the kingdom were in a very embarrassed condition, and a general uneasiness prevailed. In 1843 a rebellion took place, after which a constitution was drawn up. But Otho was after that no more popular than before, and after the outbreak of another rebellion in February 1862, he saw himself compelled to abdicate the throne (24 October). A provisional government was then set up at Athens, and the National Assembly after declaring that the throne had been forfeited by Otho, offered it in succession to Prince Alfred, of England, and Prince William George, of Denmark. The latter accepted it, and 30 March 1863 was proclaimed as King George I. At the end of that year a constituent assembly was elected for the purpose of framing a new constitution, and the result of its labors was the constitution which is still in force. In 1864 an addition was made to the small kingdom by the annexation of the Ionian Islands, which had hitherto formed an independent republic under the protection of Britain. From the first Greece has been watching for an opportunity of extending its frontier northward, so as to include the large Greek population in Thessaly and Epirus. In January 1878, during the Russo-Turkish war, Greek troops were moved into Thessaly and Epirus to the assistance of their brethren who had risen there, but on the remonstrance of England these troops were withdrawn. The Treaty of Berlin made no definite provisions for any extension of Greek territory, but in 1881 Turkey had to cede about 5,000 square miles of Thessaly to Greece. After the union of eastern Roumelia with Bulgaria, in 1885, war with Turkey was only prevented by the great powers. In 1890 an insurrection of the Christians in Crete led to the interference of Greece and to war with Turkey. The Turks speedily drove back the Greeks from the northern frontier and overran Thessaly; and Greece was enabled only through the efforts of the great powers to obtain reasonable terms of peace. The recent internal political history of Greece relates mainly to her financial obligations. After the expulsion of the Turkish troops from Crete in 1898 Prince George was appointed high commissioner of the island.

Modern Greek Language and Literature.— The Greek language seems to have preserved its purity longer than any other known to us; but a deadly blow was inflicted when the Greeks were enslaved by the fall of Constantinople (1453 A.D.). All the cultivated classes, who still retained the pure Greek, the language of the Byzantine princes, either perished in the conflict or took to flight, or courted the favor of their rude conquerors, by adopting their dialect. In the lower classes only did the common Greek survive (the *koinē, dēmodēs, haplē, idiōtikē dialektos*) the vulgar dialect of the polished classes, the traces of which occur, indeed, in earlier authors, but which first appears distinctly in the 6th century. This Greek *patois* departed still more from the purity of the written language — which took refuge at court, in the tribunals of justice, and the halls of instruction — when the Frank crusaders augmented it by their own peculiar expressions, and the barbarians in the neighborhood engrafted theirs also upon it. This popular dialect first appears as a complete written language in the chronicles of Simon Sethos, in 1070–80. After the Ottomans had become masters of the country all the institutions which had contributed to preserve a better idiom perished at once. The people, left to themselves, oppressed by the most brutal despotism, would finally have abandoned their own dialect, which became constantly more corrupt, had not the Greeks possessed a sort of rallying-point in their Church. But even here, owing chiefly to the ignorance and corruption prevailing among the clergy, little could be found to prevent the further debasement of this fine dialect, which continued till the middle of the 18th century. About this time many of the Greeks began to resort for instruction to the universities of the West, whence they returned to their native country to animate their fellow-countrymen with the desire of making nearer approaches to the more civilized nations of Europe, so as not to remain behind in the general progress. One consequence of this was that the Greeks began to pay more attention to their mother tongue, and this tendency was increased by intercourse with the more refined West, by means of more frequent visits from intelligent men of that quarter to the ruins of Grecian greatness. The Patriarch (Samuel Eugene Bulgars Theotokis) of Corfu, and the unfortunate Rhigas, may be mentioned as eminent at this period.

At first a large part of the literature of awakened Greece consisted of translations from the French, but the country now furnishes original writers in every department of literature. Among the theological works of modern Greece perhaps the most remarkable is that on 'Truth,' by Pharmakidis (1852), which is one of the most important works in the modern Greek language. The philosophical and mathematical sciences are all well represented. For these branches of knowledge much has been done by the University of Athens, many of the professors of which have published manuals (some of which have no inconsiderable scientific value) on the subjects on which they lecture. With the exception of poetry, history is perhaps the department which has attracted most writers in the modern Greek language. On this head the long and learned dissertations prefixed by Spiridion Zampelios to his 'Popular Songs of Greece' (Corfu 1852), and 'Studies on Constantinople' (1858), affording valuable and interesting materials for the history of Greece in the Middle Ages, deserve to be particularly mentioned. In the department of philology and scholarship Coray has performed important services by collecting a large mass of materials for acquiring a more thorough knowledge both of ancient and modern Greek; and after him Doukas, Darbaris, Asopios, and Rhangabe, ought to be noticed for their editions of the ancient classics with commentaries in modern Greek. At the head of the orators of the time of the struggle for independence stands Trikoupis, some of whose speeches were collected and published in 1829, and a second and enlarged edition of them in 1860. In the department of poetry a distinction must be made between that of the people and that of the cultivated classes. The former is represented chiefly in the songs of the Klephts and other songs dating from the war of independence, which are a faithful mirror of the public life at the time to which they belong. At this period the war-songs of Rhigas were caught up by the whole nation and sung with enthusiasm. At a later period the two Soutsos, Panagios and Alexander, Calvos, Solomos, and others, earned distinction in the same kind of poetry. The Soutsos were distinguished also as dramatists and novelists, and Alexander also as a satirist. Among the other leading dramatists are Rizos Nerulos and Zampelios. The most distinguished recent author, both a poet and a scholar, is A. R. Rangabé, while Demetrius Bikelas is the chief novelist.

Modern Greek, as spoken by the uneducated classes, is called Romaic, from the fact that it took on its special character at the time when the Greeks considered themselves as natives of the Roman empire, and hence called themselves *Romaioi*, or Romans. The Greek of the educated classes, that used in the newspapers and other literature of the present day, is distinguished from it by a greater resemblance to the Greek of antiquity, which renders it easy for any one who has a satisfactory acquaintance with ancient Greek to read the literary Greek of the present day. The domain of the Romaic comprises not only the whole of the present kingdom of Greece (including Thessaly), but also part of Roumelia, Albania, and Anatolia, the islands of Crete and Cyprus, as well as the islands of the archipelago not belonging to Greece. The purest Romaic is spoken in the less frequented isles of the archipelago, and in some of the mountainous districts of the interior. It is in these districts particularly that modes of expression are still found belonging to the most classical antiquity. At Megara the language is less corrupt than at Athens, where it is mixed with a considerable number of Italian words. In the northern provinces it is mixed chiefly with Albanian. Besides the foreign words which have been introduced into northern Greek, a pretty large number of words are found which have changed their original signification although they have retained their original form. Ancient words are most commonly found in significations the most remote from the original or derivative sense. The grammar has also undergone considerable modifications. For example, the numbers have been reduced to two by the suppression of the dual; and the cases to four, by the disappearance of the dative, the signification of which is now expressed by means of a preposition with the accusative. The first of the cardinal numerals is now used as an indefinite article. The degrees of comparison are sometimes expressed by the ancient inflexions, but at other times by the use of *pleon* (more). The past tenses of the verb are formed by the aid of the verb *echō* (I have), and the future tenses by the aid of *thelō* (I will). The infinitive mood, which has fallen out of use, has its place supplied by a periphrasis, in which the verb is put in the subjunctive. The middle voice has disappeared, and what remains of the old conjugation is of so little consequence that it may be regarded as an irregularity. The ancient orthography of the language is still preserved, but considerable changes appear to have taken place in the pronunciation. The vowels η, ι, and υ, and the diphthongs ει, οι, and υι, are all pronounced like *ea* in the English word *mean*. Β is now pronounced as *v*, and the sound of *b* is expressed by μπ. Δ is pronounced like *th* in *thus*, and θ like *th* in *think*.

Consult: Néroulos, 'Cours de Littérature Grecque Moderne' (1828); Rangabé, 'Histoire Littéraire de la Grèce Moderne' (1877); Nicolai, 'Geschichte neugriechischer Litteratur' (1876).

Greek Architecture. *First*, that which has existed in Greece, that is the land of the Hellenes, which, for art purposes, includes everything south of Mount Olympus on the east coast and the Island of Corfu on the west. This architecture is of several very distinct epochs. *Second*, the architecture identified with the Greek spirit at the time of the highest intellectual development of the race — viz. from about 500 B.C. to the Roman Conquest; and which is in architecture represented by the famous styles called Doric and Ionic, with the Corinthian just appearing at the time when the freedom of Greece was at an end. Each of these definitions of the term requires separate treatment.

First.— The architecture of the land of Greece is known to us in its earliest form by certain tombal chambers, in which a circular or polygonal room is enclosed and roofed with stone by one operation, that is, by laying the stones in courses continually projecting inwards, and so decreasing the size of the chamber within, until at last a single cap-stone closes the aperture at the top. These stone structures had passages leading to them, enclosed and roofed with stone; and these passages allowed of the covering in of the whole stone edifice with earth, perhaps in huge, high mounds. In this way, as in northern Europe and also in the peninsula of India, a great funereal monument was erected which cost nothing but the labor of transporting many thousand tons of earth and rough stone in addition to the comparatively slight building of the stone chamber and passage. The largest of these is among the ruins of Mycenæ, and has been known for many years as the Treasury of Atreus. More elaborate buildings are of what is known as the Mycenæan epoch (see MYCENÆAN) which is not accurately fixed, but which it is customary now (1904) to place at about 1700 B.C., lasting perhaps for 500 years. The name Mycenæan comes from the city of Mycenæ, explored first by Dr. Schilemann in 1876. We know only its remains, painting upon walls, inlays of metal, pottery and the like, and something is known of the plan of the royal palace and its accessory buildings; but no part of this enables us to fix the date. If we assume that this artistic civilization lasted until about 1200 B.C. there is less a lapse of time before the Homeric conditions began; for the palaces and fortresses described in the Iliad are generally accepted as of about 1,000 B.C. Again a blank occurs, and the earliest buildings of the Proto-Doric may be thought to begin about 600 B.C.

For the classical art of Greece, that is the building of the celebrated and beautiful temples, see the second part of this paper. This classical epoch lasts until the Roman conquest, and even beyond it in a modified form. Thus the gateway of the Agora in Athens is Doric of a style not used until the Roman control had begun; and it is extremely curious to compare this with the Doric of 500 years earlier. The Roman governors and generals built memorial buildings, porticoes and temples in a curiously modified style, partly pure Greek, partly of that Romanized Greek which was beginning to be recognized as the Imperial art for the whole Mediterranean world. Under the reign of Hadrian an attempt was made to return to a purer taste, but this was of brief duration. Greece was not to have an art of her own again until the Byzantine style was well established (see ARCHITECTURE and BYZANTINE ARCHITECTURE). The Byzantine style in the land of Greece was singularly characterized by very small proportions; there has never been an interesting style of which the monuments are so diminutive; important churches exist in Athens and other cities which would not hold two hundred persons and which are delicately built in a refined shape, and prettily if not richly decorated. The architecture of modern times in Greece is not more intelligent than that of the rest of Europe, while it is very simple and inexpensive. The country is small and poor, and even a royal palace cannot have much costly treatment; moreover the buildings in Athens are mostly of German design, according to the taste of the first dynasty established there after the freeing of Greece in 1823.

Second.— Grecian architecture in the sense of the classical style begins with what we call the Proto-Doric style as exemplified by the temple at Corinth, a building with low, thick columns and a comparatively high entablature, as far as can be ascertained. It is thought by some that the Heraion (that is the temple of Hera) at Olympia, is a still older building, and in that case the earliest piece of classical Greek architecture. It is curious in form, as it has six columns at each end with sixteen on each side, the corner columns being counted twice, that is to say, there are forty columns in all. The peculiarity of this will be seen when we speak below of the perfected type of Doric temples. In the Olympia building the columns are of different sizes, varying even more than a foot in their thickness, and the capitals also differ. The common explanation, that the columns were originally of wood and were replaced by stone, one at a time, at all events points to the extreme irregularity of the structure. The Doric buildings of accepted and permanent type may thus be thought to appear first at the beginning of the 5th century B.C. The Greek colonies in southern Italy and Sicily were flourishing at this time and we find some of the earliest Doric temples of classical form in Pesto (the Roman Paestum, the Greek Poseidonia), in Campania and in Selinunte and Girgenti in Sicily. The style rapidly took definite form and was reduced at an early date to a very definite set of rules. Thus it became a recognized arrangement that the columns on the flank of the peristylar temple should be twice as many as those on the front and one more: the corner column being always counted twice. Thus the hexastyle temples at Athens, in Pesto and elsewhere, having 6 columns in front, have 13 on the side; and the only two octostyle Doric temples known — the Parthenon at Athens and the great temple at Selinunte — have 17 columns on the side. But all temples were not peristylar; on the contrary by far the greater number had porticoes only at the east front or at the east and west end. The essential parts of the temple are, of course, the closed naos or, as the Romans called it, the cella, in which the statue of the divinity was preserved, together with certain treasures, consecrated gifts and the like. There must have been thousands of these little shrines in Greece, the Greek islands and the colonies. A somewhat larger temple would have a second chamber, the treasury (opisthodomos) at the rear or west end of the cella, and this would have its own portico. The Temple of Theseus (so called) at Athens seems to have had a single chamber and two porticoes, one at either end, these being deep and sheltered and affording place for certain sacred statues and the like. Larger temples, like the Temple of Zeus at Olympia, the Parthenon at Athens, and the one at Pesto, called the Temple of Neptune, have the interior of the cella divided into a nave and aisles by two rows of columns; but just what the connection was between these columns and the carrying of the roof is not rightly understood. Some archæologists associate them with the assumed arrangement for admitting daylight into the interior through the roof (see HYPÆTHRAL THEORY).

The style of design was this — the columns were thick in proportion to their height and tapered from bottom to top, but not as a cone tapers, for the diminution of thickness follows a decided and even visible curve which is called the entasis. These columns are channeled from top to bottom by grooves, usually twenty in number, each having an elliptical curve or nearly so and meeting one another at sharp arrises. These shafts carried capitals made of one or two blocks of stone but always in two architectural parts. The lower part is what is called the echinus. It is a circular slab of stone projecting all round as much as half the diameter of the shaft in the earliest examples, perhaps a quarter of that diameter in the later ones; and this projection is rounded in a very subtle way, becoming flat below near the shaft and rounding more rapidly above. The curve of some of these echinus capitals is of extraordinary beauty. The uppermost member of the capital is a thick square block, or die, or plinth, sharp-cornered, without ornament of any sort except for the painting. These columns carry the epistyle or architrave, which, in the Doric style, is usually plain. Upon this rests what is known as the frieze, which consists of a series of upright blocks of stone perhaps half as high again as they are wide, and their height increased in appearance by grooves running vertically. These triglyphs carry, or seem to carry, the third or crowning member, the cornice, but between the triglyphs are the spaces called metopes, which are commonly filled by slabs or blocks of stone, the outer surface of which was always a favorite place for ornamentation. The cornice projected very much beyond the frieze, and its under side was cut with a drip moulding so that rain-water would not back up and run down the entablature, that being the name given to the three parts taken together, that is, to the whole horizontal superstructure laid upon the columns. There was nothing above this cornice except at the two ends the rising gable which marks the slope of the roof (see PEDIMENT), and on the side a gutter for rain-water with spouts or scuppers in its outer space.

The building of the temple was in this way as simple as possible — square cornered, oblong, roofed with a simple gable-roof, without arches or windows or chimneys. Its decoration was largely in the extreme refinement of the parts. The proportion of height to width, the spacing of columns and their shape and character were helped out by an extraordinary system of curves by which a grace was added to the building which the eye could hardly follow in its cause or character, but which changed the whole aspect very greatly. Thus the entablature was cut with an upward curve toward the middle and in this way the whole building had a lighter aspect than if it had been strictly horizontal. The same upward curve was repeated in the stylobate or stone floor on which the columns stood. The columns themselves were curved in outline as above stated, and they were set so as to slope inward, the outer ones the most, this for the obvious purpose of making the building seem more solidly set upon its base. To the building so carefully designed there was often added a great deal of elaborate sculpture (see below) and, apparently in all cases, rich chromatic decoration. For this subject see POLYCHROMY: but it may be mentioned here that the modern world has no very clear notion of what was the effect of brilliant painting in red and blue, with gilded metal, applied to a marble building standing high upon a prominent rock in the heart of a town, the recognized centre of interest and the chief religious shrine. No living man has ever seen anything at all like that; and it is probable that no imagination can reproduce it in thought.

To the modern student, the Doric style as described above, is much the most important part of Grecian architecture; but to a Greek of the time of Alexander the Great the Ionic temples along the shore of Asia Minor would have seemed the more grand and costly, the more recent, and therefore the more identified with advanced civilization. Those great temples have disappeared with a strange completeness. While there are Doric temples nearly complete except for the roof — which has, of course, disappeared,— while there are many others of which large and most interesting remains exist, many columns standing erect and some parts of the superstructure,— there is almost nothing remaining in complete condition of all the great Ionic temples. It is on this account that the exquisite building on the Acropolis at Athens, the Erectheum, contains in itself almost all our modern notions of the style. Very near it on the Acropolis is the little square amphiprostyle temple, known as the Temple of Athenæ Nike, or as the Temple of the Wingless Victory, and this shrine may also be considered an unchanged Greek building, because, though it was entirely destroyed, the stones of it were found built into a Turkish fortification and the whole structure was piled up again by the engineers of the first European king of Greece, Otho of Bavaria, who reigned from 1832 to 1862.

We learn from these buildings what the style really was. The shafts of the columns are much more slender than those of the Doric style and are fluted with circular grooves which are separated from one another by narrow fillets instead of meeting at a sharp edge. There is a base composed of mouldings running around the column. The capital is very peculiar, having volutes or scrolls at either side so that each capital has a front and a back precisely alike, and two ends alike, differing from all other capitals in not being alike on at least four sides. The members of the entablature are the same as those of the Doric style, but there are important differences in them. Thus the epistyle, instead of being a plain smooth block, is divided into three parallel surfaces, each one slightly overhanging the one below; the frieze is continuous and not broken by triglyphs; the cornice is more richly sculptured. Figure sculpture is applied in a somewhat different way. Thus as the frieze has no triglyphs it may be carved continuously; and in the Erectheum the sculpture is in the form of statuettes in white marble secured to a gray marble ground. It is not quite decided whether this color effect was helped out by painting or gilding, and how far the other parts of the temple were painted in bright colors. Again in the famous temple of Artemis (Diana) at Ephesus, the lower part of the shafts of the columns was in some cases very richly sculptured. The term *columna cælata* is applied to one of these columns and in any one of them is found this unique device:— the base is rather unusually high and is divided up by many mouldings; beginning about four feet from the pavement is a circle of figures larger than life surrounding the lowermost of those blocks of marble which make up the shaft proper; the flutings then begin above the band of sculptured figures and stop beneath the capital in the usual way. Not all the columns were arranged in this way, apparently only about one fourth of the whole number. The ancient Temple of Artemis which existed before the later magnificent structure was built had the same singular arrangement of sculptured shafts. Near Ephesus there have been found some capitals in which the head and shoulders of a bull project on either side beyond the volutes of the capital; and on the Island of Delos there are capitals made up entirely, so far as their decorations are concerned, of the heads of bulls. In the Erectheum of Athens there is that wonderful Portico of the Maidens in which an entablature made up of peristyle and cornice alone, without frieze, is supported on the heads of six caryatides, that is, draped female statues. In the National Museum at Athens are some caryatides of another portico. In the Incantada, a ruined Greek building in Salonica, there is a row of caryatides high up in the wall. The pilasters are treated with capitals of a curious style of Asiatic sculpture in the temple of Miletus. If to this we add the extraordinary capitals which some few monuments possess, monuments which must be called Grecian, but which are quaint and barbaric in appearance and almost grotesque, it appears that the Ionic was not as disciplined a style as the Doric but was influenced by the highly decorative sense of the Asiatic peoples and allowed of great variety of decorative design.

The Corinthian style is so little known to us as of Greek invention and use that it is almost always considered as a Roman or at most a Greco-Roman style; but the unquestionably Greek building, the little choragic monument of Lysicrates in Athens is Corinthian and the equally unquestioned and much more splendid round building at Epidaurus, was absolutely Greek, of pure type, and possessed a Corinthian order: the capitals completely developed. The dates are approximately, of the Athens building, 335 B.C.; of the Tholos, about the middle of 4th century B.C. The Athenian monument stands tolerably complete. The round building at Epidaurus is ruined and the capitals much scattered, but a single capital was found in a cellar or a chamber built for that purpose, and evidently intended to preserve it as a pattern, and this is intact. It is also one of the most beautiful Corinthian capitals known to us. The style, however, is almost identified with Roman work and will be treated in connection with ROMAN IMPERIAL ARCHITECTURE.

RUSSELL STURGIS.

Greek Art. Modern students of Grecian archæology do not doubt that the Greeks of different epochs were as successful in painting of stately and religious subjects and of painting and drawing in a slighter and more popular way as they were in sculpture; but this is merely an inference. Absolutely nothing remains to us of Greek painting of high class. We can study the figures on Greek painted vases and notice their admirable disposition and the beautiful designs made of their combinations, and we can note the technical system followed, sometimes by drawing on the clay with a hard point, sometimes without that help and drawn evidently with the brush alone. The use of pigment, too, generally black but sometimes of other colors, can be perfectly understood; but this is all of the simplest character, nor can we draw any conclusions at all about the wall-paintings or panel-paintings of the Greeks. In the houses of Pompeii there are many wall-paintings which seem to have had a non-Italian and probably Greek origin, and furthermore it is known that Pompeii was a town of Greek settlement and retained much Grecian influence even under the Roman Empire. Some portrait heads have been found in Egypt painted on panel (that is, thin boards) and these are certainly non-Egyptian; they may be assumed to be Greek, of the Alexandrian epoch. In these, however, there is no background, no added incident, which might guide us to a knowledge of Greek design in Graphic art. Finally, some paintings discovered in Rome, though belonging to houses of late date, are altogether Greek in design; and these may well be reduced copies, or imitations, of famous originals three hundred years earlier. None of these paintings are of great importance. None of them give us an exalted idea of the painting which stood for their original impulse. The statements made by ancient writers with regard to the paintings of their own time and those who were then famous as having belonged to earlier times, are of very little use, because we have no standard with which to compare their critical remarks, and furthermore because no one of the books remaining to us from antiquity seems to be the work of a man greatly interested in fine art. For this reason the paintings on the vases are worthy of the most minute examination. The earliest style in which the subjects represented are at all elaborate are of the undetermined epoch which we call the Mycenæan. Those vases are rich in patterns of scrolls, bands, zigzags and spots with, somewhat rarely, animal forms introduced in bands and (as in Crete and Cyprus) as a principal subject and covering a large part of the body of the vase. The painting is generally in brownish red on a dull yellow ground, which is the natural color of the clay. The famous Warrior Vase found at Mycenæ and now in the Central Museum at Athens and which we must suppose to date from 1000 B.C., has much of that grotesque indifference to form and perfect satisfaction with an indication of meaning which we associate with barbaric art in all ages; the human form is drawn without any comeliness or grace and without any success in getting control of gesture; but the purpose is clear, viz., the displaying of a procession of warriors wearing large helmets, carrying great shields of the curious kidney shape long afterward associated with certain Asiatic influences, and carrying spears in the right hand, which spears have sometimes two heads or what seem to be heads.

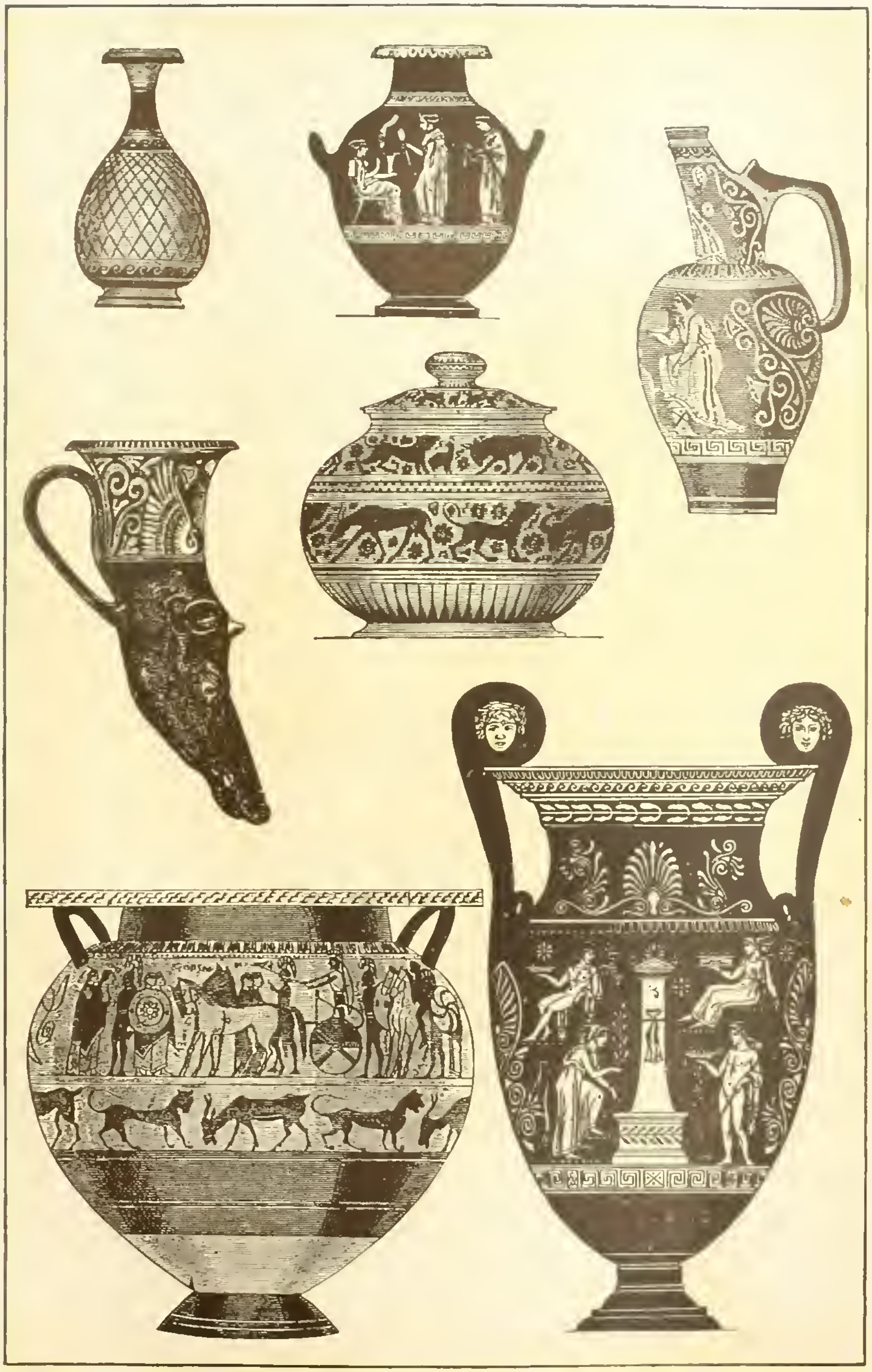
The paintings on pottery which are of the most interest are those of the period beginning about 600 B.C. and ending about 150 B.C. The earlier pieces are, of course, difficult to date even approximately. They represent warriors engaged in battle, the scene forming a broad band running around the vase; lions, bulls and stags arranged again in horizontal bands; figures draped in long garments, men as well as women carrying stringed instruments, weapons, baskets and the like; occasionally a scene which can be identified, as where Hercules brings the Erymanthian boar to show to his brother, king Eurystheus, or where Peleus is about to carry off Thetis from among her attendant nymphs; or they represent a feast, with men reclining on couches and others acting as attendants bringing pitchers and vases to fill the cup held by the reclining guest. The beautiful black glaze of the vases is used sometimes as the pigment for the figures and sometimes to work the background around the figures. These two styles are known as the black-on-red or black-figure style, the other as the red-on-black or red-figure style, and this latter style is known as the later of the two. There is still another form which is generally the latest of all. In this the black glaze is worked over the whole vase except for a panel or medallion or even a band around the vase, which is left in the red color of the pottery, and upon this the figures are painted in black. From the 5th century on the drawing is extremely vigorous and significant. It is grotesque sometimes, as where the muscles are given excessive prominence or where the attitude is exaggerated in the attempt to make it tell the story; but everywhere the drawing of the outline and the filling in with color shows singular mastery.

In a few cases the drawing itself is faultless; but in by far the greater number of cases, even of a good time, it is rather the evidently slight and swift work of a man familiar with nature and with the best traditions of art but not using his whole strength in the slight painting of the earthenware. The use of pigments other than the black glaze is not very frequent; but a red somewhat brighter than the color of the clay is used, also a kind of violet, more rarely a green, and in some cases gilding is applied — especially in late and very elaborate work. A small class of vases, identified with the city of Athens, has the body covered with a solid coat of white, upon which figures are painted in various bright colors; but this work is perishable.

In close connection with the drawing and painting applied to pottery is the engraved work on the backs of bronze mirrors, on pieces of armor, and on cists (*cistæ*). Even as in modern times some of the most elaborate and precious drawing is that of the engraver working on copper-plate (though he proposes to take prints on paper from his engraving), so the Grecian draughtsman put some of his finest work on those engravings meant for pure decoration. As we have no free drawing on paper or plaster or wood — nothing that shows how the Greek drew with a free hand — we can only reason backward from the firm and resolute setting down of lines drawn on the resistant material with the sharp point, and infer the vigor and daring of the more unfettered design.

Sculpture in its different forms is, after all, that which Greece has left us which is most important. We have the marble reliefs carved upon temples, tombs, and the walls of sacred enclosures, and also a great number of slabs which, when more than two or three feet in either dimension are generally tombstones, but which, when small, are frequently mere records carved upon a boundary stone or a memorial, or else a votive slab dedicated at the shrine of some divinity. In all of these the propriety and the freedom of design are wonderful and, in relief sculpture at least, the Greeks have set an example which has never been equalled since, neither in the actual beauty of the form nor in the intelligence shown in the composition. The

GRECIAN ART



GREEK VASES

most wonderful of the low reliefs are those of the famous frieze which forms the crowning member of the wall of the Parthenon within the screen of columns, the wall of the naos or cella. The well-known fact that this whole composition was painted in bright colors changes at once our ideas as to its decorative effect as a part of the building, but modern students can form no correct idea of the appearance of elaborate sculptures painted in an artistical fashion because they have never seen anything of the kind. One special reason why the reliefs are peculiarly important to modern students is their undoubted originality. The sculptures found at Phigalia, at Halicarnassus, at Xanthos, and at Gjolbaschi in Asia Minor are the undoubted work of the 4th and 5th centuries, and moreover they were designed for the places in which we now find them. This is not so with statues and busts, for of all the great world of Grecian statuary only three or four undoubted originals of the first rank remain. The Hermes of Praxiteles was found as Pausanius saw it in the 2d century A.D.; the Winged Victory of Paionios also; and these two were found in the excavations at Olympia in Greece. Statues of somewhat less importance have been found in the islands of the Greek archipelago and in specially protected underground chambers in the mainland of Europe, and a number of splendid bronzes, were found in a single great country house at Herculaneum near Naples; but as a general thing it has to be settled by internal evidence whether the piece discovered is of unmingled Greek character or of a less simple and perfect later style. The statues of the pediments, however, those which once stood at either end of the Parthenon, the Temple of Zeus at Olympia, the great temple of Ægina, and those which seem to have been placed between the columns of the Nereid Monument at Xanthos, are almost as certainly of their apparent epoch as are the bas-reliefs of the same buildings. In this way we have a score of fairly complete marble statues, two or three bronze statues of the highest rank, and a dozen less important ones, a score of life-size busts, and many smaller bronzes, all of which are assuredly of the best time of Greek art. Our knowledge of this subject is greatly helped by the study of engraved gems ,and coins. The gems were used for seals, or set in finger rings worn hung by a string, and the materials used were, of course, very hard stones, such as chalcedony and sardonyx; though glass was used also, and some seals are engraved in gold. The figure engraved in intaglio can be seen as if in relief when the stone is transparent and is looked at from the back. But commonly the student takes a cast in plaster or wax and studies that relief together with the original hollow sculpture of the gem. The number of these gems in our public and private collections is very great, even if we consider only those of undoubted Grecian origin. The coins are, in art, of the same character as the gems, because they are struck from a die, which die has been engraved in the same way in which the intaglio in hard stone is engraved; that is, the artist in either case keeps in mind the future relief and carves his hollow or sunken design rather with a view to its utility as a die than as to its own appearance. Greek coins are the subject of much and careful study among modern students. Greek sculpture includes also the earthenware figurines which have been found in great number in the neighborhood of Smyrna, in Sicily and the other islands of the Mediterranean, and especially in the neighborhood of Tanagra in Greece.

The years since 1850 have been rich in books on the subject of Grecian archæology, which archæology is, in great measure, the study of the existing works of art; books on Grecian vase-painting, gems and coins are to be counted by scores and hundreds. The latest are generally the best to begin with. The student will find in them the best means of judging what earlier books he may need; and at the same time he will find the latest discoveries and the most mature opinions of archæologists. The same remark applies to the periodicals, of which there are many and very valuable, for indeed much of the comparative study of this subject has been carried on in the columns of German, French and English periodicals, often issued by learned societies.

Russell Sturgis.

Greek Church, or Holy Oriental Orthodox Apostolic Church, that section of the Christian church dominant in Eastern Europe and Western Asia, especially in Turkey, Greece, Russia, and some parts of Austria. In the first ages of Christianity numerous churches were founded by the apostles and their successors in Greek-speaking countries; in Greece itself, in Syria, Egypt, Mesopotamia, Asia Minor, Thrace, and Macedonia. These were subsequently called Greek, in contradistinction to the churches in which the Latin tongue prevailed. The removal of the seat of empire by Constantine to Constantinople, and the subsequent separation of the eastern and western empires, afforded the opportunity for diversities of language, modes of thinking, and customs to manifest themselves, and added political causes to the grounds of separation. During the earliest period the chief seats of influence in the Eastern Church were Jerusalem, Antioch, and Alexandria, the seat of that mystical philosophy, by which the oriental church was distinguished. In 341, soon after the synod of Antioch, the rivalry between the Bishop of Rome and the Bishop of Constantinople began to assume importance, and before the year 400 differences of doctrine with respect to the procession of the Holy Spirit appeared. The Council of Chalcedon in 451 reaffirmed the "pre-eminence of honor" after Rome, which had been granted Constantinople by the Second General Council in 381, but also accorded to its bishop supremacy, not only over Thrace, but over Pontus and Asia. This canon, the famous 28th, Rome refused to confirm. The title of *Œcumenical Patriarch* was assumed by John, bishop of Constantinople, in 588, and in the following year the phrase 'Filioque' ('and the Son') was added by the Latins to the Nicene Creed (which now read 'proceeding from the father and the son'), an addition to which the Greek Church was opposed. In 648 Pope Theodore deposed Patriarch Paul II.; but a reconciliation of the churches was effected at the Council of Rome (680). The doctrines of the Greek Church were defined by John Damascenus in 730. The disruption was hastened by the banishment of Ignatius by Michael the Drunken, and the consecration of Photius (858). Pope Nicholas I. refused to sanction the usurpation of Photius and excommunicated him. The schism was temporarily healed after the death of Photius, but Michael Cerularius reopened it by charging the Latins with heterodoxy. He was excommunicated by Leo IX. in 1054, since which the Greeks have been severed from the Roman communion, though the Russo-Greek Church was not separated until the 12th century. The presence of the Crusaders in the East aggravated the quarrel; Latin patriarchates were established in Antioch and Jerusalem, and, though on the capture of Constantinople by the Crusaders a Latin patriarchate was set up there (1204), the schism was revived there as soon as the Latin empire fell (1262). Reunion was proposed in 1273 by Patriarch Joseph, and effected, with the acknowledgment of the pope as primate, at the Council of Lyons (1274). The union, however, was annulled in 1282 by Emperor Andronicus II., and in 1283 and 1285 by synods of Constantinople. It was again effected under John Palæologus at Florence in 1439, but was repudiated in 1443 by the Patriarchs of Alexandria, Antioch, and Jerusalem. In 1453, when the patriarch fled from the Turks, a schismatic, Gregory Scholarius, was chosen in his place. In 1575 unsuccessful negotiations were commenced with a view to union with the Lutherans, and in 1723 the English bishops even proposed that the Greek and Anglican churches should unite, a proposal revived by the archbishop of Moscow in 1860. The claims of the czar in 1853 to the protectorate of the Greek churches in Turkey was one of the causes of the Crimean War.

The Greek Church is the only church which holds that the Holy Ghost proceeds from the Father only; the Roman Catholic and Protestant Churches deriving the Holy Ghost from the Father and the Son. Like the Roman Catholic Church it has seven sacraments — baptism; chrism; penance, preceded with confession; the eucharist; ordination; marriage; and unction. But it is peculiar (1), administering baptism by threefold immersion, the chrism (confirmation) following immediately after it; (2), in adopting, as to the eucharist, the doctrine of the real presence and transubstantiation; but in ordering the bread to be leavened, the wine to be mixed with water, and both elements to be distributed to every one, even to children; (3), the parochial clergy are required to be married, but only once and to a virgin, and marriage must take place before ordination; widowed clergy are not permitted to retain their livings, but go into a cloister, where they are called *hieromonachi*. Rarely is a widowed bishop allowed to preserve his diocese. The Greek Church grants divorce in case of proved adultery, but it does not allow even the laity a fourth marriage. It differs also from the Roman Catholic Church in anointing with the holy oil, not the dying but the sick, for the restoration of health, forgiveness, and sanctification. It rejects the doctrine of purgatory, works of supererogation, indulgences, and dispensations, but admits prayers for the dead, whose condition appears to be considered undetermined until the final judgment. It recognizes no visible vicar of Christ on earth, but the spiritual authority of patriarch is little inferior to that of the pope. It allows no carved, sculptured, or molten image of holy persons or subjects; but the representations of Christ (except in the crucifix), of Mary, and the saints, must be merely painted, and at most inlaid with precious stones. In the Russian churches, however, works of sculpture are found. In the invocation of the saints, and especially of the Virgin, the Greeks resemble the Latins. They also hold relics, graves, and crosses sacred; and crossing in the name of Jesus they consider as having a wonderful and blessed influence. Among the means of penance, fasts are particularly numerous with them. They fast Wednesday and Friday of every week, and besides observe four great annual fasts, namely forty days before Easter; from Whitsuntide to the days of Sts. Peter and Paul; the fast of the Virgin Mary, from the 1st to the 15th of August; and the apostle Philip's fast, from the 15th to the 26th of November; besides the day of the beheading of John the Baptist, and of the elevation of the cross. The calendar of the Greek Church is in the old style, their New Year's Day falling on 13 January.

The services of the Greek Church consist almost entirely in outward forms. Preaching and catechizing constitute the least part of it. Instrumental music is excluded altogether. The Mass is considered of the first importance. The convents conform, for the most part, to the strict rule of St. Basil. The Greek abbot is termed *hegumenos*, the abbess *hegumenē*. The abbot of a Greek convent which has several others under its inspection is termed *archimandrite*, and ranks next a bishop. The lower clergy in the Greek Church consist of readers, singers, deacons, etc., and of priests or popes and protopopes or archpriests, who are the first clergy in the cathedrals and metropolitan churches. The members of the lower clergy can rise no higher than protopopes, for the bishops are chosen from among the monks, and from the bishops are selected the archbishops, metropolitans, and patriarchs. In Russia there are twenty-four dioceses. With which of them the archiepiscopal dignity shall be united depends on the will of the emperor. The seats of the four metropolitans of the Russian Empire are St. Petersburg, Kiev, Kasan, and Tobolsk. In the Turkish dominions the dignities of Patriarch of Constantinople, Alexandria, Antioch, and Jerusalem still subsist. The Patriarch of Constantinople still possesses the ancient authority of his see; the other three patriarchs exercise a very limited jurisdiction, and live for the most part on the aid afforded them by the Patriarch of Constantinople.

The United Greek Churches comprise those Churches of Greek rite which are in communion with the See of Rome; the adherents of these Churches are commonly styled Uniates, and the Churches Uniate Churches. There are five such Uniate Greek Churches, namely, those of the Melchites, of the Ruthenians, of the Greek Catholics of Italy, of the Græco-Rumanic rite, and of the Bulgarians. These several Churches retain their several Greek or Oriental liturgies and sacramental rites and most of the usages and ceremonies of the Eastern schismatical Churches from which they are sprung.

The Melchites represent those Churches of Syria and Egypt which, in 1680 and later, seceded from jurisdictions of the Monophysite patriarchs of Antioch, Jerusalem, and Alexandria. Their number is small, perhaps not exceeding 50,000 souls, but they have three patriarchs, with bishops subordinate to them.

The Ruthenian United Church is an offshoot of the Russian Greek Church by secession; the membership of this Church in Russian Poland and in the Austro-Hungary monarchy comprises probably 1,000,000 souls.

The United Greeks of Italy, mostly in Calabria, are estimated at 30,000.

The Græco-Romaic Church of Hungary and Transylvania has about 1,000,000 adherents.

The United Bulgarian Church dates from 1860, when several bishops with a considerable following of their people were received into the communion of the Church of Rome.

All these Churches retain the ancient Greek liturgies of the Eastern Churches from which they seceded, and to a great extent their ancient systems of discipline. The priest, as in the Greek orthodox and in the Russian orthodox Church, must be married, and the bishops must be celibates; hence the bishops are usually chosen from the monastic order. The widowed priest is not permitted to contract a second marriage. In short, these Churches retain, of the religious practices and of the discipline of the several Eastern Churches from which they seceded, whatever is not inconsistent with allegiance to the supreme pontiff in matters of doctrine.

The language of the Ruthenian United Church's liturgy is Old Sclavonic, and translated from one of the ancient Greek liturgies. The liturgy of the Melchites is that of St. John Chrysostom, and on certain occasions that of St. Basil, both in the original Greek. The liturgy of the Bulgarian Church is also of Greek origin, but translated into an ancient Sclavic idiom.

Greek Fire, a combustible composition made probably of naphtha, sulphur and nitre, which was first used in 673 A.D. by the Greeks of the Byzantine Empire against the Saracens. Its invention has usually been ascribed to Callinicus of Heliopolis, and to the year 668 A.D. The mixture appears to have been highly inflammable, and to have been difficult to extinguish; was poured out, burning, from ladles on besiegers, projected out of tubes to a distance, or shot from balistæ, burning on tow tied to arrows. At Constantinople the process of making Greek fire was kept a secret for several centuries: but the knowledge of its composition and the use of it, gradually spread to the West. It was in use for a short time after the invention of gunpowder. Combustibles of a similar kind were used at the siege of Charleston in 1863, composed of sulphur, nitre, and lampblack; and naphtha in shells was also tried.

Greek-letter Societies, or **College Fraternities,** are found in nearly all leading educational institutions, particularly the great universities, in the United States. Branches of the various societies are known as "chapters," and are found in nearly every college as well as in every large city in the country. No society has more than one chapter in any one college. While these societies are secret in character there is neither ritual nor mystery in their conduct, the protection of meetings, constitution and mottoes being all the secrecy involved. The Greek alphabet is generally used in naming a fraternity, or a chapter. There are three types of badges worn by members, the name badge, monogram badge, and symbol badge. In the latter a key, skull, or scroll is usually employed.

The oldest of these literary and social brotherhoods was established as early as 1776, and continued the sole society of its kind for 50 years. There were in 1902 more than 800 chapters of these societies in American colleges, with a membership including the alumni, of more than 100,000. It has become quite the practice for students of a particular fraternity to reside together during their college course in their "chapter" house. In 1901 there were 70 such houses in the United States owned by the "chapters," and 200 other houses rented by them. Princeton is the only prominent college in the country where the fraternal society is prohibited, and the fact that all the other leading institutions permit these organizations to exist affords strong presumption that they are regarded with favor, and that their influence is for good rather than for evil. In 1902 there were 25 of these societies for men and 8 for women, in the universities and colleges of the United States.

Phi Beta Kappa.— This, the oldest organization, is composed of 53 college chapters, and was founded 5 Dec. 1776, at William and Mary College, Williamsburg, Va. A chapter was formed at Yale, in New Haven, in Dec. 1779, and soon after at Harvard, Dartmouth, Bowdoin and Amherst. The society in 1902 had a membership of 11,000. The national council meets triennially. The badge of the society is a golden key. Among prominent members are T. W. Higginson, Seth Low, Joseph H. Choate, and H. W. Mabie.

Kappa Alpha.— Founded in 1825 at Old Union College by four members of the Phi Delta Kappa. It likewise had a golden key as a badge design. The first branch of this society was established at Williams College. The society had 1,000 members in 1902, prominent among them being Wheeler H. Peckham, John Boyd Thatcher, L. Clark Seelye, and Edward S. Bragg.

Sigma Phi.— Founded at Union College, Schenectady, N. Y., 4 March 1827, the society established branches at Hamilton, Williams, Hobart, Lehigh, Cornell and the Universities of Michigan and Vermont. It had a membership of 1,400 in 1902. The badge of the society is of the monogram type; the colors are light blue and white. Among its members are Elihu Root, Andrew D. White, and John H. Post.

Delta Phi.— Founded at Union College, 17 Nov. 1827, this society established branches at Columbia, Rutgers, Harvard, Johns Hopkins, Cornell, and other colleges. The badge is in the form of a Maltese cross; colors blue and white. There are several thousand members, among them John Jacob Astor, Ernest Howard Crosby, and R. O. Doremus.

Alpha Delta Phi.— Founded at Hamilton College, Clinton, N. Y., in 1832, the society established chapters in 10 other colleges and had a membership of 8,400 in 1902. There are 10 houses owned by the society and 24 active chapters. The badge is of green and white, with the star and cresent as symbols. Among prominent members are W. R. Day, Bartow S. Weeks, Henry Clews, Jr., Jas. K. Hackett, and H. E. Lippincott.

Psi Upsilon.— Founded at Union College, 24 Nov. 1833, this society had 4 of its original founders still living in 1902. The membership of the organization is over 10,000, with 22 chapters in various colleges. The badge is of gold, diamond-shaped; colors garnet and gold. Among its members are Chauncey M. Depew, Wm. C. Whitney, G. R. Schieffelin, and Herbert L. Bridgeman.

Delta Upsilon.— Founded at Williams College in 1834, the society has chapters in 34 colleges and universities, with a membership of 8,000. It is an open, non-secret organization and owns 24 chapter houses. Among its prominent members are David Starr Jordan, Rossiter Johnson, W. H. P. Faunce, and Rev. Charles M. Sheldon.

Beta Theta Pi.— Founded at Miami University, Oxford, Ohio, in 1839, this was the pioneer society of the Middle West. It has a membership of 12,500, with 54 active chapters. The badge is a shield with 8 sides curved inward; the colors are light pink and blue. Among its prominent members are Foster L. Backus, Paul Wilcox, and W. R. Baird.

Chi Psi.— Founded at Union College, in 1841, this was the first Eastern society to establish chapters in the West, extending its organization to the Universities of Michigan and Minnesota. It had a membership in 1902 of 4,500 with 19 active chapters. The chapter house at Cornell is the finest fraternity house in this country. The society is more secret than most of its fellows. The badge is a jeweled monogram. Among its members are Willis J. Abbot, Francis M. Scott, and Allan Lee Smidt.

Delta Kappa Epsilon.— Founded at Yale College, New Haven, Conn., 22 June 1844, by 15 members of the junior class. The society has established 48 chapters and had a membership in 1902 of 13,548, being the strongest numerically of any college fraternity. Among prominent members of the society are President Roosevelt, John D. Long, Whitelaw Reid, Howard Gould, Julian Hawthorne, Cyrus C. Adams, John DeWitt Warner, M. G. Hyde, Julius Chambers, and G. R. Hawes.

Zeta Psi.— Founded at the New York University, 1 June 1847, this society established 21 chapters, and had a membership in 1902 of 5,330. The badge is a monogram; the color white, with which each chapter blends its college colors. Among prominent members are Augustus Van Wyck, Wm. Shrady, Harrison Grey Fiske, and H. W. Bookstaver.

Delta Psi.— Founded at Columbia College, New York, in Jan. 1847, has 11 chapters and a membership of 3,000. The badge of the society is a St. Anthony cross, bearing a shield of blue enamel. Among its prominent members are Thomas Nelson Page, W. Seward Webb, F. W. Vanderbilt, Brander Matthews, Wm. E. Curtis, and D. S. Appleton.

Theta Delta Chi.— Founded like several of its predecessors at Union College, this society was organized in 1848, and has 22 chapters and 4,000 members. The badge is a monogram; the colors black, white and blue. Among its members are John Hay, J. W. Griggs, H. H. Hanna, S. Fred Nixon, and Rev. David Gregg.

Phi Gamma Delta.— Founded at Jefferson College, Canonsburg, Pa., in May 1848, this society has established 57 chapters and has a membership of 8,753. The badge is a diamond-shaped shield on a field of black, bound by a golden cord; the color royal purple. Among its members are Gen. Lew Wallace, Edward Eggleston, S. S. McClure, Leigh H. Hunt, and R. Lloyd Jones.

Phi Delta Theta.— Founded at Miami University, Oxford, Ohio, 20 Dec. 1848, this society has established 68 chapters and has a membership of 12,000. The badge is a shield, bearing a scroll; the fraternity colors are argent and azure. Among its members are C. P. Bassett, Irving R. Bacon, C. P. Van Alen, and Rev. E. A. Dent.

Phi Kappa Sigma.— Founded at the University of Pennsylvania, 16 Aug. 1850, has established 15 chapters and has a membership of 1,000. The badge is a gold Maltese cross, with a skull and crossbone centre; the colors are old gold and black. Its membership includes H. C. King, J. R. Paxton, M. J. Asch, Geo. G. Battle, and Wm. McClure.

Phi Kappa Psi.— Founded at Jefferson College, Canonsburg, Pa., 19 Feb. 1852, has established 40 chapters and had, in 1902, over 8,000 members. The badge is a shield of gold; the colors pink and lavender. Prominent among its members are Henry T. Scudder, F. E. Hamlin, W. L. Stoddard and Thos. A. Nelson.

Chi Pi.— Founded at Hobart College, in Dec. 1854, has organized 19 chapters with a membership of 4,700. The fraternity was reorganized in 1890. The badge is a monogram. Geo. S. Hobart, H. C. Platt, F. A. Mandeville, and F. C. Weber are among its prominent members.

Sigma Chi.— Founded at Miami University, Oxford, Ohio, 20 June 1855, has organized 50 chapters and has 8,000 members. The badge is a cross of gold and white enamel; the colors are blue and gold. Among its members are Thos. Ewing, Jr., Wm. E. Quimby, H. W. Chatfield, and Henry A. Potter.

Sigma Alpha Epsilon.— Founded at the University of Alabama in 1856, has organized 59 chapters and has 7,000 members. Among its prominent members are Charles B. Harvey, F. K. Knowlton, T. W. Beach, and H. P. Nash.

Delta Tau Delta.— Founded at Bethany College in 1860, has organized 37 chapters and has a membership of 1,200. The colors are purple, gold and white.

Alpha Tau Omega.— Founded at the Virginia Military Institute, 11 Sept. 1865, has organized 45 chapters and has a membership of 6,000. Among its prominent members are Irving Bacheller, Hugh S. Thompson, E. B. Southworth and Walter H. Page.

Kappa Sigma.— Founded at the University of Virginia in 1867, has established 49 chapters and has a membership of 3,500. The badge is a crescent and star; the colors old gold, maroon and blue.

Sigma Nu.— Founded at the Virginia Military Institute, 1 Jan 1869, has organized 46 chapters and has a membership of 5,000. The badge is designed after that of the Legion of Honor of France; the colors are black, white and gold.

Phi Sigma Kappa.— Founded at the Massachusetts Agricultural College, 15 March 1873, has organized 14 chapters and has a membership of 1,050. The colors of the society are silver and magenta. Among its members are Wm. H. Bishop, S. C. Thompson, J. W. Goff, Jr., and M. C. Valentine.

Among the Greek-letter Societies of women are the Alpha Chi Omega, Alpha Phi, Chi Omega, Delta Delta Delta, Delta Gamma, Kappa Alpha Theta, Kappa Kappa Gamma, and Pi Beta Phi. The Alpha Phi was founded in 1872, has 10 chapters and 1,100 members. The Delta Delta

Delta was founded in 1888, has 17 chapters and a membership of 1,000.

In October 1903 there was organized at the Indiana University the first negro Greek-letter society in the United States. It is known as the Alpha Kappa, with a charter membership of 10.

Greek Music, the theory and practice of melody and harmonics among the ancient inhabitants of Hellas. The subject of Greek music is an obscure and difficult one, but there are enough data extant to afford us a general idea of the Greek musical scale, of the use of instruments, and employment of the voice in solo and chorus among the Greeks. The earliest notion of music was derived from the necessity of keeping time in the dance. This at first would be effected by merely clapping the hands. The use of instruments of percussion would follow, and the drum and cymbal came into use. The cymbal originated in Egypt, and reached Greece as a permanent element in the practice of music. The rustle of the wind through the reeds, sometimes with a shrill whistling vibration, suggested the application of the human breath to hollow pipes, and what is still called the Pan's pipes was invented. Wind instruments of various kinds came afterwards into vogue, the flute, and the double flute were employed, and seem generally to have been blown as accompaniments to the elegy and the love song. These pipes were of various kinds and were considered as good accompaniments to the recitations of the poet, as well as for regulation of movement in a dance. They were employed in the ceremonies of the mysteries, and Plato speaks of an often recurring thought as resembling «the sound of the flute in the ear of the mystic.»

Instrumental music attained its highest development in the invention of the lyre. The Egyptians attributed this invention to their god Thoth. In Greece Hermes is celebrated as the inventor of the lyre, which became henceforth the instrument of the epic poet and the rhapsode or reciter. It had originally four strings, which it is said were suggested by the tendons stretched over the shell of a tortoise. The first Greek philosopher to attempt a scientific theory of musical scales and intervals appears to have been that profound and versatile man Pythagoras (585 B.C.). The Greeks did not use the word music in application to the art which we so name. Music to them comprised everything which the Muses inspired, and even history and astronomy as well as poetry were music. What we mean by the term was called by the Greeks harmonics, which means the art of fitting, that is, adjusting the intervals in a scale, in the strings of a lyre. The scale of Pythagoras had seven notes, corresponding with the seven strings of his lyre, and he professed to derive his idea of music from the music of the spheres. The sun revolving round the earth was to him the chief planet, and was represented by the middle string of the lyre which was considered the key-note, corresponding with A in the modern scale. On one side were strings representing Mercury, Venus and the Moon, on the other side three more corresponding with Mars, Jupiter and Saturn. It is said that Pythagoras discovered the ratios of the perfect intervals from hearing blacksmiths striking an anvil with hammers of different weights. Aristoxenus (B.C. 300) discovered the difference between the major and minor tones and has been called «the father of temperament.» Claudius Ptolemy (B.C. 150) demonstrated the musical axiom which obtains in modern times that the major tone should be below the minor.

The Greeks had four modes or scales, the Dorian, the Phrygian, the Lydian, and the Mito-Lydian. The Dorian was set in the key of F natural, and the rest were distinguished by analogous differences.

The ancient Greeks were passionately fond of music, and elaborate treatises were written by them on the science and art. They did not understand harmony, and Aristotle (384 B.C.) speaks of the only chorus singing known as that of men singing a melody an eighth lower than it was sung by boys, which of course would be unison. Music was employed at Athens by wandering epic minstrels; it was also common in religious ceremonies, and to regulate the movements of the army. It formed part of the drama. We are told that Æschylus, the father of tragedy, composed the music for his own dramas and that Sophocles accompanied on the lyre the performance of one of his plays.

Greek Philosophy, the various speculations of the ancient Greeks with regard to the origin of things. This is but a partial description of the intellectual efforts made by the keen and powerful minds of the ancient world to solve those problems which science now-a-days is so eagerly investigating. The origin of Greek philosophy was the gradual disbelief that had seized men's minds as to the truth of the ancient poetical cosmogonies, and antique mythologies of religion. Faith was dead and reason had awakened. In the 7th century before our era, in the flourishing city of Miletus, capital of the Ionian colony, the first Greek philosopher propounded the question which is still being put, What is the basic substratum of all phenomena? In our own days Huxley called it protoplasm; Herbert Spencer said it was force. Thales of Miletus (636 B.C.) declared it was water, which to him seemed to permeate and give life to all things. Thales was the first of the Greek physicists, or materialists, and was considered one of the Seven Wise Men of Greece. He was the founder of the Ionian School of Philosophy. He was succeeded in the long line of philosophical inquirers by Anaximenes (529 B.C.): who looking for the first element, the first cause, found it in air. Air was universal and must be the parent of all things. It was the breath of life and must therefore be the source of it. Diogenes of Apollonia (460 B.C.) fixed upon a higher notion as the first cause of things. He saw the ruling race of mankind prevailed over nature by their intelligence. He decided that intelligence was the cause and foundation of all things. In these speculations as to the nature of the universe and its origin we come upon two remarkable men, Anaximander of Miletus (610 B.C.) and Pythagoras, who invented the word philosophy. The former taught that all existence came from the infinite — a vague term, which did not mean the infinite intelligence but the infinite existence. Pythagoras said that number was the first thing, from which all else proceeded — a metaphysical abstraction, which almost defies analysis. Aristotle says the Pythagoreans «taught that number was the beginning of things, the cause of their material existence, and of their modifications and different states."

The school of Eleatics is chiefly represented by the poet Xenophanes (620 B.C.). His philosophic creed is thus described by Aristotle: "Casting his eyes upward at the immensity of heaven, he declared that *The One* was God." Reason and imagination led this thinker to become at once a Monotheist and a Pantheist. Parmenides who was born (536 B.C.) at Elea, a city which gave its name to Eleatics, was the first to make the great distinction between truth and opinion, between the deductions of reason and the impressions of sense. He made being the basis of things, for non-being was impossible — a discovery which at that stage in philosophical speculation was of great importance. Zeno, another Eleatic, b. 500 B.C., who was the inventor of logic, was persecuted and put to death for free-thinking, and was a follower and disciple of Parmenides. Plato says that the master proved the existence of the one; the disciple established the non-existence of the many. He preserved his master's distinction between truth and opinion. "Your senses," he would say, "tell you that there are many things existing; reason avers that there is but one."

A contemporary of Zeno was a man who began at Ephesus those speculations as to the origin of the universe to which as preliminary he added a theory on the origin of knowledge. This was Heraclitus (503 B.C.). He was a disciple of Xenophanes, and taught that fire is the origin of everything, and there is no existence, but only change; things cannot be said to be, but only to be becoming; processes and not states formed the mode of existence. We cannot know or name anything with truth, for as we look at it, it changes, and is something different from what we thought it.

Anaxagoras came from Clazomenæ to Athens just when the age of Pericles was dawning: he had indeed Pericles, Euripides, and Socrates as his pupils. He attacked the patriotic religion of the proud city and was banished to Lampsacus. He thought that all sense — knowledge — was delusive until corrected by reason. He believed that intelligence was the creative and regulating influence of the universe. Things as they are were brought about by the concourse of infinite atoms; but these atoms were of all sorts, and that like was united to like in an infinite series of movement and combination; gold by the union of gold atoms that had existed from eternity, fires from fire atoms, air from atoms of air. These atoms were the famous homœomeriæ spoken of and condemned by Aristotle. Empedocles (444 B.C.) was of the great city of Agrigentum; in his views of knowledge he belonged to the Eleatics, and maintained that the senses were fallible, while reason was a sure guide to truth. He was a poet and declaimed against anthropomorphic ideas of deity. He gathered in one the doctrines of the Ionian physicists declaring the primary elements were four, namely, earth, air, fire and water. Love was the formative principle of things, hate the dissolver and destroyer. One was harmony, the other discord, and God is the One, "a sphere fixed in the bosom of harmony, rejoicing in calm rest."

Democritus of Abdera (460 B.C.) was a rich man who entertained Xerxes at his house. He went one step further than Anaxagoras, and almost entered the circle of our modern science by teaching the atomic theory, namely that everything in the world is the result of a fortuitous concourse of atoms, all of the same substance, but making various things through the various forms they take in uniting. Color, sweetness, cold, are the result not of substances essentially differing; all is form.

All attempts had so far failed to solve the problems of the material world, and of human knowledge. Many theories were put forth, none were universally accepted, although they were each discussed. This brought the Sophists on to the stage of philosophy — men who taught the arts of discussion, not of investigation. One of the greatest of them was Protagoras. He was a disciple of Democritus, and taught that opinion was everything. "Man, the individual man, each for himself, is the measure of all things." The Sophists were the first skeptics, but a new epoch rose with Socrates (469 B.C.). He was the most remarkable man in all the Greek world; for his love of disputation he was classed by some with the Sophists, for his ridicule of traditional views in religion and physics, he was condemned to death — yet he succeeded in substituting morals for physics as the subject of philosophy. He first gave to philosophical methods the definition and the inductive argument, or reasoning by analogy. One of his disciples, Aristippus of Cyrene, while he followed the method of his master, founded the Cyrenaic school which taught that pleasure was the criterion of the true; Socrates had taught that the good as judged by the individual conscience was that criterion. Then followed the Cynics, under Antisthenes, who went to the opposite extreme to Aristippus, became an ostentatious ascetic, and in this was followed by Diogenes of Sinope, who made his home in a cask or tun, and tried to set the example of a rugged virtue, which is misanthropic, but triumphant over bodily appetite. It was left to Plato to exhibit the complete adoption and application of the Socratic method. He believed that in each man resided the power of detecting the truth, from having seen the perfection of things, in an ideal world during a previous state of existence; he could judge of the good and the beautiful here from his memory of what their perfect archetypes were. His voluminous writings enable us to judge both of his ethical and political system, but they both fail in practicality. His most famous pupil was Aristotle (384 B.C.), a man of encyclopedic mind, the first scientific observer, the inventor of the syllogism. Plato was an idealist and a rationalist; Aristotle a materialist and an empiric. The one trusted to reason, the other to experience. Aristotle always argued against the ideal theory of his master, and deduced his conclusions from things as he saw them. He invented grammar as well as logic, and was in himself an epitome of the philosophic learning of his predecessors. But by reasoning from experience he had opened the way for the skeptics, of whom the first was Pyrrho, who taught that there is no criterion of truth. Phenomena are mere appearances, how can we prove they are anything else? This was what in modern times is called agnosticism, for we cannot prove and therefore cannot know the truth of anything we see. But after this suicide of philosophy in the school of Pyrrho, she revived again as a moral mentor in the person of Epicurus, of Samos (342 B.C.). He taught the highest good is pleasure; this is the moral end of existence. He was controverted by the Stoics. Zeno was their leader, a man of stern unbending character and abstemious life, whose aim was to show that virtue consisted in manhood, and manhood in the power to endure hardness and to despise the body. Skepticism, indifference, sensuality and epicurean softness were not to be combated by the vague dreams of Plato, or the cumbrous system of Aristotle. The Stoic attempted to meet the growing decadence by an exactly opposite self-denial and impassive reserve. But Stoicism was egotistic; its aim was the repression of feeling, it was apathy, death in life. The last struggle of Greek philosophy to dominate the mind of society was witnessed in the rise of the New Platonists and their New Academy. Carneades (213 B.C.) was their most illustrious representative, and he was the type of a school that took up the doctrines of Plato, expanded and enlarged them until the time when Christianity appeared, and faith, not reason, as in the old days seven hundred years before, dominated the world of opinion. See PHILOSOPHY, HISTORY OF.

Greek Theatre, First in America, the gift of William R. Hearst to the University of California, is exactly similar in its proportions to the famous theatre of Dionysus at Athens.

The structure was used for the first time at the University of California commencement 1903 when President Roosevelt was the orator of the day. It was then learned that every one of the 8,000 spectators seated in the theatre could hear with perfect distinctness.

No roof shuts out the sunlight or starlight from the audience. Situated right in the heart of magnificent scenery, tall trees towering up above the walls on all sides and the building itself being an architectural gem, it will readily be seen that very little stage scenery will be needed when presenting the early plays which will be given by university students and the leading actors of the world as soon as all is ready.

The entire structure is white; the hangings will be a blending of the Greek and Roman colors; but there will be very few decorations used aside from architectural carvings, the splendor of the place being in its dimensions and simplicity.

Though this theatre is modeled in a general way after the ancient classic buildings of a similar character, no single historic example has been literally followed. The theatre at Epidaurus, in Greece, however, offers many points of similarity, notably in the difference of slope between the upper tiers of seats and the inner and lower portions of the auditorium. The new theatre is of approximately the same size as the larger theatre at Pompeii.

The building is, as a whole, made up of two separate and distinct parts, namely, the stage, corresponding to the ancient logeion, and the auditorium.

The floor of the stage is 133 feet wide and 28 feet deep. It is entirely open toward the auditorium and surrounded on the other three sides by a wall 42 feet in height. This wall, which corresponds with the ancient skene, is enriched by a complete classic order of Greek Doric columns with stylobate and entablature, the ends of the side walls toward the auditorium forming two massive pylons. Five openings pierce the wall, the entrance in the centre of the back of the stage being the most important — the so-called royal door of the ancients. This is flanked by two minor doors to the right and left the two remaining openings occurring on the return walls at either end of the stage.

The auditorium or theatre proper is semicircular in form, 254 feet in diameter, and is divided into two concentric series or tiers of seats. The first series is arranged about a level circle 50 feet in diameter and 5½ feet below the stage, which corresponds to the space anciently devoted to the chorus, orchestra, etc.

From this circle the receding rows of seats step up gradually until the stage level is reached at a circle corresponding in diameter with the terminal pylons of the stage wall. This line is marked architecturally by a passage, anciently named the diazoma or diodos, running around the semicircle of seats midway between the orchestra and the topmost circle. The diazoma is protected on its outer side by a wall, beyond which the seats step up more steeply, approximately at an angle of 30 degrees with the horizontal, to the outer limit of the theatre.

It is estimated that more than 7,000 persons can be seated in the theatre proper. The stage will accommodate some 600 more, a number which can be readily added to by the temporary extension of the stage floor toward the auditorium.

Greeley, Horace, American journalist: b. Amherst, N. H., 3 Feb. 1811; d. Pleasantville, N. Y., 29 Nov. 1872. More than 30 years after his death, Horace Greeley's name remains at the head of the roll of American journalists. Successors in the primacy of current discussion may surpass him, as doubtless some of them already have, in consistency and learning, but hardly in the chief essentials of a journalistic style; others may exert a more salutary influence, if not so personally diffused: but in the respect of high ideals, courage, intellectual force, and personal magnetism, the qualities which impel a man of letters to be also a man of action, Horace Greeley was of heroic mold. He was no pop-gun journalist firing from a sky-sanctum, but a face-to-face champion in the arena of public affairs, laying about him with pen and speech like an ancient Bayard with his sword. The battles he fought for humanity, and the blows he gave and received, have made him for all time the epic figure of the American press.

Born in rural New Hampshire, of English and Scotch-Irish descent, he epitomized his heritage and his attainment in the dedication of his autobiography "To our American boys, who, born in poverty, cradled in obscurity, and early called from school to rugged labor, are seeking to convert obstacle into opportunity, and wrest achievement from difficulty."

Though physically a weak child, his intellect was strong, and when near his tenth year his father removed to Vermont, the boy took with him the reputation of a mental prodigy; so, with little schooling and much reading, he was thought when 14 to be a fit apprentice to a printer, setting forth four years later as a journeyman. His parents had moved to western Pennsylvania, and he followed; but after a desultory practice of his art he came to the metropolis on August 17, 1831, with $10 in his pocket, and so rustic in dress and manners as to fall under suspicion of being a runaway apprentice. Later in life, at least, his face and his figure would have lent distinction to the utmost elegance of style: but his dress was so careless even after the long period of comparative poverty was passed, that the peculiarity became one of his distinguishing features as a public character; and to the last there were friends of little discernment who thought this eccentricity was studied affectation: but manifestly his dress, like his unkempt handwriting was the unconscious expression of a spirit so concentrated on the intellectual interests of its life as to be oblivious to mere appearances.

After 18 months of dubious success in New York as a journeyman, in his 21st year, he joined a friend in setting up a modest printing-office, which on March 22, 1834, issued the 'New Yorker,' a literary weekly in the general style of Willis' 'Mirror,' under the firm name of H. Greeley & Company. For four years the young printer showed his editorial aptitude to such good effect that in 1838 he was asked to conduct the 'Jeffersonian,' a Whig campaign paper. This was so effective that in 1840 he was encouraged to edit and publish the 'Log-Cabin,' a weekly which gained a circulation of 80,000, brought him a reputation as a political writer, and active participation in politics with the Whig leaders, Gov. Seward and Thurlow Weed. It contributed much to the election of Gen. Harrison, but very little to the purse of the ambitious editor. On April 10 of the following year, 1841, he issued the first number of the New York *Tribune*, as a Whig daily of independent spirit. He was still editing the 'New-Yorker' and the 'Log-Cabin,' both of which were soon discontinued, the 'Weekly Tribune' in a way taking their place. Though the 'New-Yorker' had brought him literary reputation, it had not been profitable, because of uncollectible bills which at the end amounted to $10,000. Still, at the outset of the *Tribune* he was able to count $2,000 to his credit in cash and material. He was then 30 years of age, and for 30 years thereafter the paper grew steadily in circulation, influence, and profit, until, a few weeks after his death, a sale of the majority interest indicated that the "good-will" of the *Tribune*, aside from its material and real estate, was held to be worth about a million dollars. The Greeley interest was then small, since he had parted with most of it to sustain his generous methods of giving and lending.

He had great capacity for literary work, and when absent for travel or business was a copious contributor to his paper. To his rather delicate physical habit was perhaps due his distaste for all stimulants, alcoholic or otherwise, and his adherence through life to the vegetarian doctrines of Dr. Graham; another follower of the latter being his wife, Mary Young Cheney, also a writer, whom he married in 1836. His moderate advocacy of temperance in food and drink, coupled with his then unorthodox denial of eternal punishment, helped to identify him in the public mind with most of the "isms" of the time, including Fourierism and spiritualism; when in fact his mind and his paper were merely open to free inquiry, and were active in exposing vagaries of opinion wherever manifested. Protection to American industry, and abolitionism, were the only varieties which he accepted without qualification: and while the pro-slavery party detested him as a dangerous agitator, it is possible at this day even from their point of view to admire the moderation, the candor, and the gentle humanity of his treatment of the slavery question. In all issues concerning the practical affairs of life, like marriage and divorce, he was guided by rare common-sense, and usually his arguments were scholarly and moderate: but in matters of personal controversy he was distinctly human, uniting with a taste for the intellectual fray a command of facts, and a force and pungency of presentation, which never seem admirable in an opponent.

He was in great demand as a lecturer and as a speaker at agricultural fairs, his addresses always being distinguished by a desire to be helpful to working humanity and by elevated motives. Though not a jester, genial humor and intellectual exchange were characteristic of his social intercourse. His books, with one or two exceptions, were collections of his addresses and newspaper articles. His first book, 'Hints Toward Reforms,' appeared in 1850, and was followed by: 'Glances at Europe' (1851); 'A History of the Struggle for Slavery Extension or Restriction' (1856); 'The Overland Journey to California' (1859); 'An Address on Success in Business' (1867); 'Recollections of a Busy Life,' formed on a series of articles in the New York 'Ledger' (1869); 'Essays Designed to Elucidate the Science of Political Economy' (1870); 'Letters from Texas and the Lower Mississippi, and an Address to the Farmers of Texas' (1871); 'What I Know of Farming' (1871); and 'The American Conflict,' written as a book, the first volume appearing in 1864 and the second in 1867. This work on the Civil War is remarkable, when considered in the light of his purpose to show "the inevitable sequence whereby ideas proved the germ of events"; but it was hastily prepared, and while strikingly accurate in the large sense, will not bear scrutiny in some of the minor details of war history.

Neither his political friends, nor his party, nor the causes he espoused, could hold him to a course of partisan loyalty contrary to his own convictions of right and duty. As a member of the Seward-Weed-Greeley "triumvirate," he was often a thorn in the flesh of the senior members; his letter of Nov. 11, 1854, dissolving "the political firm," being one of the frankest documents in the history of American politics. During the Civil War he occasionally embarrassed Mr. Lincoln's administration by what seemed then to be untimely cries of "On to Richmond!" immediate emancipation, and peace. On the whole, his influence for the Union cause was powerful; but when, the War being over, he advocated general amnesty, and finally as an object lesson went on the bail bond of Jefferson Davis, he lost the support of a large body of his most ardent anti-slavery admirers. The clamor against him called forth a characteristic defiance in his letter to members of the Union League Club, who were seeking to discipline him. Having further alienated the Republican party by his general attitude in "reconstruction" matters, he became the logical candidate for the Presidency, in 1872, of the Democrats at Baltimore and the Liberal Republicans at Cincinnati, in opposition to a second term for Gen. Grant. Though personally he made a brilliant canvass, the influences at work in his favor were inharmonious and disintegrating, and the result was a most humiliating defeat. This he appeared to bear with mental buoyancy, despite the affliction of his wife's death, which occurred a week before the election, he having left the stump in September to watch unremittingly at her bedside. On November 6, the day after his defeat, he resumed the editorship of the *Tribune*, which six months before he had relinquished to Whitelaw Reid. Thereafter he contributed to only four issues of the paper, for the strain of his domestic and political misfortunes had aggravated his tendency to insomnia; on the 12th he was seriously ill, and on the 29th he succumbed to inflammation of the brain. The last few months of his eventful career supplied most of the elements essential to a Greek tragedy. On December 23, the *Tribune* having been reorganized, with Mr. Reid in permanent control, there first appeared at the head of the editorial page the line "Founded by Horace Greeley," as a memorial to the great journalist and reformer. A bronze statue has been erected in the portal of the new *Tribune* office, and another statue in the angle made by Broadway and Sixth Avenue, appropriately named "Greeley Square," after the man who was second to no other citizen in establishing the intellectual ascendency of the metropolis. CLARENCE CLOUGH BUEL.

Greeley, Colo., city, county-seat of Weld County; on the Cache la Poudre River, the Union P. and the C. & S. Railroads; about 50 miles north of Denver. The place was settled in 1870 by the "Greeley Colony" (named after Horace Greeley), made up mainly of New England people. By irrigation they have made of the almost barren region an excellent agricultural country. It is the seat of a State Normal School. The chief manufactures are flour, beet-sugar, and lumber. Its trade is in its manufactured articles, also sheep, cattle, grain, and vegetables. Pop. (1900) 3,023.

Greely, Adolphus Washington, American Arctic explorer: b. Newburyport, Mass., 27 March 1844. After receiving a high school education he enlisted as a private in the 19th Massachusetts volunteer infantry, serving in the Civil War from 1861 to 1865. He entered the regular army in 1867 as second lieutenant and was appointed to the signal service. In 1881 he was put in command of an Arctic expedition, organized to carry out the plan of establishing circumpolar stations in accordance with the recommendations of the International Geographical Congress held at Hamburg in 1879. The exploring party made their headquarters for two years at Discovery Harbor, Grinnell Land. In an expedition made by a detailed party, the highest point north attained up to that date, 83° 24′, was reached. On his way back he reached Cape Sabine with great difficulty, and during the winter of 1883 lost, through cold and famine, all but seven of his twenty-five companions. Meanwhile Com. Winfield S. Schley had been despatched on a relief expedition, and in June 1884 rescued them at Cape Sabine. From his services to geographical science Lieutenant Greely was awarded the Founder's Medal of the Royal Geographical Society, and the Roquette Medal by the Société de Géographie of Paris. He was promoted to the rank of captain in the United States Army, and in 1887 succeeded Gen. W. B. Hazen as chief signal officer, with the rank of brigadier-general. Consult: Greely, 'Three Years of Arctic Service' (1886); Schley, 'The Rescue of Greely' (1885).

Green, Alice Sophia Amelia (STOPFORD), English historian: b. Kells, Ireland, 1849. She was privately educated. In 1877 she was married to J. R. Green (q.v.) the well-known historian. She collaborated with him in 'A Short Geography of the British Islands' (1879), edited his 'Conquest of England' (1883), prepared a revised edition (1888) and, with Miss K. Norgate, a finely illustrated edition (1892) of the 'Short History of the English People.' Her original works are 'Henry II.' (1888) and 'Town Life in the Fifteenth Century' (1894).

Green, Andrew Haswell, American lawyer: b. Worcester, Mass., 6 Oct. 1820; d. 13 Nov. 1903. He studied law, practised his profession in New York, and was there president of the board of commissioners of education, and comptroller (1871–6). In the latter capacity he re-established the municipal credit, seriously impaired by the embezzlements of the Tweed ring. He originated in 1868 the plan for Greater New York, executed in 1897, and also devised the plan for the consolidation of the Astor, Lenox, and Tilden foundations as the New York Public Library. He also assisted in establishing the American Museum of Natural History and the Metropolitan Museum of Art, and founded and became president of the New York Zoological Society. He was shot by Cornelius M. Williams, a negro, pronounced insane. It developed that he lost his life through resemblance to another against whom the assassin had a supposed grievance.

Green, Anna Katharine. See ROHLFS, ANNA K. G.

Green, Ashbel, American Presbyterian clergyman: b. 6 July 1762; d. 19 May 1848. He was graduated from the College of New Jersey (now Princeton University) in 1783, and appointed tutor and subsequently professor of mathematics and natural philosophy in that institution, which latter position he held for a year and a half. In 1786 he was licensed to preach and took up ministerial work in Philadelphia. From 1792 to 1800 he was chaplain to Congress, and in 1809 took a prominent part in forming the Philadelphia Bible Society, the earliest institution of the kind in the United States. He drafted the constitution of the Princeton theological seminary, of which he was one of the originators, and in 1812 was elected president of Princeton College. In 1822 he resigned this office and returned to Philadelphia to edit the 'Christian Advocate,' a religious monthly. For half a century he was one of the leading men in the Presbyterian Church. Among his many writings are 'Discourse Delivered in the College of New Jersey, with a History of the College' (1822); 'History of Presbyterian Missions', 'Lectures on the Shorter Catechism.'

Green, Bartholomew, American publisher: b. Cambridge, Mass., 1666; d. 1732. He published the first newspaper that appeared in the American colonies, and succeeding to his father's business at Cambridge extended it at Boston, where the office of the 'Boston News Letter' was situated. The proprietor and editor was John Campbell, postmaster of Boston. He eventually bought in the paper, which became notable for outspokenness on topics of religion and politics.

Green, Beriah, American abolitionist: b. New York State 1794; d. 1874. He was educated at Middlebury College, Vermont; became professor of sacred literature in Western Reserve College in 1821, but was compelled to resign in a few months through the opposition aroused by his anti-slavery views. He was for many years president of the Oneida Institute, Ohio. He was a great friend of William Lloyd Garrison, and exerted a wide influence in abolitionist circles. Among his writings are 'History of the Quakers' (1823).

Green, Duff, American politician and journalist: b. Woodford County, Ky., 1791; d. Dalton, Ga., 1875. He served with the Kentucky militia in the War of 1812; after the admission of Missouri as a State was appointed State Senator (1823), and became editor and proprietor of the St. Louis *Enquirer.* In 1825 he removed to Washington, D. C., where he purchased the United States *Telegraph.* This became the administration organ and Green rose to high favor with President Jackson. He was a member of the 'Kitchen Cabinet.' After the rupture between Calhoun and Jackson the *Telegraph* as the organ of the nullificationists bitterly attacked Jackson. After some years spent in Europe he returned to the United States (1844) and edited a short-lived newspaper in New York. During the latter years of his life he was actively engaged in promoting the development of the South, and was one of the founders of the town of Dalton, Ga.

Green, Hetty Howland Robinson, American financier: b. New Bedford, Mass., 21 Nov. 1835. She is the richest woman in America and probably the boldest and ablest woman financier of her time. Although she has an interest in nearly every large corporation and important enterprise in the world, she manages personally her own property in stocks, bonds, and real estate in Chicago, New York and elsewhere.

Green, Jacob, American Presbyterian clergyman: b. Malden, Mass., 1722; d. 1790. He became president of the College of New Jersey in 1757, and in 1775, as a member of the New Jersey Provincial Congress, was chairman of the committee chosen to prepare a State Constitution. He suggested in print a scheme for the redemption of the Continental currency, closely resembling that which Congress later adopted.

Green, John Cleve, American merchant and philanthropist: b. Lawrenceville, Mercer County, N. J., 14 April 1800; d. New York 28 April 1875. He entered a counting-house in New York, went as supercargo to South America and China, and in 1833 became a member of the firm of Russell & Co. at Canton. In 1839 he returned to New York, where he continued in the Chinese trade. For many years he was a director of the Chamber of Commerce, and was actively connected with numerous public and charitable institutions. He was liberal in his gifts, particularly to New York University, and Princeton University. At Princeton he established (1873) the John C. Green School of Science by the gift of $50,000, subsequently increased by the residuary legatees. In this school instruction is given in general science, civil engineering, and electrical engineering. The courses are four years in length and lead to the degrees of bachelor of science, civil engineer and master of science. In 1902-3 the number of students in this department was 305. The endowed proprietary school for boys at Lawrenceville, N. J., was re-established in 1882 upon a gift from the executors of his estate known as 'The John C. Green Foundation.'

Green, John Richard, English historian: b. Oxford 1837; d. Mentone, France, 7 May 1883. He was graduated in 1859 from Jesus College, Oxford, where, since the study of modern history had not yet taken any considerable place in the university, the officers failed of sympathy with his preference for Matthew Paris to the classics. In 1860 he was ordained deacon and became curate of St. Barnabas, London, in 1863 was appointed to Holy Trinity, Hoxton, and in 1866 to St. Philip's, Stepney. Failing health and increasingly liberal views caused him to withdraw from clerical life, and from 1869 he was librarian at Lambeth. His first literary work of importance consisted of articles, especially brief essays on historical subjects, in the 'Saturday Review.' In 1874, after having been twice rewritten, his 'Short History of the English People' appeared. This work unified English history as no other had yet done. 'What Macaulay had done for a period of English history,' says Creighton, 'Green did for it as a whole.' Green's purpose was to exhibit the development of popular life by a description of the leading manifestations of social progress. The book was skilful in arrangement and artistic in style, and met with an instant and large success. The author expanded it into his 'History of the English People' (1877-80) not only to secure greater fulness but also to defend views merely stated in the smaller work. He then attempted a history for scholars, of which but two parts were published — 'The Making of England' (1882), which extends from Britain as left by the Romans to the consolidation under Egbert, and secured his fame as a critical historian, particularly through his method of employing archæology for the purposes of history; and 'The Conquest of England' (1883), which continued the narrative to the arrival of the Normans. Green's influence on historical studies in England was very great, and his 'Short History' and 'History' still hold a foremost rank. The Oxford Historical Society and the 'English Historical Review' were originally suggested by him; and he further published 'Stray Studies in England and Italy' (1876), a reprint of early papers; 'Readings from English History' (1879), a series of extracts; 'A Short Geography of the British Isles' (1880); and an edition of Addison's 'Essays' (1881). His 'Letters' were published in 1901.

Green, Joseph, American poet: b. Boston, Mass., 1706; d. London, England, 11 Dec. 1780. He was graduated at Harvard 1726, and was famous for his wit and satirical powers. During the War of the Revolution he was prominent on the Loyalist side. His works include: 'The Wonderful Lament of Old Mr. Tenor' (1744); 'Poems and Satires' (1780).

Green, Seth, American pisciculturist: b. Irondequoit, N. Y., 19 March 1817; d. Rochester, N. Y., 20 Aug. 1888. He learned the natural history necessary for his profession from observation and private reading, and began his life's work by the artificial hatching of trout roe. He was looked upon as the leading expert in this department of fish culture, but his first great triumph in new fields came with his success in the reproduction of shad. The Seth Green shad-hatching box was invented in 1867, and, although it has been superseded, by this device shad culture was first demonstrated to be possible and its inventor must be looked upon as the pioneer in this difficult department of pisciculture. The Connecticut River was restocked by means of this invention. In 1868 he was made fish commissioner for the State of New York, and the following year undertook the artificial reproduction of whitefish. He was successful in his experiments, and was acknowledged as one of the fathers of fish culture in the United States. From 1870 until his death he was superintendent of the state hatchery at Caledonia, N. Y.

Green, Thomas Hill, English philosopher: b. Birkin, Yorkshire, 7 April 1836; d. Oxford, 15 March 1882. He was educated at Rugby and Oxford; was elected fellow at Balliol in 1862, the first lay tutor on that foundation (1867), and in 1878 Whyte professor of moral philosophy in the university. His principal work as a philosopher was the foundation of the so-called Neo-Hegelian School. He is supposed to have been taken by Mrs. Ward as a model for her Mr. Gray in 'Robert Elsmere'; but the resemblance is by no means complete, as Mr. Gray's work is undoubtedly, as he appears in 'Robert Elsmere,' rather that of a destructive literary critic than a constructive philosopher. His works include: 'Introduction to Hume's Treatise of Human Nature' (1874); and 'Prolegomena to Ethics' (1883.)

Green Bay, Wis., a city and county-seat of Brown County, situated at the head or southern point of the bay of the same name, and at the mouth of the Fox River, on the Chicago & Northwestern, Chicago, Milwaukee & St. Paul, the Green Bay & Western R. R.'s.

Commerce and Industry.— Green Bay has an extensive commerce. Twenty-four passenger trains arrive daily over the four railroads entering the city. An extensive lake traffic is also carried on, the harbor, through government appropriations, having been made accessible to the largest vessels upon the Great Lakes. Coal constitutes the largest single import, Green Bay being an advantageous distributing point. The largest export by way of the lakes is grain, although much lumber has hitherto been shipped out. A line of excursion steamers is also run to nearby summer resorts and to Mackinac and the "Soo." The city is provided with a complete electric railway system, including an interurban line up the Fox River valley to Kaukauna, where a junction is made with another electric line passing through Appleton, Neenah, Oshkosh and Fond du Lac. A light and power plant furnishes gas for lighting and heating and electricity for light and power, many electric motors now being in use. There are a number of manufacturing plants — 3 large breweries, 2 paper mills and 1 sulphite mill, 2 large saw mills, 2 planing mills, 1 very large canning factory, 1 shoe factory, 1 glove factory, 1 pure milk factory, 1 furniture factory, 2 woodenware factories, 3 machine shops, 1 candy and biscuit factory, 1 pickle factory, 1 coffin factory, 1 carriage factory, 1 cornice factory, 1 paper-box factory. Several jobbing and wholesale houses do a large business, the most important being a grocery house, a hardware house, and a crockery house. An extensive fish-shipping business is also carried on. Water is supplied from artesian wells by a private company.

Educational Institutions, Etc.— Green Bay has a number of fine public buildings, the Kellogg library, the Federal Buildings, Saint Joseph's Academy, three Hospitals, and just outside the city limits the State Reform School. The public school system consists of 2 high schools and 13 ward schools, employing 84 teachers. There are also several parish schools, graded in the same manner as the public schools. There are 6 Roman Catholic churches, 2 Baptist 2 Congregational, 1 Episcopal, 2 Evangelical, 2 Lutheran, 4 Methodist, 2 Moravian, 2 Presbyterian, and 1 Christian Scientist.

History.— Green Bay, the oldest town in Wisconsin, was first visited in 1634 by Jean Nicollet, who had been sent by Champlain, governor of New France, to find the rumored short route to China. The site was a favorable one for an Indian village as well as a landing place for explorers and missionaries. It is known that Marquette, Joliet, Allouez, and Tonti spent considerable time here. The town was therefore settled by the French, who impressed their character upon it for over 200 years, although it fell into the hands of the English at the close of the French and Indian war in 1763. In 1816 the Americans established a fort on the opposite side of the river, known as Fort Howard, around which a prosperous town of the same name grew up. In 1895 Fort Howard was annexed to Green Bay, and is now known as the West-Side.

Government, Etc.— The government of the city is administered by a mayor and common council, the latter consisting of sixteen members, elected for two years, two from each ward. Assessed valuation: Lots exclusive of buildings, $4,150,235; buildings, $4,279,740; personal property, $2,827,140; total, $11,257,115. Pop. (1903 est.) 20,142.

A. W. Burton,
Superintendent of Schools.

Green Bay, an arm of Lake Michigan, on the southwestern coast of the upper peninsula of Michigan and the eastern coast of Wisconsin. It is 120 miles long, from 10 to 20 miles wide, has an average depth of about 100 feet. Fox River, the outlet of Lake Winnebago, enters the bay at its head, at the city of Green Bay. The bay is navigable for the largest lake steamers. The largest cities on the bay are Green Bay and Marinette, in Wisconsin, and Menominee and Escanaba in Michigan.

Green Cove Springs, Fla., town, county-seat of Clay County; on the St. John's River, the Jacksonville, T. & K. W. railroad. It contains a warm sulphur spring noted for its medicinal properties. The trade is chiefly in fruits, vegetables, and lumber. Pop. 1,015.

Green Island, N. Y., a village of Albany County, on an island in the Hudson River opposite Troy, on the Delaware & H. and the New York C. & H. R. R.R.'s. It is connected with Watervliet and Troy by bridges; and has iron manufactories, machine shops and railroad car shops. Pop. (1900) 4,770.

Green Manuring, the agricultural practice of plowing under crops while succulent in order that they may enrich the surface layer by their decay. It is of ancient origin and wide popularity, especially in mild climates; less in tropical than it should be. The objects gained are the opening of the soil and especially the subsoil by the roots of deep feeding plants; the raising of plant food from the lower strata to the surface layer and the saving of available plant food in the surface layer, material that would leach away beyond the reach of shallow-rooted plants; the addition of humus to the soil by the decay of the plants; and, with certain crops, the addition of nitrogenous foods obtained from the air. As the plants decay they also act upon insoluble plant food in the soil and make it available. They belong to two classes: (1) shallow-rooted plants such as rye, buckwheat, mustard, rape, etc., which are specially useful on hard and poor soils open the way for more exacting crops; (2) deep-rooted plants such as clover, cow-pea, velvet bean, vetch and other leguminous plants which are still further useful because of their power of obtaining nitrogen from the air. See CLOVER; FERTILIZERS; LEGUMINOUS PLANTS; MANURES AND MANURING; ROOT-TUBERCLES; SOIL, and articles on the crops mentioned.

Green Monkeys, three similar species of small African monkeys, often seen in menageries, and representing the genus *Cercopithecus*, may properly be called green monkeys because of the prevailing tint of their fur. The one most commonly seen is *C. callitrichus*, the size of a cat, and remarkable for its unbroken silence. The vervet (*C. lalandi*) is smaller, grayish green, reddish white on the cheeks, throat and underparts, while the face, paws and end of the tail are jet black. It is common all over South Africa, where no other species of its large genus are found. The grivet (*C. griseoviridis*) is speckled olive-green, with a whitish forehead, chin and rump; it dwells in Abyssinia and is not numerous. All these monkeys, at least when young, are exceedingly docile and good-natured in captivity.

Green Mountain Boys, the regiments of Vermont settlers raised to defend the New Hampshire grantees against the efforts of New York to oust them or collect quit-rents, and later for service in the Revolution. See ALLEN, ETHAN.

Green Mountain State, a popular name for the State of Vermont, from its being crossed by the Green Mountains. See GREEN MOUNTAINS; VERMONT.

Green Mountains, a range belonging to the Appalachian system properly extending from near Long Island Sound through the western part of Connecticut and Massachusetts, into Vermont and Canada. In the State of Vermont the range is known as Green Mountains; but south, in Massachusetts and Connecticut, it is called by the names Berkshire Hills, Taconic Mountains, and Hoosac Mountains. The peaks of this range, one of the oldest in North America, have been worn down by erosion and weathering, until in many places they have become low, round hills. Their greatest elevation is in Vermont; Mounts Killington, Mansfield, Camels Hump, Lincoln, and Jay being the highest. Summit, a hamlet in the town of Mount Holly, in Rutland County, is the highest point crossed by a railroad. Some of the best building stone in the country is obtained from the Green Mountains. Granite and marble exist in large quantities, and on the western slope are layers of red sandstone. Iron and slate abound, and copper and manganese are found in several places. The range forms the divide between the basin of the Connecticut on the east and the Lake Champlain and Hudson River basins on the west. The rivers rising in the Green Mountains are short streams, but their water-power is abundant. In the fertile valleys are rich farms, and sheep and cattle are raised on the uplands. The hemlock, spruce, pine, and other evergreens which form striking parts of the forests, have given the name to this range. Hard wood trees and the sugar maple are found on both the east and west slopes of the mountains. The beauty of the scenery and the climate make the Green Mountains a place much frequented in summer by tourists.

Green River, in Kentucky, has its rise in Lincoln County, flows south and west to Adair County; west, a very irregular course, to Butler County; then northwest to the Ohio River which it enters a few miles above Evansville, Ind. It is about 350 miles long, and is navigable for small steamers for a distance of about 200 miles from the Ohio; but for a part of this distance artificial means have been used to make it navigable. In Edmonson County this river passes within 80 feet of the mouth of Mammoth Cave. The subterranean stream called Echo River, which is seen in connection with the Mammoth Cave, flows into Green River.

Green River, in Utah, has its rise in the western part of Wyoming, flows south and east into Colorado, south and west into Utah, then in a southern direction to the southeastern part of the State where it unites with the Grand to form the Colorado River. Major Powell (q.v.) and other explorers have passed through several of the remarkable cañons of this river. Its length is about 525 miles.

Green Snake, in the United States, a very slender, agile, harmless, grass-green, yellow-bellied serpent (*Liopeltus vernalis*), which is not only common in grassy places but in bushes, its color concealing it well in both places. It feeds mainly on insects. Several poisonous serpents of the far East, are called "green snakes" by English-speaking residents on account of their color.

Green Springs, Va., Battle of, 6 July 1781. Lafayette, reinforced by Steuben, was pressing close on Cornwallis' rear down York peninsula; and the advance-guard under Wayne came unexpectedly upon an entire division of the British at Green Springs, on the James River. Immediate retreat meaning destruction, he charged them so fiercely that Cornwallis, thinking the entire American army was upon him, merely repulsed the assaulting party and drew off his men, while Wayne retreated in the other direction. The American loss was 145.

Green Vitriol. See COPPERAS.

Green'away, Kate, English artist: b. London 1846; d. there 8 Nov. 1901. She studied at Heatherley's, South Kensington, and the Slade School, and first exhibited in 1868 at the Dudley Gallery. For many years her work regularly appeared in the exhibitions of the Water Color

Society and the Academy. Her illustrations were widely published and popular in the United States as well as in Great Britain. She became especially famous for her pictures of child life, characterized by individuality of design, skilful coloring, and humorous touches. Her books include 'A Painting Book for Boys and Girls' and 'Kate Greenaway Birthday Book.'

Greenback-Labor Party, or **National Party.** The workingmen during the "panic years" (1874-8) increasingly resorted to political activity to right their grievances, and in Ohio in 1877 began to call their local organization the "National Party." In Massachusetts and Pennsylvania they fused with the Greenback Party (q.v.). On 22 Feb. 1878, at Toledo, Ohio, they held a convention which organized the fusion as the "National Party;" but the popular name for it was the old fusion name "Greenback-Labor." Their platform was the Greenback one, with planks against prison contract labor and in favor of legislation for shorter hours. The new organization awakened hopes in the hopeless minorities in several States where the majority, Republican or Democratic, could not be overturned: and they organized fusions with it, which raised it at once to a popular vote (apparently) of over 1,000,000, and elected 14 Congressmen. In the close States each old party kept its own vote, with a slight falling off to the new one. The party proper elected but two representatives, five of the 14 being really Republicans and seven Democrats. In 1880 (9-10 June) it held a national convention at Chicago, and nominated James B. Weaver of Iowa, and B. J. Chambers of Texas, for President and Vice-President; Chambers declined, but no substitute was nominated. The platform had all the old planks in substance, and new ones against Chinese immigration, land-grants to railroads, and favors to corporations and bondholders, and in favor of sanitary regulations for manufactories. The fusions had largely disappeared, and the popular vote sunk to 306,867, and the Congressmen to eight; four from Missouri, two from Maine, one from New York, and one from Texas. It retained its organization till 1884, when it fused with the Anti-Monopoly Party (q.v.) and nominated Benjamin F. Butler for the Presidency, polling in all 175,380 votes. It then practically disappeared.

Greenback Party (its own name INDEPENDENT PARTY), 1874-6. The prosperity of western agriculture during the War, due largely to the heavy government purchases and the payability of mortgages in depreciated paper, was attributed by a large section there to the plentifulness of the paper by itself; hence, when hard times had succeeded, it was believed that a fresh inflation of greenbacks would reproduce the same conditions. The chief obstacle to this was thought to be the eastern banking interests, which, having bought government bonds in greenbacks, had obtained the act of 1869 making them payable in coin whether so specified or not; and should have been forced to take what they gave, the more since paper was now at par and their bonds were not taxed. By 1868 the Ohio Democrats, led by George H. Pendleton, were insisting on the payment in greenbacks of all bonds not specifically payable in coin, as the 5-20's; this was called the "Ohio Idea." Western Democratic conventions placed this plank in their platforms for three or four years, but the nomination of Greeley put an end to that in 1872. The revival of greenbackism is often attributed to the silver demonetization act of 1873; but in fact silver was above par at that time, the act drew no general attention, and but for the later fall in silver probably never would have done so. The real cause was the bringing forward of the Resumption Act, passed 14 Jan. 1875, to take effect 1879. On 25 Nov. 1874 a Greenback convention was held to protest against it, and adopted three resolutions — (1) that all bank and corporation currency should be withdrawn; (2) that no currency be allowed except government paper "based on the faith and resources of the nation," and exchangeable on demand for 3.65 per cent bonds; (3) that coin should be paid only for interest on the national debt, and for that part of the principal which promised it. Several Democratic conventions indorsed these; but in 1876 the prospect of the hard-money Tilden being the next Presidential candidate, led the party to form an organization of its own. At a convention at Indianapolis, 17 May, they nominated Peter Cooper of New York and Newton Booth of California for President and Vice-President; Booth declined, and Samuel F. Cary of Ohio was substituted. The platform, besides the three points above, demanded the repeal of the Resumption Act. The ticket polled 81,737 votes, over half of them in Michigan, Illinois, Indiana, Iowa, and Kansas. In the State elections the next year the party polled 187,095 votes, but the main strength continued to be in the West. The next year it was absorbed in the Greenback-Labor Party (q.v.).

Greenbacks (as printed in green ink), the current name, from the first, of the legal-tender notes first issued by the government during the Civil War. (See DEBT, NATIONAL.) The authorizing act was signed by Lincoln 25 Feb. 1862; it was the first ever passed by Congress making anything but coin legal tender, and nearly all the Democrats and many Republicans declared it unconstitutional. But war necessities were too exigent, and the bill authorized $150,000,000 of the notes, not receivable for import dues nor payable by the government as interest on its obligations. On 11 June 1862 and 3 March 1863 further issues were authorized; and on 3 Jan. 1864 they reached their maximum amount of $449,338,902. The great inflation, the uncertain fortunes of the War, and the belief that even if victorious the United States neither could nor would pay its enormous debt at face value, but would repudiate or scale it, combined to depreciate the value of the notes; throughout 1864 they were worth on an average only about 45 cents on the dollar, and on one day, 11 July, when Early was threatening Washington, they dropped in panic to about 35 cents — or as currently expressed, the "premium on gold" was 285. The legal-tender acts had always been understood to be temporary war measures only, and a choice of evils; the secretary of the treasury (McCulloch) in his report for 1865, expressed the opinion that they ought not to be in force a day longer than was necessary to prepare for a return to the gold standard. The House passed a resolution of cordial concurrence, 144 to 6; and on 12 March 1866 both houses agreed on a reducing act, by which on 31 Dec. 1867 the volume of greenbacks stood at $356,000,000. But the demoralization of economic sentiment and judgment wrought by them, which afterward issued in the Greenback party, was already at work: many attributed the prosperity of the time to the currency inflation, and even in Congress a majority had determined to make the paper currency a permanent feature of our finance. On 4 Feb. 1868 any further reduction was prohibited, and the volume stood at this mark till October 1872, when it began to increase, amounting on 15 Jan. 1874 to $372,979,815. On 20 June 1874 the maximum was fixed at $382,000,000. Meantime a test case had been made up to try the question of their constitutionality (Hepburn v. Griswold: see LEGAL TENDER CASES), and in 1869 the Supreme Court, by five to three, headed by Chief-Justice Chase, decided against them. The fiercest political opposition was roused by this, however, and it became a party question. The Supreme Court, in May 1871, reversed its decision by one majority. This experience has led the Supreme Court to be excessively cautious about taking jurisdiction in any case where strong political feeling is involved. The question of legal tender has become unimportant since the passage of the 'Gold Standard Bill' (q.v.), under which no depreciation in value is possible.

Green'brier, any of various prickly vines of the genus *Smilax* (q.v.), commonly the catbrier (*S. rotundifolia*), which grows all over the eastern half of the United States and is especially numerous in the Southern Alleghanies, where it designates various mountain-ranges, streams, etc.

Greenbrier Mountains, a range of mountains in the eastern part of West Virginia, lying west of the main part of the Alleghanies and parallel to the Greenbrier River (q.v.). Their average height is about 2,000 feet, the highest point being about 3,500 feet.

Greenbrier River, a river of West Virginia, rising in the Rich Mountains, Randolph County, flowing southwest into New River; length 150 miles.

Greenbrier White Sulphur Springs, W. Va., the name sometimes given the White Sulphur Springs in the Greenbrier Mountains to distinguish them from less important springs of similar character. See WHITE SULPHUR SPRINGS, W. VA.

Green'bush, N. Y., formerly a town now a part of the city of Rensselaer in Rensselaer County on the Hudson River and the Boston & A. and the New York C. & H. R. Railroads. See RENSSELAER.

Green'castle, Ind., city and county-seat of Putnam County, on the Cleveland, C., C. & St. L., the Louisville, N., A. & C. and the Vandalia Line R.R.'s; 35 miles northeast of Terre Haute. It is the seat of De Pauw University, with her 9 large buildings. She has excellent public schools and a fine library building containing 7,000 volumes. It was settled in 1822 and incorporated in 1849. The form of government is by a mayor and a municipal council elected every two years. Greencastle contains lumber-mills and manufactories of lightning rods, pumps, and one of the largest and best equipped tin-plate factories in the world. Pop. (1904) 4,200.

Greene, Aella, American journalist and poet: b. Chester, Mass., 1838; d. Springfield, Mass., 1903. He was the author of: 'Rhymes of Yankee-Land'; 'Into the Sunshine' (1881); 'Stanza and Sequel' (1884); 'Gathered from Life.'

Greene, Albert Gorton, American lawyer and poet: b. Providence, R. I., 10 Feb. 1802; d. Cleveland, Ohio, 4 Jan. 1868. Graduated from Brown University 1820, he was admitted to the bar in 1823; in 1832 became clerk of the town and of the municipal court of Providence, and in 1858 judge of the court. From 1867 he was in Cleveland, Ohio. He was at one time president of the Rhode Island Historical Society, was a founder of the Providence Athenæum, began the Harris collection of American verse (now at Brown University), and wrote some well-known poems, such as 'Old Grimes' and 'The Baron's Last Banquet.'

Greene, Charles Ezra, American engineer: b. Cambridge, Mass., 12 Feb. 1842; d. Ann Arbor, Mich., 17 Oct. 1903. Graduated from Harvard in 1862 and from the Massachusetts Institute of Technology in 1868, he was United States assistant engineer in 1870–1, city engineer of Bangor, Maine, in 1871–2, and in 1872 became professor of civil engineering in the University of Michigan. He also practised as consulting engineer, and in 1876–7 was associate-editor of the 'Engineering News.' His writings include: 'Graphical Method of Analysis of Bridge Trusses' (1875), 'Structural Mechanics' (1897), and other technical works.

Greene, Christopher, American soldier: b. Warwick, R. I., 1737; d. Westchester County, N. Y., 13 May 1781. He was among the first to take the field on the American side after the engagements at Lexington and Concord. Subsequently, as colonel of a Rhode Island regiment, he participated in the campaign in Canada under Arnold. In 1777, while in command at Fort Mercer at Red Bank, on the Delaware, he sustained an attack from a large force of Hessians under Col. Donop, who were repulsed with great slaughter. For these services a sword was voted him by Congress, and a monument commemorative of the battle and of the valor of the American commander was erected in the neighborhood of Fort Mercer in 1820.

Greene, Edward Lee, American botanist: b. Hopkinton, R. I., 20 Aug. 1843. After studying at Albion College, Wis., he took orders in the Protestant Episcopal Church (1871); but in 1885 entered the Church of Rome. He has been professor of botany at the Roman Catholic University in Washington since 1895, and has published 'Illustrations of West American Oaks' (1889); 'Flora Franciscana' (1891); and 'Pittonia' (1890).

Greene, Francis Vinton, American soldier: b. Providence, R. I., 27 June 1850. He was graduated at West Point with the rank of second lieutenant of artillery. In 1876 he was made military attache at St. Petersburg and remained at the headquarters of the Russian army during the Russo-Turkish War (1877–8), in the course of which he was twice decorated for bravery. Obtaining his captaincy in 1883 he was three years later appointed instructor in military engineering at West Point, but left the service to join the Barber Asphalt Company, and was president of the National Asphalt Company when the trust went into the hands of receivers. He entered the National Guard in

1889 on the staff of Gen. Louis Fitzgerald and was elected colonel of the Seventy-first regiment in 1892. In the Spanish-American War he was commissioned major-general of volunteers and served principally in the Philippines. In 1902 he was appointed police commissioner of New York. He has written: 'The Russian Army and its Campaign in Turkey' (1879); 'Army Life in Russia' (1880); 'The Mississippi' (1882); 'Life of General Nathanael Greene' (1893).

Greene, George Sears, American civil engineer and soldier: b. Warwick, R. I., 6 May 1801; d. Morristown, N. J., 28 Jan. 1899. He was graduated at West Point in 1823 and was for several years one of the professors there, but in 1836 adopted civil engineering as a profession, after sending in his resignation as an officer in the United States army. He was engaged subsequently in railway construction in many eastern States, and in 1856 the Croton Aqueduct Department of New York city commissioned him to execute several important works. He designed and constructed the reservoir in Central Park, widened High Bridge, and built a water tower and reservoir at its western extremity. At the beginning of the Civil War he took command of the Sixtieth New York Volunteers, and was put in command of a brigade at Cedar Mountain and a division at Antietam. He took part in many other important events of the war and was severely wounded in an engagement near Chattanooga, in 1863. In 1866 he retired from the army and the following year was appointed commissioner and chief engineer of the Croton Aqueduct Department, and in 1871 was called to Washington, D. C., as chief engineer of public works. During his three years' incumbency of that office he planned the sewer system of the national capital.

Greene, George Washington, American historian: b. East Greenwich, R. I., 8 April 1811; d there 2 Feb. 1883. He was a grandson of Gen. Nathanael Greene (q.v.) of Revolutionary fame. After study in Brown University, he traveled extensively in Europe, was United States consul at Rome in 1839–45, and from 1848 until his resignation in 1852 was professor of modern languages at Brown University. He was appointed non-resident professor of history at Cornell in 1872. His publications include several historical works, such as: 'Historical View of the American Revolution' (1865), 'Life of Nathanael Greene' (1867–71), 'The German Element in the War of American Independence' (1876), and a 'Short History of Rhode Island' (1877).

Greene, Homer, American author and lawyer: b. Ariel, Pa., 10 Jan. 1853. He was graduated from Union College in 1876, from the Albany Law School in 1878, was admitted to the bar in 1879, and entered practice at Honesdale, Pa. In Pennsylvania politics he has been active as a Republican. He has contributed much verse and prose to the magazines, and published: 'The Blind Brother,' 'Burnham Breaker,' 'Coal and the Coal Mines,' and 'The Riverpark Rebellion.'

Greene, Nathanael, American soldier: b. Patawomut, Warwick County, R. I., 7 Aug. 1742; d. Mulberry Grove, Ga., 19 June 1786. His father, a leading preacher among the Quakers, was the owner of an anchor forge and a grist mill. He was brought up as a Quaker, and trained from childhood to work on the farm and at the forge. Resolute perseverance in the midst of many obstacles gave him in the course of time a more than ordinary familiarity with ancient and English history, geometry, law, and moral and political science. In 1770 he was chosen a member of the general assembly for Coventry, whither he had removed to take charge of another forge; and from that time continued to take an active part in public affairs. He was one of the first to engage in the military exercises which prepared the way for resistance to the encroachments of the mother country, and this open renunciation of the principles of his sect was promptly followed by formal excommunication. In 1774 he joined the Kentish guards as a private; in July of the same year was married to Catharine Littlefield of Block Island, and in 1775 was appointed by the general assembly to command as brigadier-general the Rhode Island contingent to the army before Boston. He joined his command at Roxbury on 3 June and from that time remained in active service without a day's furlough till the final disbandment of the army in 1783. At Boston his brigade was distinguished by its discipline, and after the evacuation he was entrusted with the defense of Long Island. He distinguished himself in the battle of Harlem Heights, later commanded a portion of Washington's army near Ft. Washington on the Hudson, and in September he was made major-general, and appointed to the command in New Jersey. At Trenton he led the division with which Washington marched in person, and, with Knox, was for following up the advantages of that brilliant surprise by advancing directly upon the other detachments of the enemy. He took an equal part in the battle of Princeton, and was entrusted by Washington during the winter with a confidential communication to Congress. At the Brandywine he commanded a division, and by a rapid march and successful stand preserved the army from utter destruction. At Germantown he commanded the left wing which penetrated into the village. On 2 March 1778, he accepted the office of quartermaster-general, which he held till August 1780, fulfilling its arduous and complicated duties in such a manner as to call forth from Washington when he left it the declaration "that the States have had in you, in my opinion, an able, upright, and diligent servant." On 23 June 1780, he checked with two brigades and a small body of militia the advance of a corps of 5,000 of the enemy in the brilliant battle of Springfield. He was in command of the army during Washington's visit to Hartford in September 1780, when Arnold's conspiracy was discovered, and sat as president of the court of inquiry upon Major André. In October of the same year, he was appointed to the command of the Southern army, which he found on his arrival, in December, in a state of utter disorganization and want. He soon advanced to a well-chosen camp on the banks of the Pedee, and began a series of operations which in less than a year stripped the enemy of nearly all their hard-won conquests in the two Carolinas and Georgia, and shut them up within the narrow limits of Charleston and its immediate neighborhood. Among the events of this active year were the battle of the Cowpens, won by Gen. Morgan at the opening of the campaign; a brilliant retreat from the Catawba to the Dan; the battle of Guilford Court House in which he lost the field, but gained the end for which he fought: the pursuit of Cornwallis to the Deep River: the daring advance into South Carolina; the battle of Hobkirk's Hill, a second defeat followed by the results of victory: the siege of Fort Ninety-six, raised by the advance of Lord Rawdon, but followed by the immediate evacuation of the post and the retreat of the enemy toward the west: the drawn battle of Eutaw Springs, and the advance upon Dorchester, spoken of by Washington as another «proof of the peculiar abilities» of Gen. Greene. Congress presented him with a medal for services in the battle of Eutaw Springs, and North and South Carolina and Georgia made him valuable grants of property. He removed to the estate of Mulberry Grove, on the Savannah River, Georgia, where he died of a sunstroke. Consult G. W. Greene, 'Life' (1867-71); F. V. Greene, 'General Nathanael Greene' (1893).

Greene, Nathaniel, American journalist: b. Boscawen, N. H., 20 May 1797; d. Boston, Mass., 29 Nov. 1877. At 12 he entered the office of the *New Hampshire Patriot*, published at Concord, and at 15 became editor of the *Concord Gazette*. After editing papers at Portsmouth, N. H., and Haverhill, Mass., he removed to Boston, where he established a new Democratic paper known as the *Boston Statesman*, and published semi-weekly, its first appearance being on 6 Feb. 1821. During the administration of J. Q. Adams it was opposed to the almost unanimous sentiment of the city and State; but in 1829, when the general government passed into the hands of the Democratic party, President Jackson appointed Greene postmaster of Boston. He held the office for 12 years without interruption, and, although removed in 1841, was reappointed to it by President Tyler in 1844, and held it until 1849. In 1836 he translated a 'History of Italy' from the Italian of Sforzozi, which was followed by the translation of two volumes of 'Tales from the German' (1837). In 1843 he published 'Tales and Sketches from the French, German, and Italian.'

Greene, Robert, English writer: b. Norwich, 1558?; d. London, 3 Sept. 1592. Though little is known of his early life, Robert Greene was probably born in 1558; his father may have been a saddler. The greater part of his career is conjectured from his more or less autobiographical novels and pamphlets. He entered Saint John's College, Cambridge, in 1575, and took his B.A. in 1578. Already in his college years, perhaps earlier, he had entered heartily into the dissipation for which he was notorious, though perhaps his own record of himself and that left by his enemy Gabriel Harvey, may both be exaggerated. Upon leaving college he seems to have traveled extensively abroad, learning, from his own account, far more evil than good. Shortly after his return to England he heard a sermon in Saint Andrew's Church, Norwich, which strongly moved him to repentance, but he soon recovered his usual recklessness. The incident, however true, is characteristic of him; his excesses alternated with highly emotional confessions of penitence, which were probably quite sincere. The original fineness of his spirit was little harmed by his wild courses: his writing throughout is remarkably pure-minded. In 1580 'Mamilia,' his first novel, was registered; it was published three years later. It seems that he was then studying medicine at Cambridge, where he took his M.A. in 1583. Within two years afterward he married a woman of good family. After their one child was born, Greene deserted her, and gave himself up to a wild life in London. It has been pointed out that the character of the patient, deserted wife recurs through his writings, as though the woman he had wronged was always in his mind.

Greene's first occupation in London was the writing of prose romances, varying between the type of Sidney's 'Arcadia' and Lyly's 'Euphues.' His success in this kind of writing was immediate. He had a better narrative faculty than either Sidney or Lyly, and in addition to an unusual facility in composition he had something of the journalist's skill in finding the interest of the moment. Before 1590 he had written 'Penelope's Web,' 'Euphues, his Censure to Philautus,' 'Alcida,' 'Greene's Metamorphosis,' 'Perimedes the Blacksmith,' 'Orpharion,' 'Pandosto,' 'The Spanish Masquerado,' 'Menaphon,' and 'Tullies Love.' He had also made many good friends. Nash he had known before; now he met Lodge and probably Marlowe. But at the same time he was living a strangely profligate life, among thieves and outcasts, his special comrade being their chief, Ball, who ended his career at Tyburn. Ball's sister was Greene's mistress, the mother of his son Fortunatus.

In 1590 appeared 'The Cobbler of Canterbury,' a collection of six coarse tales, ascribed to Greene. Greene repudiated the book in a pamphlet, 'Greene's Apology,' announcing his intention to write no more such romances as might make him seem the likely author of 'The Cobbler.' As further expressions of this characteristic repentant mood appeared in the same year his 'Mourning Garment' and 'Never Too Late,' and in 1591 'Farewell to Follie.' Within the next year he wrote his five pamphlets on «cosenage» or «coney-catching»—descriptions of the lives and methods of thieves and cutpurses; for his material he drew on his own experience and observation, and the pamphlets present pictures of astonishing realism. His old companions whom he had now turned on, are said to have tried to kill him.

In a satire on the social evils of the times, 'A Quip for an Upstart Courtier' (1592), Greene took occasion to insult Gabriel Harvey and his two brothers, one of whom, Richard, in a pamphlet on the Martin Marprelate Controversy had spoken harshly of Greene and his friends. The wrath of the Harveys was turned upon Greene, and pursued him even after his death, in Gabriel Harvey's 'Four Letters and Certain Sonnets especially touching Robert Greene'—a cruel account of Greene and of his last hours.

The first play of Greene's, according to the most recent scholarship, was 'Alphonsus,' about 1591, an imitation of Marlowe's 'Tamburlaine'; the second was probably the 'Looking Glass for London and England,' in which some of the material of the «coney-catching» pamphlets is reflected. Before 1592 he had written the 'Orlando Furioso,' 'Friar Bacon and Friar Bungay,' and 'James IV. of Scotland,' probably in that order.

At the end of the year 1592 Greene fell ill, and with death at hand, his better nature reasserted itself. On his deathbed he wrote or completed his 'Groatsworth of Wit Bought with a Million of Repentance,' and 'The Repentance of Robert Greene,' which were published shortly after his death. His affecting letter to his wife, whom he now remembered; the pathetic squalor of his death scene in the shoemaker's house; his ironical request to be crowned with bays—complete one of the romances of literary biography.

Greene is an important figure in the history of the English novel, drama, and lyric. His amorous romances are in the Euphuistic style, and their subject-matter is Arcadian; but Greene's vital interest in life at first hand and his humor tend to humanize the artificial manner, and to bring the content of the stories out of the pastoral glamour into a natural world. The pastoral habit of beauty is perilously near shipwreck in the passage in 'Menaphon' where the shepherd and his jealous mistress, Pesana, begin to quarrel with true rustic energy and frankness; and the same genius for realism found its opportunity in the later «coney-catching» pamphlets, which, though formless, practically have the interest of the picaresque tale. The delicacy of his feminine characters, however, proves Greene's sympathy with the courtly world of beauty that his realistic power helped to supplant.

Greene's dramatic work, with the exception of 'Friar Bacon and Friar Bungay' and 'James IV. of Scotland,' is unimportant, but in the first of these better known plays he is clearly a forerunner of Shakespeare; as in the romances, he represents a transition, from the serious drama, religious or heroic, to a realistic mingling of moods and themes; and his country folk belong to England, not to Arcadia.

His real fame rests on the lyrics in the romances. These songs, like those in the 'Arcadia,' all highly wrought, are quite without Sidney's pedantry; they are at times stately, as in «Doron's Description of Samela,» or pathetic, as in «Sephestia's song to her child,» or metrically ingenious, as in Menaphon's song, «Some say love»; but they all have a certain silvery music, a tone of dignity without heaviness, which in its peculiar quality is found only in Greene. Lodge's lyrics are the only examples that can be compared with his. In 'Rosalind' the famous «Love in my bosom like a bee» is perhaps smoother than anything in Greene; and «Rosalind's Description» is the best example of Lodge's rich, pictorial coloring. But Lodge's art, though finer, is less directly human than Greene, whose lyrics, like the account of his career, stir one with a sense of the actual man.

Bibliography.—The best complete edition is that by Grosart, 'The Huth Library'; the best edition of the plays and poems is that by Churton Collins. For biography and criticism, consult 'Introductions' to above.

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Greene, Samuel Dana, American naval commander: b. Cumberland, Md., 11 Feb. 1840; d. Portsmouth, N. H., 11 Dec. 1884. Graduated at the Naval Academy in 1859, he volunteered in January, 1862, to serve as executive officer of the Monitor, whose capabilities were then untested, and during the engagement of the Monitor with the Confederate ram Merrimac, in Hampton Roads, he commanded the vessel on account of an accident to Captain Worden, his superior. After the war he was a professor at the Naval Academy for 10 years.

Greene, Sarah Pratt McLean, American novelist: b. Simsbury, Conn., July 1856. She was educated at South Hadley Seminary and for several years taught school in Plymouth, Mass. In 1887 she was married to F. L. Greene. She has published 'Cape Cod Folks'; 'Towhead, the Story of a Girl' (1884); 'Lastchance Junction' (1889); 'Leon Pontifex' (1897); 'The Moral Imbeciles' (1898); 'Vesty of the Basins' (1900); 'Flood Tide' (1901); 'Winslow Plain' (1902); etc.

Greenfield, Ind., city, county-seat of Hancock County, on the Pittsburg, C., C. & St. L. R.R., 20 miles east of Indianapolis. It has foundries, machine shops, and manufactures of glass, paper, stoves, etc. It is the birthplace of James Whitcomb Riley (q.v.). Pop. (1900) 4,489.

Greenfield, Mass., town, county-seat of Franklin County; on the Connecticut River, the Boston & M. R.R.; about 34 miles north of Springfield. Greenfield was once a part of Deerfield; but in 1738 it petitioned for a separation which was not granted until 1743. Greenfield and vicinity has many famous historic associations. The massacre of Deerfield occurred in the winter of 1704, and a monument marks the place where an Indian struck down Eunice Williams, the wife of the parson, John Williams, on 1 March, 1704. The chief manufactures are machinery, cutlery, shoes, paper, boxes, wooden-ware, bricks, toys, children's carriages. Pop. (1900) 7,927.

Greenfinch, or **Greenlinnet,** one of the most common and beautiful of European finches (*Ligurinus chloris*). The general color of the male is olive-green; primaries grayish-black, with bright yellow edges; under parts yellow; female brownish. Although its song is uninteresting it is a favorite cage-bird in Germany. In Texas a greenish towhee bunting (q.v.) is locally called «greenfinch.»

Greenhouse, any glass-roofed house used for plant growing. The term excludes cold frames and hot-beds, but in America includes many structures known in Europe by special names, such as stove-houses, graperies, conservatories, etc. Greenhouses may be divided according to the temperature maintained in them; for example, cool-house, used for such plants as violets, pansies, daisies, etc.; conservatory, used for plants displayed but not propagated or forwarded in growth; the forcing house in which plants are rapidly pushed to marketable condition; the warm-house, used for tropical and heat-loving plants. Then there are houses designed for special crops and known as rose-, carnation-, palm-, orchid-, asparagus-houses, etc.

Since the beginning of the 19th century, and especially during the latter half, improvements in greenhouse construction, heating, ventilation, and management have made remarkable progress. In place of the heavy shade-casting roof of large wooden rafters and small panes is the large-paned, small iron-raftered roof; steam and hot water have supplanted the old flue systems; and the carefully pitched roof which favors the entrance of light in winter and not in summer, has replaced the roof of scarcely considered slant. Much attention is also given to location, some points considered being exposure to the sun, shelter from prevailing winter winds, adequate water supply, proximity to market, etc.

An idea of the importance of greenhouses may be gained from the knowledge that during the first quarter of the 19th century there were almost no greenhouses except the few cumbersome ones upon some private places, and that in 1899 there were about 9,000 commercial florists' establishments averaging about 2,500 square feet, valued at 50 cents a square foot, and a producing capacity of $1.00 a square foot — totals of $11,250,000 and $22,500,000, respectively. Besides these are hundreds of private establishments, many of which would have been considered very extensive as commercial houses 75 or even 50 years ago.

Consult: Taft, 'Greenhouse Construction' (New York 1893); Leuchars, 'Hot-Houses' (1850); Hunt, 'How to Grow Cut Flowers' (Terre Haute, Ind., 1893); Taft, 'Greenhouse Management' (New York 1898); Scott, 'Florists' Manual' (Chicago 1899); Bailey, 'Forcing Book' (New York 1897); id., 'Cyclopedia of American Horticulture' (New York 1900–02).

Greenhouse Insects. Plants cultivated under glass are as subject to insect depredations as are those growing in the garden and orchard, unless the greatest care is exercised. In addition to many species of foreign origin, such as numerous kinds of scale-insects (q.v.) and aphides which are constantly being imported with exotic plants, we have native insects firmly established as indoor pests. One of the commonest and most destructive is the black scale (*Lecanium oleæ*), which is also a pest of importance in groves of citrus fruits and olives. The related hemispherical scale (*Lecanium hemisphæricum*) is still more distinctively a greenhouse pest; and several injurious orchard scales and mealy bugs (q.v.) are likely at any time to become so, but all may be controlled by fumigation with hydrocyanic-acid gas. The "white fly" (q.v.), which name, as used by florists, covers a number of species of *Aleyrodes*, is to be similarly treated.

Many plants grown artificially are attacked also by omnivorous greenhouse pests, such as the red spider (*Tetranychus bimaculatus*) and the greenhouse leaf-tyer, and by general field and garden pests such as cutworms, wireworms, and white grubs (qq.v.). The greenhouse leaf-tyer (*Phlyctænia ferrugalis*) is less affected by fumigation than most insects, and, with other caterpillars, can be successfully controlled only by hand picking, clipping off and destroying the affected leaves, and by spraying with arsenical mixtures.

Roses are peculiarly subject to insect injury, and there are several specific indoor rose pests, such as Fuller's rose beetle (*Aramigus fulleri*), which also attacks azaleas, begonias, lilies, primrose, geranium, canna, and others. It appears to be nearly immune to insecticides in the adult condition; one must, therefore, employ hand methods, collecting and destroying the beetles, preferably in November and December, when they congregate on various plants. Injured plants should be pulled out, and the larvæ about them destroyed with kerosene emulsion or bisulphid of carbon. Numerous leaf-rollers, bud-worms, and leaf-tyers (qq.v.) are very injurious to the rose, by eating into the buds just before blossoming. Roses are seriously injured at times by gall-flies and by the rose-scale (*Aulacaspis rosæ*), and other scale insects. Violets cultivated under glass are much injured by insect pests, principally by the black or brown aphis (*Rhopalosiphum violæ*), violet gall-fly (*Diplosis violicola*), violet saw-fly (*Emphytus canadensis*), and the red spider, and greenhouse leaf-tyer. The black aphis is still restricted and dependent on commerce for carriage from one greenhouse to another, but has caused losses of thousands of dollars to single firms. It may be controlled by fumigation with hydrocyanic-acid gas, which also destroys the saw-fly and the gall-fly (properly a gall-gnat, q.v.), which attacks the leaves while they are young, the larva or maggot developing in folds, incorrectly termed "galls." Tobacco preparations and buhach insect-powder are also useful against these minute pests.

Green'land, an extensive island belonging to Denmark; on the northeast of the continent of North America, from which it is separated by Davis Strait, Baffin Bay, and Smith Sound; area 46,740 square miles. A great part of its north and precipitous east coast is yet unknown; but it does not extend farther than about lat. 83° N. Like the northern parts of North America generally, Greenland is colder than the corresponding latitudes on the eastern side of the Atlantic. In June and July the sun is constantly above the horizon, the ice on the coast is broken up and a few small lakes are opened; but the short summer is followed by a long and dreary winter. The interior, which is lofty, is uninhabitable, and all the villages are confined to the coasts, which are lined with numerous islands and deeply penetrated by fiords. The Danish colony extends to the Bay of Disco, in lat. 69° N. Cultivation is confined to the low shores and valleys, where grassy meadows sometimes occur with stunted shrubs and dwarfed birch, alder, and pine trees. Attempts to raise oats and barley have failed, but potatoes and turnips attain the size of a pigeon's egg, and cabbages grow very small. The radish is the only vegetable which grows unchecked.

The inhabitants of Greenland (see ESKIMOS) are of the Eskimo race, more or less mixed with European blood. The individuals of the mixed race hardly differ as to language and habits from the genuine Eskimo. Besides the natives, about 250 Europeans usually reside in the country, 30 to 40 of whom have married native women. The inhabitants are largely dependent on hunting and fishing. Whale blubber and seal oil

1. Blue Passion-flower (P. cœrulea). 2. Pomegranate, with opened fruit and flower. 3. An Orchid (Cattleya). 4. Abutilon (A. insigne). 5. Monkshood (Tropælium). 6. Anthurium (A. scherzerianum). 7. Begonia (B. bolivensis). 8. Pitcairnia (P. furfuracea). 9. Ladies' Slipper (Cypripedium venustum).

are used as fuel. The land animals are the Eskimo dog, the reindeer, the polar bear, the Arctic fox (blue and white), the ermine, the Arctic hare, and the musk ox. Among the amphibia the walrus and several species of seal are common. The seas abound in fish, the whale and cod fisheries being of special importance. Seafowl are abundant in summer, and largely killed. The chief mineral product is cryolite, but graphite and miocene lignitic coal are also found. Oil, eider down, furs, and cryolite are exported. For administrative purposes Greenland, or rather its coast, is divided into two inspectorates of North and South Greenland. The residences of the inspectors are at Disco Island and Godhaab, but the most populous district is Julianehaab.

Greenland was discovered by an Icelander named Gunnbjörn about 876 or 877, and was colonized from Iceland about the end of the 10th century. In the reign of Elizabeth Frobisher and Davis rediscovered the coast, but nothing was done to explore it till the Danish government in 1721 assisted Hans Egede, a clergyman, to establish a European mission settlement, Good Hope (Godhaab), which was successfully carried on by him and his son. Whale fisheries were established on the coast by the English and Dutch about 100. The interior of the country was first crossed by Nansen in 1888. There are 12 chief stations for trading and the Danish Mission; the southernmost is Julianthaab, the northernmost Upernavik. At Godhaab there is a seminary for training native catechists; of late, too, natives have been appointed pastors. Pop. (1901) 67,681.

Greenland Whale, or **Bowhead**, the largest and most restricted of the "right" or whalebone whales of the genus *Balæna* (*B. mysticetus*), which is absolutely confined to the arctic region, reports of its occurrence on other coasts originating in mistaking for it the almost cosmopolitan southern right whale. It grows occasionally to a length of 70 feet, but is usually considerably less; and is black, except a white patch on the under side of the jaw. This whale may yield 275 barrels of oil, and 3,000 pounds of whalebone. It has become comparatively rare through constant pursuit. Its general habits agree with those of its family (*Balænidæ*), for which see WHALEBONE WHALES.

Greenleaf, Simon, American jurist: b. Newburyport, Mass., 5 Dec. 1783; d. Cambridge, Mass., 6 Oct. 1853. He commenced the practice of law in 1806 at Standish, afterward practising at Gray and Portland. He was a reporter of the Supreme Court 1820–32; professor of law at Harvard University 1833–48, succeeding Judge Story in the Dean professorship in 1846; and upon his resignation in 1848 was made professor emeritus. Beside nine volumes of reports of the Maine Supreme Court proceedings he published: 'Treatise on the Law of Evidence' (1842–53); 'Principles of Freemasonry' (1820); 'Examination of the Testimony of the Four Evangelists by the Rules of Evidence, as administered in Courts of Justice, with an Account of the Trial of Jesus' (1846). He also edited Cruise's 'Digest of the Laws of England respecting Real Property' (1849).

Greenlings, a family (*Hexagrammidæ*) of coast-fishes allied to the rose-fishes, many species of which occur abundantly from northern California to Bering Sea, including several excellent and of local importance as food-fishes. They are brilliant in color, yellow and green being prominent; are carnivorous; and seek their food among keip and about rocks.

Greenock, grĕn'ŏk, Scotland, in Renfrewshire, on the south shore of the Firth of Clyde, 22½ miles by rail west-northwest of Glasgow. The Watt Institution contains a marble statue of Watt by Chantrey. The harbor works date from 1707, and have cost upward of $7,500,000. Ship-building has been carried on since 1760; sugar refining began in 1765, and there are also manufactures of steam-engines, anchors and chain cables, ropes, sailcloth, paper, wool and worsted, etc. Besides being the birthplace of James Watt (q.v.), famous because of his work on steam-engines, of Spence the mathematician, and of Principal Caird, it has memories of Rob Roy, John Wilson, and Galt, and contains the grave of Burns' "Highland Mary." Pop. (1901) 67,645.

Gree'nockite, or **Cadmium Blende**, a native sulphid of cadmium, having the formula CdS, and crystallizing in hemimorphic forms belonging to the hexagonal sytem. It is transparent, or nearly so, and yellow, with a vitreous or resinous lustre. It turns carmine when heated in a closed tube, returning to its original color upon cooling; and it dissolves in hydrochloric acid, with liberation of sulphuretted hydrogen. Greenockite is brittle, and has a hardness of from 3 to 3.5, and a specific gravity of about 5.0. In the United States it is found in Marion County, Ark., in the zinc-bearing districts of southwestern Missouri, and in a zinc mine in Lehigh County, Pa.

Greenough, grēn'ō, **Horatio**, American sculptor: b. Boston 6 Sept. 1805; d. Somerville, Mass., 18 Dec. 1852. When he entered Harvard at 16 he had already modeled in clay and attempted sculpture. A French sculptor named Binon, resident in Boston, was his first master. During his college career he enjoyed the friendship and advice of Washington Allston, and produced the design from which the present Bunker Hill monument was erected. He was graduated in 1825, and went to Rome with letters to Thorwaldsen. He returned to Boston in 1826, and after modeling busts of John Quincy Adams, Chief Justice Marshall, and others, again went to Italy and established his studio in Florence. His first commission was from James Fenimore Cooper, for whom he executed his 'Chanting Cherubs,' suggested by a portion of one of Raphael's pictures. This was the first original group from the chisel of an American sculptor. To Cooper, also, he was indebted for the commission from Congress to execute his colossal statue of Washington, finished in 1843, after many years' labor, and now in the national capital. During this time he executed, among other original works, the 'Medora,' the 'Angel Abdiel,' and the 'Venus Victrix' (Gallery of the Boston Athenæum). In 1851 he returned to the United States to superintend placing in its destination in Washington his group of the 'Rescue,' in which the triumph of civilization is symbolized. Many vexatious delays prevented the arrival of the work from Italy, and Greenough, unaccustomed by long absence to the turmoil of American life, and the variations of the American climate, was attacked by brain fever, soon after he had commenced, in Boston, a course of lectures on art. He published a volume of 'Essays' on art topics. Consult: Tuckerman, 'Memorial of Horatio Greenough' (1853).

Greenough, James Bradstreet, American Latin scholar: b. Portland, Me., 1833; d. Cambridge, Mass., 11 Oct. 1901. He was graduated from Harvard College in 185[illegible], for some time practised law in Michigan, in 1865 was appointed tutor in Latin at Harvard, in 1874 assistant professor of Latin, and in 1883 professor. In 1872 he began at Harvard a course in Sanskrit and comparative philology, and until 1880, when a chair of Sanskrit was founded, gave instruction in those subjects. He became widely known through a series of Latin text-books, particularly a 'Latin Grammar,' prepared in collaboration with J. H. Allen; and wrote also a 'Special Vocabulary to Virgil' verse in both Latin and English, and, with G. L. Kittredge, 'Words and Their Ways in English Speech' (1901).

Greenough, Richard Saltonstall, American sculptor: b. Jamaica Plain, Mass., 27 April 1819; d. Rome, Italy, 23 April 1904. Among works by him are the notably fine bronze statue of Franklin in front of the City Hall, Boston; the marble statue of Governor Winthrop at Mount Auburn cemetery, Cambridge; 'The Shepherd Boy and the Eagle' at the Boston Athenæum.

Greenough, Sarah Dana Loring, American author: b. Boston 19 Feb. 1827; d. Franzensbad, Austria, 9 Aug. 1885. She was the wife of R. S. Greenough (q.v.). Her works include: 'Treason at Home,' a novel (1865); 'Arabesques' (1871); 'In Extremis, a Story of a Broken Law' (1872); and 'Mary Magdalen,' a poem (1880).

Greenport, N. Y., village of Suffolk County, on the eastern end of Long Island, on the Long Island R.R.; 90 miles east of Brooklyn. It has an excellent harbor and shipyards, and the chief industries are fishing and shipbuilding. It is also a popular summer resort. Pop. (1900) 2,366.

Greens, Pot-herbs. Any plant whose foliage and succulent stems are prepared for the table by boiling. The former term is less applied to the plants themselves than to the dish prepared from them; the latter is often applied to the living plants, but rarely to the culinary preparation. Greens are eminently a spring dish; by proper management they may be obtained long before spring-sown vegetables grown from seed planted out of doors, thus arriving at a time when the appetite is jaded with the usual winter vegetables. Comparatively few (for example, basella and New Zealand spinach) are useful during the hot summer months, but then other vegetables and many fruits take their place. Some (for example, mustard, witloof) are obtainable in the autumn, and a few (kale, endive) even during winter.

In general these plants should all be grown upon rich, moist, well-drained, friable, loamy soil, since upon such they grow quickly, to a large size, and remain succulent and edible longer than upon poorer or drier soils. A soil containing abundant available nitrogenous plant food is particularly desirable. The ground should be thoroughly prepared by deep plowing or digging and the surface made as fine as possible by harrowing or raking. For earliest crops of such hardy plants as spinach and corn salad, the seed may be sown in autumn, and, where the winters are severe, and especially if snowless, protected with a mulch of marsh hay or other material free from weed seeds. They may also be sown as early in the spring as the ground can be worked. Tender plants such as basella, and those that require a high temperature for the germination of their seeds, for instance, purslane, should be sown only after the ground becomes warm. Beyond keeping the surface of the soil loose and free from weeds, the crops need practically no further care. To be best appreciated, greens should be gathered while very succulent and within as few minutes of meal time as are possible to wash and cook them. Since most of them occupy the ground for only a few weeks in earliest spring, they are usually planted by market gardeners between the rows of other slower growing crops or as precursors to the main crop.

Besides the cultivated pot-herbs (in America a rather small list), there are several scores of plants known mostly widely as weeds. Several of these are superior in some ways to the cultivated kinds. There is no reason why they should not be cultivated; indeed, they deserve cultivation. When to be grown in the garden, and when seed cannot be purchased, seed should be selected from those plants that most nearly meet the intending grower's ideal. Probably the best known and most frequently used weeds or wild plants are the following, several of which are more or less cultivated: Lamb's quarters or Goosefoot (*Chenopodium album*), Pigweed (*Amarantus*, various species), Pokeweed (*Phytolacca decandra*), Marsh marigold, "Cowslip Greens" (*Caltha palustris*), Mustard (*Brassica*, various species), Dock (*Rumex*, various species), Quinoa (*Chenopodium Quinoa*), Sorrel (*Oxalis*, various species), Purslane (*Portulacca oleracea*), Plantain (*Plantago*, various species), Chicory (*Cichorium Intybus*), Cress (*Cardamine, Spilanthes, Barbarea, Senebiera, Gynandropsis, Nasturtium* — various species in each genus), Peppergrass (*Lepidium*, various species), Mercury or markery (*Chenopodium Bonus-Henricus*), Nettle (*Urtica*, various species), Winter purslane (*Montia perfoliata*), Rocket salad (*Eruca sativa*), Salad-burnet (*Poterium Sanguisorba*).

Of the cultivated pot-herbs the following are probably the best known and the most widely cultivated: Spinach, corn salad, chard, borage, dandelion, collards, mustard, kale, orach, marigold, [illegible], chicory, endive, nasturtium, unheaded cabbage and cauliflower, young beets and turnips, whole or only the leaves, and rape are frequently used also.

Green'sand, in geology, the name given to two series of cretaceous formations, the Upper and Lower Greensand. The Upper Greensand is a subdivision of the Upper Cretaceous rocks, and is situated immediately below the chalk marl, and just above the gault. The beds of which it is composed have in them green particles of a mineral called glauconite. Among the fossils peculiar to it are various ammonites, two pteropods, two species of fusus, etc. Some are of opinion that the so-called Upper Greensand from which these fossils came is itself gault. The Lower Greensand is a series of beds constituting the Lower Cretaceous rocks and the lowest member of the cretaceous group. It is called in Europe Neocomian, a name adopted by Lyell, he considering the term greensand peculiarly inapplicable, as in the district where these strata were first observed sand of a green color was rather the exception.

Greens'boro, Ala., town, county-seat of Hale County; on a branch of the Southern R.R.; about 72 miles southwest of Birmingham. It was settled in 1816, and is in a cotton-growing section. The chief industries are the cultivation of cotton and corn. It is the seat of Greensboro Female Academy and of the Southern University. The latter was established by the Methodist Episcopal Church, South, and was opened in 1859. Pop. (1900) 2,416.

Greensboro, Ga., city, county-seat of Greene County; on the Georgia R.R.; 70 miles west of Augusta. It is the trade centre for a thriving agricultural region, and it has a large creamery, a cotton-mill, cotton-gin, and a cottonseed-oil mill. Pop. (1900) 1,511.

Greensboro, N. C., city, capital of Guilford County, on the Southern R.R.; 81 miles northwest of Raleigh; named in honor of Gen. Greene, who commanded the Continental army in the battle of Guilford Court House 15 March 1781. Here are the Greensboro Female College, Bennett School for Colored Youth, Guilford College, and the State Normal and Industrial College. Greensboro is the centre of a tobacco, fruit, and grain region, which has gold, copper, and iron mines, and contains a blast furnace for the manufacture of Bessemer steel; cotton-mills and other industries. The growth of the city has been marvelous and shows the rapid development of the New South. Pop. (1880) 2,105; (1890) 3,317; (1900) 10,035; (1903) 22,000.

Greensboro Female College, a non-sectarian educational institution for women in Greensboro, N. C.; founded in 1826 as the Edgeworth Female Seminary; reported at the close of 1900: Professors and instructors, 15; students, 250; volumes in the library, 7,000; income, $25,000; number of graduates, 692.

Greensburg, Ind., city, county-seat of Decatur County; on the Cleveland, C. C. and St. L. R.R.; about 55 miles northeast of Cincinnati. Nearby are large stone-quarries; it is surrounded by a good agricultural region, and is supplied with natural gas. Its chief manufactures are flour, furniture, farm implements, and carriages. Pop. (1900) 5,034.

Greensburg, Pa., borough, county-seat of Westmoreland County; on the Pennsylvania R.R.; 31 miles east-southeast of Pittsburg. It is in a coal-mining, coking and natural gas region; and contains a steam-heating apparatus factory, steel works glass works, nut and bolt works, and has three National banks. It is the seat of St. Joseph's Academy. In Hanna's Town, which was near the present Greensburg, was held (1773) the first regularly organized court of justice west of the Alleghany Mountains. Hanna's Town was destroyed by the Indians in 1782. Pop. (1900) 6,508.

Green'shank, a large species of sandpiper (*Totanus glottis*) breeding in the northern parts of the Old World, and migrating far southward. Several allied species of similar habits occur in America, of which the greater and lesser yellow-legs (q.v.) are familiar to gunners.

Greens'let, Ferris, American writer: b. Glens Falls, N. Y., 30 June 1875. He was educated at Wesleyan University and beside contributions to reviews has published 'Joseph Glanville: a Study in English Thought and Letters of the 17th Century' (1900).

Green'stick Fracture, the name given to a fracture of a bone when continuity is not entirely severed one portion of the bone remaining unbroken or bent. The leg and arm bones of children are particularly liable to this fracture.

Green'stone, formerly a granular rock, consisting of hornblende and imperfectly crystallized feldspar, the feldspar being more abundant than in basalt, and the grains or crystals of the two minerals more distinct from each other. It was called also dolorite. Sir Charles Lyell included under the term greenstone those rocks in which augite was substituted for hornblende, the "olorite" of some writers, and those in which albite replaced common feldspar. This was sometimes termed andesite. The term is now used the same as diorite, which is an essentially crystalline granular admixture of triclinic feldspar and hornblende. It is not now held to be the equivalent of dolorite. In geology, volcanic rock, occurring in dykes, tabular masses, etc.

Green'ville, Ala., city, county-seat of Butler County; on the Louisville & N. R.R.; about 77 miles northeast of Mobile. Its chief manufactures are lumber and furniture; it has a cotton-gin, and its trade consists principally in cotton and lumber. Pop. (1900) 3,162.

Greenville, Ill., city, county-seat of Bond County; on the Vandalia & T. H., and the Louisville J. & St. L. R.R.'s; about 42 miles east of Alton. It is the seat of Greenville College, under the auspices of the Free Methodist Church. The chief manufactures are flour, lumber, wagons, and carriages, bricks, and in addition to its manufactured articles, it has considerable trade in coal, from the coal-fields of the vicinity, and in the agricultural products of the surrounding country. Pop. (1900) 2,504.

Greenville, Mich., city, in Montcalm County, on the Flat River, the Toledo, S. & M. and the Pere M. R.R.'s; about 42 miles northeast of Grand Rapids. Its chief manufactures are lumber, flour, agricultural and lumbering implements, refrigerators and furniture. Its trade is in its own manufactured products and in the agricultural products of the surrounding country. Pop. (1900) 3,381.

Greenville, Miss., city, county-seat of Washington County; on the Mississippi River, the Southern and the Yazoo & M. V. R.R.'s; about 130 miles south of Memphis. It contains several cottonseed-oil-, saw-, and planing-mills, a national bank, and has steamboat connection with all important ports on the river, and a large cotton trade. Pop. (1900) 7,642.

Greenville, Ohio, city, county-seat of Darke County; on Greenville Creek, and the Cincinnati, J. & M. the Dayton & U., and the Pittsburg, C., C. & St. L. R.R.'s; 35 miles north of Dayton. It is noted as the site of Anthony Wayne's treaty with the Indians, 3 Aug. 1795.

In the early part of the 19th century Tecumseh (q.v.) lived here, in a little Indian village. It has a foundry, lumber mills, and machine shops, and is the trade centre for a large agricultural section. Pop. (1900) 5,501.

Greenville, Pa., borough, in Mercer County; on the Shenango River, the Erie, the Pennsylvania, and the Pittsburg, B. & L. E. R.R.'s; about 52 miles southeast of Erie. The Shenango furnishes an abundance of good water-power. The chief industrial interests are flour-mills, woolen-mills, saw- and planing-mills, foundries, machine-shops, railroad-shops, carriage and wagon works, tube-mills, machinery for oil-wells, and coal-mining. The coal and oil fields and the stone-quarries in the vicinity add to the industries of the town. The trade of the town is considerable, as it is the commercial centre of a large section of Mercer County and places nearby in Ohio. Greenville was formerly the seat of Thiel College, opened in 1870 under the auspices of the Lutheran Church. Pop. (1890) 3,674; (1900) 4,814.

Greenville, S. C., city, county-seat of Greenville County; on the South Carolina & G., the Southern, the Atlantic C. L. R.R.'s.; 153 miles northwest of Columbia. It is the seat of Furman University (Baptist), Greenville College for Women, Chicora Female College (Presbyterian), Greenville Female College (Baptist), a military institute, and a business college. It has cotton mills, carriage and wagon works, iron works, and flour mills. Pop. (1900) 11,860.

Greenville, Texas, city, county-seat of Hunt County; on the St. Louis Southwestern, the Texas Midland, and the Missouri, Kansas & Texas R.R.'s; about 235 miles north of Houston and 51 miles northeast of Dallas. Greenville was settled in 1844 and incorporated in 1875. It is situated in an agricultural and stock-raising section. The chief industrial interests are connected with cotton and live stock. It has cotton-compresses, cotton-seed-oil mills, flour mills, machine-shops, stock-yards, and brick-yards. It is the trade centre for a large extent of country and has a large cotton trade. It is the seat of Burleson College, under the auspices of the Baptist Church, and of Holiness College. Its executive officers are a mayor and a municipal council who hold office for two years. The electric-light plant is owned and operated by the city. Pop. (1890) 4,330; (1900) 6,860.

Greenville (Ohio), Treaty of, 3 Aug. 1795. A treaty between the United States and all the Northwestern Indian tribes; the former represented by Anthony Wayne, who had defeated the Indians in the campaign of 1794, especially at the battle of the Fallen Timbers (q.v.). A full delegation was present from every hostile tribe, the whole numbering 1,130. They surrendered to the whites all southern Ohio and southeastern Indiana, with lands around Fort Wayne, Fort Defiance, Detroit, Michilimackinac, and the French towns, and 150,000 acres near the Falls of the Ohio (Louisville) which had been allotted to George Rogers Clark and his soldiers. The United States acknowledged the Indian title to the remaining territory, and agreed to pay annuities of $9,500 in all to the tribes. All prisoners on both sides were restored. This peace secured quiet to the borders for 15 years. But the guaranty of the lands to the Indians enabled the British to use the latter to desolate the borders in the War of 1812; and after the war (see TREATY OF GHENT) Great Britain attempted to make this treaty boundary a permanent one, forbidding United States settlement beyond it. See GREENVILLE, O.

Greenway, Thomas, Canadian statesman: b. England, 1838. In 1844 he came with his father to Ontario. He took up land in Manitoba, and in 1887 became the Liberal leader and Prime Minister in the provincial government, when his party came into power in 1888. He has always studied the well-being and progress of his province; has attempted to abolish French as an official language, and to do away with the separate school system.

Greenweed. See DYEWEED.

Greenwich, grĕn'wich, Conn., town, in Fairfield County, on Long Island Sound, the New York, N. H. & H. R.R., about 28 miles northeast of New York. The town was founded in 1640 as a part of the province of New York and remained within the jurisdiction of the Dutch colony from 1642 to 1650, when, by agreement between the English and Dutch, it became a part of Connecticut. In order to preserve the charm of its country life, it has retained the old form of town meeting government, with three selectmen as agents, as it was over 250 years ago, except in the central part of the town, where a borough government, a warden and six burgesses, has charge of affairs. There are five residential centres within its area of 50 square miles; namely, Byram Shore, Belle Haven, Greenwich village, Riverside, and Sound Beach. It is the seat of Greenwich Academy, Brunswick School, and Rosemary Hall. Pop. (1900) 12,172. Consult: Mead, 'History of the Town of Greenwich.'

Greenwich, grĭn'ĭj, England, metropolitan borough of London, in Kent, five miles from St. Paul's Cathedral and six miles southeast of London Bridge. It has many noted institutions, one of which is the Greenwich Royal Observatory, founded in 1675 by Charles II.; its first astronomer-royal was Flamsteed. Geographers of all countries reckon longitude from the meridian of Greenwich, although the local geography of many countries may be reckoned from their respective capitals. Greenwich Hospital, founded by Queen Mary, for disabled seamen "who protected the public safety in the reign of William and Mary, 1694," is located on the site of the palace where Henry VIII and his daughters Mary and Elizabeth were born, and where Edward VI. died. The hospital consists of four distinct buildings, one of which was designed by Inigo Jones (q.v.), and the other three by Sir Christopher Wren (q.v.). James Stuart made the designs for the restored portion of the chapel; and the statue of George II., in the central square, is by Rysbrack. In 1873 Greenwich Hospital became the college for the Royal Navy. The Royal Hospital School, for boys who may enter the navy, and the Blue-Coat School, are liberally endowed. Pop. (1901) 95,120.

Greenwood, Grace. See LIPPINCOTT, SARAH JANE (CLARKE).

Greenwood Cemetery, N. Y., the principal burial place of New York and neighborhood, in South Brooklyn, near Gowanus Bay; area 475 acres. It occupies a picturesque site, and is laid out so handsomely as to make it almost without a rival in the world. From its heights the waters of New York Bay may be seen on the one hand, and the broad expanse of the Atlantic on the other. There are 20 miles of roadway and more than 25 miles of footpaths. Many distinguished men and women are buried here. The main gateway is adorned with four magnificent sculptures in *alto relievo*, representing four scenes in the resurrection. The number of interments up to 1901 exceeded 300,000.

Greer, David Hummell, American clergyman: b. Wheeling, W. Va., 20 March 1844. He was graduated from Washington College, Washington, Pa., in 1862, and studied theology in the Episcopal Seminary at Gambier, O. From Brown University and Kenyon College he received the titles of Doctor of Divinity and Doctor of Laws. His first ministry was at Covington, Ky.; from there he was transferred to Clarksburg, W. Va., and in 1871 he was called to Grace Church, Providence, R. I. In 1885, Dr. Greer became rector of St. Bartholomew's Parish, the most fashionable and richest of New York Episcopal parishes. In 1890 he established the St. Bartholomew's Parish House, at 42d street and 3d avenue, at a cost of $400,000, built largely through the liberality of Cornelius Vanderbilt. This parish house embraces a wide field of charitable, missionary and educational work.

In 1903 Dr. Greer was elected coadjutor to Bishop Potter of the New York Episcopal diocese. He had previously declined three bishoprics, that of coadjutor-bishop of Rhode Island, bishop of Pennsylvania, and bishop of Massachusetts to succeed Phillips Brooks.

Greer, James Augustin, American rear-admiral: b. Cincinnati, O., 28 Feb. 1833; d. Washington, D. C., 17 June 1904. Entering the navy in 1848, he was promoted lieutenant in 1855, and was on board the San Jacinto when that vessel intercepted the English steamer Trent, on which were Mason and Slidell, the Confederate commissioners. He commanded the ironclad Benton in the fleet that passed the Vicksburg batteries; and in 1873 was in command of the Tigress in its search of the polar seas for the Polaris. He became rear-admiral in 1892 and was retired in 1895.

Greey, grē, **Edward,** American writer: b. Sandwich, Kent, England, 1 Dec. 1835; d. New York 1 Oct. 1888. After spending several years in Japan, he came to the United States in 1868, became a citizen, and engaged in commercial pursuits in New York. He published 'Young Americans in Japan' (1881); 'The Wonderful City of Tokio'; 'The Golden Lotus' (1883); 'The Captive of Love,' founded on a Japanese romance; 'The Loyal Ronins,' a translation from the Japanese, etc.

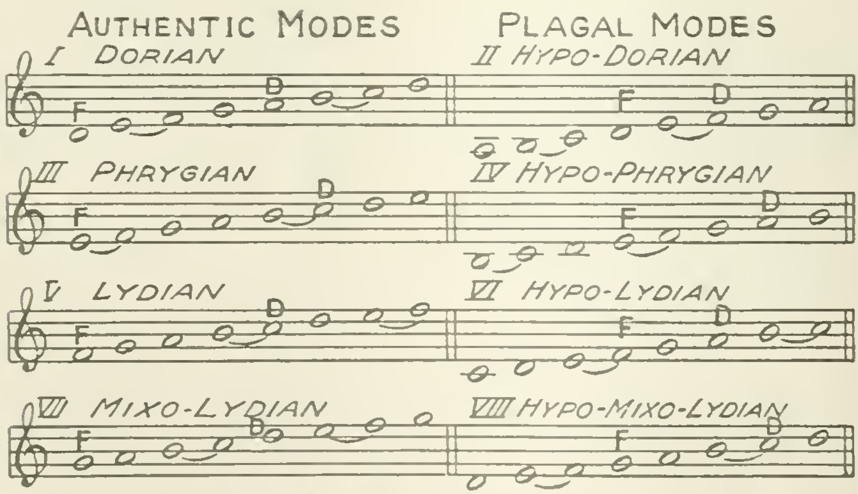
Greg'arine, a parasitic sporozoan (see SPOROZOA) dwelling in the intestines of many insects, crawfishes, and other arthropods.

Gregg, David, American Presbyterian clergyman: b. Pittsburg, Pa., 25 March 1846. He was graduated at Washington and Jefferson College in 1865. He has been pastor in several places, and since 1889 has preached in Lafayette Avenue Presbyterian Church, Brooklyn, N. Y. He is editor of 'Our Banner,' and among his many published volumes may be mentioned: 'Makers of the American Republic' (1896); 'Ideal Young Men and Women' (1897); 'Facts that Call for Faith' (1898); 'Things of Northfield and Other Things' (1899).

Grégoire, Henri, ŏṅ-rē grä-gwär, COUNT, French churchman and statesman: b. 4 Dec. 1750; d. Paris 28 May 1831. In 1789, while curé of Emberménil, in the district of Nancy, he was sent by the clergy of Lorraine as their representative to the States-General. As one of the secretaries of the constituent assembly he joined the extreme democratic section, and in the convention voted for the condemnation, though not for the death, of the king. Although extreme in his democratic opinions, he was an unflinching Jansenist. He was a member of the Council of Five Hundred, of the corps législatif, and of the senate (1801). On the conclusion of the concordat he resigned his bishopric of Blois. He voted against the establishment of the imperial government, and alone in the senate resisted the restoration of titles of nobility. He himself afterward accepted the title of count, but in the senate always opposed Napoleon, and in 1814 was one of the first to vote for his deposition. He left numerous works, among them 'Ruines de Port Royal' (1801); 'Essai Historique sur les Libertés de l'Eglise Gallicane'; 'Historie des Sectes Religieuses depuis le Commencement de ce Siècle'; 'Annales de la Religion' (1795–1803).

Gregorian Chant (Latin, *cantus gregorianus, cantus planus, cantus firmus;* Italian *canto fermo;* French, *chant gregorien, plain-chant;* German, *gregorianischer Choral*) is as old as the Church itself. As an integral part of the liturgy, music has its origin in the celebration of the Last Supper. According to the evangelists, Matthew and Mark, after the consecration and breaking of bread, our Lord and the apostles *sang* a hymn, which is commonly accepted to have been the "Great Hallel" of the Jewish passover celebration, that is, the Psalms, cxii.–cxvii. (Douai version), inclusive. The first Christian communities of Jerusalem in Palestine and Antioch in Syria were founded by newly converted Jews. Consequently it is more than probable that, although the converts from paganism were soon in the majority, melodies in use in the temple and in the synagogues continued to be sung at their religious meetings. This hypothesis is all the more reasonable because the recruits from paganism could offer nothing either in the way of poetry or music which would have been acceptable to the new cult. As to how the chant came to Rome and concerning its early development, archæology has so far been unable to ascertain any definite information. Conjecture and probability are the most we have to go by. Without doubt Greek music, which was known to the Romans, as was every other form of Hellenic culture, had its influence on the formation of the Christian worship music. It is certain also that there was a constant development and that singing played an ever greater role in the early liturgy. There were hardly any religious functions of which the singing of psalms, responsories and hymns did not form a part. From the fruitful soil of the early Church sprang with great exuberance a new hymnology, which in turn, as its logical complement, was translated into melodies. Many of the latter were spontaneous improvisations, the children of ardent hearts and imaginations illumined by the New Light. At first the whole religious community participated in the singing, but as the liturgy became more elaborate and the assemblies more numerous, this participation on the part of all the faithful had to be restricted to certain portions of the service. Other, more particular parts were performed by the Primicerius, Præcentor or Monitor, who also had general charge of the singing and whose office it was to see that the faithful were well prepared for their allotted task. After emerging from the catacombs at the beginning of the 4th century the Church displayed its ever-growing vitality in the unfolding of her liturgy and the increasing splendor of her cult. At this period the chants used must have been numerous and varied. Popes and bishops fostered the liturgical music in every manner. Pope Sylvester (314) and Hilarius (461) founded schools for its cultivation. Saint Ambrose, Archbishop of Milan (367), took a step which was of greater importance than anything which had been done up to that time. He gave system and order to the melodies and chants in use in his archdiocese by giving them a theoretic basis. This he accomplished by adopting four modes or scales, each one of which had as its initial one of the four notes of the Tetrachord (sequence of four notes), D, E, F, G. The four modes adopted by Saint Ambrose were consequently: (*a*) (Dorian) D, E,F, G, a, b,c, d; (*b*) (Phrygian) E,F, G, a, b,c, d, e; (*c*) (Lydian) F, G, a, b,c, d, e,f; (*d*) (Mixo-Lydian), G, a, b,c, d, e,f, g. All the melodies and chants used had some one of these modes for their foundation. Saint Ambrose originated the custom of singing hymns and psalms antiphonally.

When 200 years later, Gregory the Great, the man who gave the music of the Church its permanent character and from whom it is named, ascended the papal throne, the number of feasts and consequently of liturgical chants had increased to such an extent that the four modes fixed by Ambrose were no longer sufficient. Many of the new melodies did not belong to any one of the scales enumerated above. They had grown beyond the original frame. As Gregory partly reformed and, at least in outline, gave shape to the ecclesiastical year as we now know it, he was compelled also to rearrange existing chants, reject inferior ones, adapt old ones to new texts and add new ones of his own creation. In order to carry out this vast plan he found it necessary to enlarge the tonal system then in use. He retained the four Ambrosian modes, which were henceforth designated as the *authentic* modes, and added thereto four more which he called *plagal*. Gregory formed the new modes by transposing the last four notes of the existing — authentic — scales an octave lower, so that each plagal mode began a fourth below the *authentic* from which it sprang. Thus the tonal system as completed by Saint Gregory was as follows:



[N. B. — The letters F and D in the above diagram stand respectively for *final* and *dominant*. The *final* is the tone on which a melody finds repose, or a satisfactory ending. As will be observed, the *final* for any given authentic mode and its derived plagal are identical. The *dominant* is that tone which occurs oftenest or predominates in any melody.]

Four more modes were added to these in later centuries, but they are not different in essence from the eight named above. By means of various signs — dots, strokes, bars or hooks, collectively called neums — all of which had a conventional meaning, and which were placed over and alongside the words of the texts, Saint Gregory indicated the melodies to which these texts were to be sung. The book containing the chants for the numerous offices was called "Antiphonarium centonum." It was deposited near the altar of St. Peter so as to convey that the pontiff wished it to be considered as the norm for the whole Christian world.

In order to gain an insight into and an appreciation of the nature and character of the Gregorian melodies, it will be well to examine a little more closely the tonal material out of which they are constructed. We will notice that all the scales are diatonic, that is to say that each one has five whole tones or steps and two half-steps or semi-tones; furthermore that the half-steps or semi-tones occur in a different place in each scale, according to what the initial note happens to be, and, finally that only one of them has a *leading tone* or half-step between the seventh step and the octave or repetition of the initial note. It is these three features which differentiate the Gregorian modes so markedly from our modern scales and which give them that impersonal and objective character so marvelously suited to the purpose they serve, namely, that of expressing the ideas and sentiments conveyed by the sacred texts. In other words, these modes, or tonalities, lend themselves to the expression of a mental attitude of objectivity as against the modern scales which, on account of their chromatic character, are more pliable vehicles for conveying the emotions springing from subjectivism and introspection. If we remember, in addition to the general character of the Gregorian, or Church modes — as they are often called — the rule which permits the use of six intervals only in the formation of Gregorian melodies, namely: the major and minor second, the major and minor third, the perfect fourth and the perfect fifth, we realize that this tonal system is better adapted for the expression of reverence, humility, peace, and joy, whereas the modern chromatic system is more suited for the expression of passion and dramatic conflict.

Saint Gregory used every means at his command to propagate the chant and have it universally adopted. He established schools for its proper interpretation. At one of these he is said to have taught in person. Missionaries who were sent from Rome into foreign lands took with them a copy of the antiphonarium, and, of course, a knowledge of how the melodies it contained should be sung. Thus, Saint Augustine brought the melodies to England at the command of St. Gregory himself. The great pope's successors continued the process of propaganda during the following centuries. In the 8th century Saint Boniface introduced the chant in Germany, and by him several "scholæ cantorum" were established on German soil. Through Pepin and after him through Charlemagne, it found its way into Gaul and into the whole territory under the emperor's sway.

It is held by many historians that the original chant was, in the main, syllabic, that is to say, that only one note was sung to each syllable and that only the word "alleluja" was ever extended over several notes. Be that as it may, it is certain that it gradually developed into a melismatic system, syllables being often extended over smaller and greater groups of notes.

From the time of Saint Gregory until the advent of Guido d'Arezzo (995–1050?) the primitive means of determining the melody, the neums described above, remained in use. As has been pointed out, these signs were intended to assist the memory of the singers in reproducing the melodies which they had learned by oral transmission. It is not to be wondered at that, in the course of time, many of the melodies were altered and modified in the many places where they were in use. There were frequent variations and modifications due to local habits, different temperaments, but, above all, to the insufficiency of the means employed to indicate with precision the form of the melodies. Careless copyists and finally the arbitrariness and caprice of singers in the various countries led to confusion. Before the time of Guido d'Arezzo, attempts had been made to fix with more precision the intervals of the melodies. He found in use two lines, a red and a yellow one, drawn across the page. Upon the red line was placed the F, and C was put upon the yellow one. Above, below and between these two lines the neums were written. By placing a black line between the two already existing and adding another above or below these three as the *ambitus* or range of the melody might require, Guido created the four line staff which has been used ever since for the chant, and made it possible to indicate precisely the form of a melody for all time to come. Guido and his pupils transcribed the existing chants into the new system of notation. Copies of these transcriptions found their way into the cathedrals and monasteries of many countries where they took the place of the books formerly in use. Though the neums as a *system of notation* were superseded by the more precise invention of Guido, they continued nevertheless to be employed to indicate the manner of *interpretation*. Although Guido's invention was epoch-making and of incalculable importance in the history of music, it must not be inferred that it was at once universally adopted. Neums as a means of notation continued in use in many places and institutions far into the 13th century. Nor must we imagine that because of the introduction of the new system of notation no further modifications of the chant took place. As new saints were canonized and new feasts instituted by the Church, offices and chants were necessarily created. Then the growing skill of professional singers gave rise, especially in the Alleluja following the gradual, to improvisations, elaborations and displays of virtuosity which often exceeded the limits of good taste and appropriateness.

As the melodies comprising ecclesiastical music grew out of the sacred texts and were never performed without being wedded to these texts, it is but natural to assume that the melodic construction partook of the rhythmical form of the texts. Especially must this have been the case when the chant was still largely syllabic. Some maintain that the ancient chant had a definite — artificial — rhythm, as in our modern music, in contradistinction to the natural, or that dictated by the rhythm of the text. Whatever the prevailing rhythm was at the beginning of the 10th century, it was now to undergo a gradual change. The monk Hucbald invented the *organum* or diaphony, that is, the practice of having a second voice sing the melody a fifth above or a fourth below the original, or add to the fifth also the octave, the first voice meantime maintaining the original melody. By this step Hucbald paved the way for the polyphony which was soon to develop and find its culmination in the wonderful creations of Palestrina and his school in the 16th century. Sulzer in his 'Allgemeine Theorie der Künste' in the article on harmony, points out that polyphony was latent in the unison singing of the Gregorian melodies by old and young, men and boys, each class of voice, soprano, alto, tenor, baritone, and bass, having a different pitch.

Hucbald's system of parallel motion of fifths and octaves was soon succeeded by attempts at contrary motion, and counterpoint as we know it, that is, point against point (or note against note) was born. To the Gregorian melody which now became "cantus firmus," that is, unchangeable melody, were added one or more others. In giving birth to the new system and continuing to be its foundation and the source whence polyphony drew its life and being, the Gregorian chant lost its most distinguishing characteristic, that is, its natural rhythm. The themes taken from the chant and used by contrapuntists as "canti fermi" were forced into the rhythmical straight-jacket. Each note of the cantus firmus had now to assume a definite value in order that the added melodies simultaneously sung might harmonize with it. Polyphony, or the new school of music, increased in favor very rapidly to the detriment of the old chant. Instrumental music, which was gradually developing, also had a deteriorating influence on the execution and cultivation of the ancient music of the Church. Counterpoint in many instances lost its original purpose and degenerated into artificiality. Composers used it to display their skill rather than to give expression to the ideas and emotions latent in and suggested by the text to which it was wedded. A reform movement toward primitive simplicity set in toward the end of the 15th and the beginning of the 16th century. The Council of Trent enacted laws concerning the abuses that had crept into the chant as well as against the extravagances which the display of skill for its own sake had brought about and which in fact almost caused the total exclusion of figured music from the Church. In a brief dated 25 Oct. 1577, Pope Gregory XIII. directs Giovanni Perluigi Palestrina and Annibale Zoilo (Palestrina was at the time director of the papal choir and Zoilo a member of the same) to revise the chants contained in the "Antiphonaria," "Gradualia," and "Psalteria," and "eliminate" therefrom "all barbarisms, obscure passages, contradictions, and superfluous additions which, through the ignorance, neglect, and also through the malice of composers, copyists, and singers, have crept into these books." A pupil of Palestrina, Giovanni Guidetti, had, a few years previously, edited the various chants for the celebrant contained in the Missal, which had been newly revised by a commission of cardinals appointed for this purpose after the Tridentine Council. Palestrina, Zoilo, and Guidetti in their labors of revision acted upon the principle which had been lost sight of for a time, but which was now generally accepted by musicians in Rome, "that the words of the texts should be sung to the notes as they ought to be spoken or declaimed without notes." This principle in its application brought into universal use the three different kinds of note-values: the longa, the brevis, and the semibrevis. The work of revision, of the Graduale only, which was continued and completed after Palestrina's death (2 Feb. 1594) by Felice Anerio and Francesco Suriano involved many excisions and abbreviations; reduced many chants which had been elaborately melismatic to a syllabic form. This revised edition derived its name "editio medicea," from the fact that it was printed by the "stamperia" or press of that name established in Rome by Cardinal Ferdinand de Medici. The Congregation of Sacred Rites, in 1595, appointed Giovanni Maria Nanino, Giovanni Andrea Dragoni, Luca Marenzio, and Fulgentio Valesio to edit, in accordance with the principles stated above, the 'Pontificale Romanum.' The revised books were now printed and published with the approbation of Pope Paul V. (1605–21) and that of the prefect of the Congregation of Sacred Rites. This approbation did not carry with it the prohibition of the use of the old, more elaborate, now called traditional, versions of the chant. No doubt because of the latitude thus permitted, the abbreviated version did not make much headway outside of the papal territory. Besides this, monody (solo singing) and the theatrical style in general came into vogue in Italy at the beginning of the 17th century. It took such a hold of public taste that even the works of Palestrina and the masters of his school were temporarily forgotten for the trashy and trivial products which now had the upper hand. This being the case with regard to the polyphonic style, it was natural that the austere, chaste, and simple Gregorian melodies should suffer even greater neglect. While in Italy and in some other parts of the world the chant was for a time neglected, there were countries, such as France, Belgium, Spain, and the Catholic parts of Holland, where it never ceased to be cultivated according either to the traditional or the abbreviated version. Many different editions came into use, notably in France, where many dioceses had their own versions. Toward the middle of the 19th century the plan entertained by Gregory XIII., Clement VIII., and Paul V., of having uniformity for the whole Catholic world in everything pertaining to the liturgy, including the chant, was revived with new vigor. Pope Pius IX., in 1868, appointed a commission to whom he entrusted the task of editing, in accordance with existing requirements, the "editio medicea," which Pius IX. and his successor, Leo XIII., repeatedly declared to be the official version of the Gregorian chant for the whole Church. During the past 30 years or more, however, archæologists — notably the Benedictines of Solesmes, A. Dechevrens, S. J. of Paris, the Belgian savant, G. A. Gevaerts, Dr. Peter Wagner of Freiburg, Switzerland, and others — have made exhaustive studies of the manuscripts dating from the 9th century (the oldest so far discovered) up to the Renaissance. The results of these studies have induced the present Pope, Pius X., to appoint (1904) a commission for the purpose of preparing what is to be called the "editio vaticana," which will embody the fruits of the researches and labors of learned men for many years past. Whatever may be the differences between this latest version and the many that have gone before, they will in no sense change the essential character of the chant. This character has its root primarily in the nature of the scales or modes used, as has been shown above, and, secondly, in the intervals in the construction of the melodies. As has been pointed out, the melodies sprang from the sacred texts of the liturgy: they were their complement and splendor. The Church has always declared the chant to be her own music par excellence. Other forms of music which she admits in her cult, the Palestrina, or polyphonic, and the modern styles, are to be judged as to their fitness in the light of the Gregorian chant, which is the norm and standard of excellence because it best expresses the attitude of prayer.

Bibliography.—Some of the works on the Gregorian chant which may be profitably consulted are: Haberl, 'Magister Choralis'; Kienle, 'Choral-Schule'; Gietmann, 'Kunstlehre' (Vol. III.); Kornmüller, 'Lexikon der Kirchlichen Tonkunst'; Gevaert, 'La Melopée Antique dans le Chant de l'Église Latine'; the Benedictines of Solesmes, 'Paléographie Musicale'; Dechevrens, Études de Science Musicale.'

JOSEPH OTTEN.

Gregorian Liturgy, the ritual which Pope Gregory I. introduced after 590 in the Roman Catholic Church in the administration of the Eucharist, as exhibited in the book entitled 'Gregorianum Sacramentarium.' St. Gregory made a new arrangement of the liturgy of Gelasius, which was previously in use, expunging from it what seemed to him useless and adding a very few new prayers. The celebration of the mass is still essentially the same as it was then.

Greg'ory, Saint, or **Gregory of Armenia**, surnamed "THE ILLUMINATOR," founder of the Armenian Church: b. Valarshabad, Armenia, 257; d. Mount Sebuh, Upper Armenia, 332. He was conveyed by a Christian nurse from his home in Armenia, when but two years old, to Cæsarea in Cappadocia to escape being slain with his family for the crime of his father Prince Auak, who had assassinated Chosrov I., king of Armenia. When he reached manhood he married a Christian lady of Cæsarea, who after bearing him two sons retired to a monastery. Thereupon Gregory entered the service of Tiridates III., son of Chosrov, who, with the help of the Romans, had recovered his father's throne. Tiridates imprisoned him for 14 years in a deep pit, for refusing to perform an act of idolatrous worship, whereupon the tyrant was punished by a horrible temper, of which Gregory cured him and converted him to Christianity. After the baptism of Tiridates Gregory was appointed bishop and patriarch of Armenia and consecrated by Leontius of Cæsarea. Tiridates established Christianity as the national religion of Armenia, a measure afterward imitated on a larger scale by Constantine the Great. Gregory spent the last year of his life in a hermitage on Mount Sebuh.

Gregory, Saint, of Nazianzus (GREGORIUS NAZIANZENIUS), Greek Church Father: b. Arianzas, near Nazianzus, Cappadocia, about 330; d. about 390. Receiving baptism, he retired for some time with St. Basil to Pontus. He began to preach in 362 and between 365 and 374, chiefly at Nazianzus. He went to Constantinople about 378 or 379 to oppose the Arians, and was appointed patriarch of that see in 380. The election was confirmed by the Council of Constantinople in 381, but during the same year he resigned and retired to his former charge of Nazianzus. We possess a number of sermons by him, a large number of letters and many poems. His eloquence is said to have placed him nearly on a level with Basil and Chrysostom. His festival is celebrated on 9 May.

Gregory, Saint, of Nyssa, Greek Church Father: b. Sebaste Pontus, about 332; d. about 398. By the influence of his brother St. Basil (q.v.), he was made bishop of Nyssa, in Cappadocia. He took a prominent part in the Councils of Constantinople from 381 to 394. He was less of an orator than Gregory of Nazianzus, but was more distinguished than any of the Greek fathers for a philosophical spirit, and for his acquaintance with the writings of the Greek philosophers. He also exhibited a liberality in his views uncommon in his day. His festival is on 9 March. His works consist of dogmatic treatises, Scripture commentaries, sermons, letters, etc.

Gregory, the name of 16 popes, as follows:

Gregory I., called the "GREAT": b. Rome about 540; d. 12 March 604. The death of his father put him in possession of great wealth, which he expended in the foundation of monasteries and charitable institutions. Disgusted with the world, he took the monastic vows himself and became a member of one of his own establishments. On the death of Pope Pelagius in 590 he was chosen his successor, an honor which he very unwillingly accepted. He displayed great zeal for the conversion of heretics, the advancement of monachism and the rigid enforcement of celibacy among the clergy: and there was nothing in which the Church was concerned that he deemed too small to lie beyond the sphere of his personal interest and action. (See GREGORIAN LITURGY, GREGORIAN MUSIC.) During his pontificate the pretension of John, patriarch of Constantinople, to the title of ecumenical patriarch, which Gregory repudiated, contributed to bring about the schism between the Greek and Latin Churches (see GREEK CHURCH). The works ascribed to him are very numerous, and have been frequently published. His genuine writings consist of a treatise on 'Pastoral Duty' (translated by King Alfred), 'Letters,' 'Scripture Commentaries,' etc. Consult: Snow, 'St. Gregory the Great' (1892); Mann, 'Lives of the Popes in the Early Middle Ages' (1903).

Gregory II.: b. Rome; d. 10 Feb. 731. He was elected pope and his pontificate is specially noticeable as forming an epoch in the progress of the territorial pre-eminence of the Roman See in Italy. Gregory II. was distinguished by his zeal for the evangelization of heathen lands; it was under his auspices that the famous Winfried or Boniface entered on his missionary work in Germany.

Gregory III.: b. Syria; d. 28 Nov. 741. He succeeded Gregory II. in 731. The encroachments of the Lombards in Italy during his pontificate became so formidable that as the eastern emperors still remained powerless or indifferent to the protection of the Italian provinces, the Romans charged Gregory to send a deputation to Charles Martel, which promised him the title of patrician and consul of Rome in return for his help against the Lombards. Charles Martel's preoccupation with the Saracens made it impossible for him to respond to this plea. But the fact that Gregory was authorized by the Roman primus to approach Charles on this subject and in this way shows how Rome was breaking away from the East, and so marks an epoch.

Gregory IV.: b. Rome; d. 27 Jan. 844. He succeeded Valentine in 828, and was greatly esteemed for his learning and piety. During his pontificate the observance of the feast of All Saints was made general.

Gregory V.: b. Germany; d. 18 Feb. 999: sometimes styled BRUNO OF CARINTHIA. He was nephew of the Emperor Otto III. and through his influence was chosen first German pope and at the age of 24 succeeded John XV., in 996. An anti-pope, named John XVII., was set up against him by Crescentius, a consul of Rome, but was expelled by the emperor.

Gregory V., Ecumenical patriarch of the Greek Church: b. Dimitzana, Arcadia, Greece, 1739; d. Constantinople, 1821. His original name was Georgios Angelopulus, and he took his ecclesiastical name on entering the monastery on Mount Athos where he received his theological training. He was appointed archbishop of Smyrna in 1784 and patriarch of Constantinople in 1795. When the French invaded Egypt in 1798, the national spirit of Greece was aroused by hopes of deliverance from the Turkish yoke. Suspicions of conspiracy fell upon Gregory, and the Turks clamored for his head. Sultan Selim therefore banished him to Athos, but he was soon afterwards reinstated in his see. In 1821 the Greeks of the Morea revolted, and 21 March banishment was proclaimed against all who took part in the rebellion. Gregory had been put in charge of the family of Prince Murusi, who without the patriarch's connivance had been permitted to escape by the Russian ambassador. On Easter morning, 22 April, 1821, by command of the sultan Gregory with three bishops and eight of the clergy were hanged in front of the basilica. Three days later the Jews threw his body into the sea, where it was recovered by Greek sailors and carried to Odessa. The Greeks looked upon their murdered archbishop as a martyr, his bones were placed by the government in the cathedral at Athens, and his statue was raised in front of the university. Among his writings is a translation of St. Paul's epistles into modern Greek, with a commentary.

Gregory VI.: b. Rome; d. Cologne 1048. He succeeded John XIX. Finding the lands and revenues of his church much lessened by usurpations, and the roads infested by robbers, he acted with such vigor that a powerful party was raised against him by those accustomed to live by plunder. At a council, held at Sutri, in 1046, Gregory abdicated the pontificate.

Gregory VII. (HILDEBRAND): b. Soana, Tuscany, about 1015; d. Salerno, 25 May 1085. He became a monk at Cluny, and when Bruno, bishop of Toul, was elected pope by the emperor and diet in 1048 Hildebrand accompanied him to Rome, having persuaded him, it is said, to lay aside the insignia of the pontificate until he should receive the free suffrages of the clergy and people of Rome. Henceforth Hildebrand became the ruling spirit of the papacy. Leo IX. (Bruno) and his successors, Victor II. (1055), Nicholas II. (1058), Alexander II. (1061), confided in his counsels. He influenced the election of several of these popes, and procured the expulsion of the anti-popes Benedict and Honorius, who were opposed to Nicholas and Alexander. Under Nicholas II he succeeded in changing the mode of election to the pontificate. Hitherto the clergy and the people of Rome had a voice in the election He gave the power of nomination to the cardinals alone, leaving the clergy and people only a right of concurrence, of which they were subsequently deprived. On the death of Alexander II. (1073) Cardinal Hildebrand was raised to the Papal chair. His efforts were directed to free the Church from the interference of temporal rulers, which had become quite an abuse in his day, and reform the numerous irregularities which had crept in among the clergy, especially in relation to the violation of the law of celibacy. In 1074 he issued his edicts against simony and the marriage of priests, and in 1075 an edict forbidding the clergy, under penalty of forfeiting their offices, from receiving the investiture of any ecclesiastical dignity from the hands of a layman, and at the same time forbidding the laity, under penalty of excommunication, to attempt the exercise of the investiture of the clergy. The Emperor Henry IV. refused to obey this decree, and Gregory, in 1076, issued a new decree summoning the emperor before a council at Rome, to defend himself. Henry then caused a sentence of deposition to be passed against the pope by a German council assembled at Worms. The pope, in return, excommunicated the emperor, and released all his subjects and vassals from their oath of allegiance. To escape being deposed by the pope, Henry hastened to Italy, where he submitted at Canossa (1077) to a humiliating penance, and received absolution. In the meantime his friends again assembled round him, and he then caused the pope to be deposed by the Council of Brixen, and an anti-pope, Clement III., to be elected in 1080, after which he hastened to Rome and placed the new pope on the throne. Gregory now passed three years as a prisoner in the castle of St. Angelo, but could never be induced to compromise the rights of the church. The character of Gregory was ardent and unyielding. In the pursuit of his ends in guarding the liberties of the Church he spared neither friend nor foe. The long dispute he began with Henry IV. about investitures survived both pope and emperor. The same subject involved him in disputes with France and England. He carried out his ecclesiastical reforms with an unbending rigor. He vigorously prosecuted those of the clergy who broke the law of celibacy, and in his contests with the emperors vindicated the spiritual authority of the Church as independent of the secular power. To the last he refused to withdraw the excommunications he had launched against the emperor, the anti-pope, and their adherents. The words which have been put into his mouth in dying, whether authentic or not, do no injustice to his inflexible spirit, "I have loved justice and hated iniquity; therefore I am left to die in exile." See Milman' 'Latin Christianity' (Vol. III.); Giesebrecht, 'Geschichte der deutsch-Kaiserzeit' (Vol. III.); Bowden, 'Life of Gregory VII.' (1840); Voigt, 'Hildebrand als Papst' (2d ed. 1846); Gfrorer, 'Papst Gregor VII.' (1859–61); Stephens, 'Hildebrand and his Times' (1888); and the studies by Soltl (1847), Villemain (1872; Eng. trans. 1873), Langeron (1874), and Meltzer (1876).

Gregory VIII.: b. Benevento; d. Pisa 17 Dec. 1187 He succeeded Urban III. in October 1187, and died the same year, after having exhorted the Christian princes to undertake a new crusade, and absolved Henry II. of England for the murder of Becket.

Gregory IX. (UGOLINO, COUNT OF SEGNI), b. Campania about 1147; d. Rome 21 Aug. 1241. He became a bishop of Ostia and cardinal, and in 1227 succeeded Honorius III. The principal events of his pontificate were the various incidents of his contest with the great Emperor Frederick II., whom he four times excommunicated, absolving his subjects from their allegiance, and proclaiming a crusade against him. The 'Decretals,' which he published in 1234, form the basis of the canon law of the Church.

Gregory X. (TEBALDO VISCONTI), d. Arezzo, 10 Jan. 1276. He was elected Pope in 1271, after an interregnum of two years. He convened a council at Lyons in 1274, the chief purpose of which was to promote a union between the Eastern and Western Churches.

Gregory XI. (PETER ROGER), b. Maumont, Limoges, France, 1329; d. Avignon, 30 Dec. 1378. He was a nephew of Clement VI., and succeeded to the pontificate in 1370, after the death of Urban V. He was a patron of learning, and endeavored to reconcile the princes of Christendom and to reform the religious societies. He transferred the papal see from Avignon to Rome.

Gregory XII. (ANGELO CONARIO), b. Venice about 1325; d. 18 Oct. 1417. He became pope in 1406, during the great schism of the West, Benedict XIII. being the other pope. Both were deposed by a council held at Pisa, and Alexander V. elected in their stead. Gregory abdicated at the Council of Constance in 1415, and thenceforward held the rank of cardinal-bishop of Porto.

Gregory XIII. (UGO BUONCOMPAGNO), b. Bologna 7 Jan. 1502; d. 10 April 1585. He was one of the theologians of the Council of Trent; on his return thence was created cardinal in 1565. On the death of Pius V. Gregory was elected pope in 1572. Not one among the post-Reformation pontiffs has surpassed Gregory XIII. in zeal for the promotion and improvement of education; a large proportion of the colleges in Rome were wholly or in part endowed by him. The most interesting event of his pontificate, in a scientific point of view, is the correction of the calendar (q.v.), which was the result of long consideration, and was finally made public in 1582. Under his care was published also a valuable edition of the 'Decretum Gratiani' with learned notes. He was a zealous patron of the Jesuits, and supported the League in France against the Huguenots. He strongly supported Philip II. of Spain in his designs against England; and left the mark of his energy on almost every department of church life and work.

Gregory XIV. (NICHOLAS SFONDRATE), b. Cremona 1535; d. 15 Oct. 1591. He was made a cardinal in 1583 and succeeded Urban VII. in 1590.

Gregory XV. (ALESSANDRO LUDOVICO), b. Bologna 9 Jan. 1554; d. 8 July 1623. He became a cardinal in 1616 and succeeded Paul V. in 1621. He was the founder of the College of the Propaganda, and in 1622 canonized Ignatius Loyola, Francis Xavier and Philip de Neri.

Gregory XVI. (BARTHOLOMMEO CAPELLARI) b. Belluno 18 Sept. 1765; d. Rome 1 June 1846. He was made prefect of the Propaganda in 1826 and was in effect minister of foreign affairs. He succeeded Pius VIII. in 1831. His rule was a period of no ordinary interest and difficulty in the history of the Church, and in the relations of the Vatican with the temporal powers of Christendom. Of simple habits he was very active in his conduct of affairs. His 'Triumphs of the Papacy' (1790) has been translated into both German and French.

Gregory, Casper René, American scholar: b. Philadelphia, Pa., 1846. Was graduated at the Universities of Pennsylvania, Princeton and Leipsic (1864–76). He has done important work in New Testament criticism, and has been professor of New Testament exegesis in the theological faculty at Leipsic. In addition to translations of critical works from the German, he has written 'Les Cahiers des Manuscrits Grecs' (1885); and the 'Prolegomena to Tischendorf's Editio Octava Critica Major of the New Testament' (1893).

Gregory, Edward John, English painter: b. Southampton, 1850. He first exhibited at the Royal Academy in 1876, and became known as a genre painter of distinction, whose lightness and refinement, combined with rare technique, were almost more French than English. His most characteristic pictures are 'A Rehearsal' (1882); 'The Swans of the Thames'; and 'Is it a Mouse?'

Gregory, Eliot, American painter and author: b. New York 13 Oct. 1854. He studied at Yale, obtained his education in art at Rome, and at Paris as a pupil of Cabanel and Carolus-Duran, and exhibited both sculpture and painting at the Salon. His pictures include genre works and portraits, among the latter being those of Admiral Baldwin, Ada Rehan and August Belmont. His books, published under the pseudonym "AN IDLER," are: 'Idler Papers'; 'Worldly Ways and By-Ways' (1898); and 'The Ways of Men' (1900), containing satirical observations on American life, especially that of plutocratic society.

Gregory, Francis Hoyt, American admiral: b. Norwalk, Conn., 1789; d. 1866. He was appointed midshipman in the United States navy in 1809, and during the war of 1812 was attached to the command of Commodore Chauncey on Lake Ontario. He was captured by the English in 1814 and confined till the close of hostilities. He saw service in repressing the Algerine pirates (1815–16) and the buccaneers of the West Indies (1821–23); took part in the Mexican War and commanded the African squadron (1849–52). He retired with the rank of rear-admiral in 1862.

Gregory, John Milton, American educator: b. Sand Lake, N. Y., 16 July 1822; d. Washington, D. C., 20 Oct. 1898. After graduation at Union College in 1846, he entered the Baptist ministry, but soon relinquished preaching for teaching. He was State superintendent of public instruction in Michigan in 1858–63; president of Kalamazoo College 1863–67; and president of the Industrial University in Champaign, Ill., in 1867–80. He published 'Compend of the School Laws of Michigan'; 'Handbook of History' (1866); 'A New Political Economy' (1882); 'Seven Laws of Teaching' (1883); etc.

Gregory of Tours (GREGORIUS FLORENTIUS), historian of Gaul, b. Averni, now Clermont, France. 538; d. Tours 17 Nov. 593. He lived some time at the court of Austrasia, and became bishop of Tours in 573. His 'Historia Francorum,' though destitute of style or method, contains an invaluable collection of facts bearing on the manners of the Franks and Gallo-Romans, and the historical events of the period, and has caused him to be ranked as the Herodotus of Gaul. He also wrote lives of fathers, ecclesiastics and martyrs, etc. His complete works are contained in Migne's 'Patrologia' (Vol. LXXI.), and his history is included in the first volume of the 'Monumenta Germaniæ Historica' (1884–85).

Grenada (grĕn-ā'da) and **Grenadines,** grĕn-a-dēnz', islands of the West Indies. Grenada is the most southern of the Caribbean chain, and may be characterized as the most British and the most beautiful of all the British Antilles. Its length is 18 miles, its width 7, and its area 33 square miles. Lofty volcanic craters rise high above fertile and well-watered valleys. The volcanic character of the island is perhaps more marked, and is certainly regarded by geologists as being more recent than that of the northern Caribbees. A lake two miles in circumference lies among the mountains just mentioned, at an altitude of 3,200 feet. St. George, the capital, has a good harbor, a fort, and pretty houses and churches. The island is headquarters of the government of the Windward group (which includes with this the Grenadines, St. Vincent and St. Lucia), and has excellent schools, roads, waterworks, etc. The chief product is cocoa. Population about 54,000, of which number four-fifths are negro peasants. The Grenadines are long, low islands "of quaint forms and euphonious names," lying between Grenada and St. Vincent. The largest of them is less than 8,000 acres in extent, and their total area is approximately 87 square miles. They have in all more than 6,000 inhabitants, who raise and export cattle and provisions.

Marrion Wilcox,
Authority on Spanish America.

Grenade, grẹ-nād', a small hollow ball, cylinder, or cube, of metal, glass, or paper, about two and one half inches in diameter, which is filled with some explosive, and burst by means of a fuse when it falls among the enemy. Until about the end of the 17th century trained soldiers called grenadiers threw grenades by the hand. Grenades have been delivered from mortars, to repel the close attacks of besiegers sheltering themselves under the besieged walls. They have been found useful also in repelling boat attacks. At the siege of Mafeking in 1899–1900 dynamite grenades are said to have been thrown by the besieged. Grenades were one of the earliest forms of explosive projectiles. The gradual disuse of hand-grenades in war dates from the battle of Steinkerque in 1690. Hand-grenades are in use at the present time as fire extinguishers, chemicals being used to fill hollow glass balls, which are thrown into a burning mass. Many hotels, hospitals and public buildings are equipped with hand-grenades.

Gren'fell, George, English missionary and African explorer: b. Penzance, Cornwall, England, 1848; d. Basoko, Congo Free State, 1 July 1906. In 1874 he was despatched to Kameroon, Central Africa, where he founded the settlement of Victoria. He later reached the Congo, and rendered good services to science by his hydrographic survey of the Congo valley during his voyage in the steamboat "Peace." Notable was his exploration of the Ubangi (1885) whose identity with the Welle Makua he convincingly established. The geographical societies of Germany, France and England, published valuable communications from this intrepid traveler, who shares with Livingstone the reputation of a missionary who did much to promote an accurate scientific knowledge of interior Africa.

Gren'ville, George, English statesman: b. 1712; d. 13 Nov. 1770. He became treasurer of the navy in 1754, secretary of state in 1762, and first lord of the treasury and chancellor of the exchequer in April, 1763. In 1765 the Commons accepted his scheme for stamp-duties to be levied in the American colonies, which was one of the proximate causes of the American War of Independence. In 1766 he defended the stamp act in Parliament; in 1769 opposed the expulsion of Wilkes from the House of Commons, and in 1770 brought in the Controverted Elections Bill, which was passed. He was able, hard-working and honest, but narrow-minded and obstinate, wanting in tact and foresight. The 'Grenville Papers,' edited by W. J. Smith (1852–53), contain interesting information on the politics of the day.

Grenville, Sir **Richard,** English naval officer: b. about 1541; d. September 1591. In 1585 he commanded a fleet of seven vessels intended to aid in the colonization of Virginia. His most brilliant exploit occurred in 1591, when he attempted to cut his way through a Spanish fleet of 53 ships. His ship while becalmed was attacked by 15 of the largest Spanish vessels. Not till after 15 hours of battle and when only 20 out of his 150 men were left alive did he strike his colors. He died from wounds received in the engagement. It is upon this incident that Tennyson has founded his spirited ballad, 'The Revenge.'

Grenville Act, 6 April 1764. An act passed by the English Parliament on the proposal of George Grenville, a member of Lord Bute's ministry. Its purpose was more effectively to protect English trade and manufactures from foreign competition, to raise better revenues from the colonies. It was based on the act of 1733, which, to protect the British West India sugar industry, laid prohibitory duties on the import of French West India sugar and molasses into the colonies, and which, if enforced, would have ruined New England commerce. The new act made the duty on molasses a heavy revenue one instead; increased the duty on sugar, and laid new duties on wines; decreased the drawbacks on foreign articles exported to America; imposed regulations on manufacturers, and attempted to enforce the navigation acts more thoroughly; and prohibited all trade between the colonies and the French islands St. Pierre and Miquelon.

Gresh'am, Walter Quinton, American jurist and statesman: b. near Lanesville, Harrison County, Ind., 17 March 1832. His family originated in Kentucky, from which State his grandfather had removed to Indiana. There his father met with success as a farmer, and also exercised the art of cabinet-making. He was elected sheriff and was murdered in the performance of his duties. The son was educated at the local school, and the State University, Bloomingdale, Ind. After leaving the latter he went to Corydon, Ind., and began the study of law, while filling the office of deputy clerk (1854). In 1860 he was elected to the State legislature. When the Civil War broke out he was commissioned in the Federal service as lieutenant-colonel of the 38th Indiana regiment. He was promoted under Grant, and at Vicksburg had charge of a brigade with the rank of brigadier-general of volunteers. He joined Sherman's forces in the expedition against Atlanta, Ga., where he commanded the 4th division of the 17th Army Corps. At Leggetts Hill, in January, 1864, he was severely wounded and disabled from service, and in the following year was retired as major-general of volunteers. He chose as his home New Albany, Ind., and began an active life as law practitioner. In 1866 he was put forward by his friends as Republican candidate for Congress, but was defeated at the polls, and for the two following years resided in New York, as the financial agent of his State. His next field of activity was as a jurist, for in 1869 President Grant appointed him judge of the United States circuit court for Indiana. He had previously declined an appointment as collector of customs at New Orleans, which would have necessitated his removal from Indiana. He had also declined the position offered him as district attorney. But his great abilities and high character had pointed him out as fitted for some important employment, and in 1882 no surprise was felt, but rather general expectation was satisfied when he received an appointment to the cabinet with the portfolio of postmaster general (1882). In 1884 he was called to the secretaryship of the treasury, in the discharge of whose duties he would doubtless have increased his reputation as a financier, had he not been appointed a few months later as United States circuit judge for the 7th judicial district. He made himself conspicuous as favoring the third term of his old friend Gen. Grant (1880). His own name had been put forward with some enthusiasm as presidential candidate in 1884, and again in 1888. There were many who thought that he had good claims to be invested with the office of the chief magistrate. Subsequently he changed his convictions on the most important question of the hour, and ranged himself on the side of views of tariff legislation with which the Republican party had no sympathy. The Populists, however, looked upon him with favor as his judicial decisions had in many cases been to their advantage. Had he consented, they would have nominated him for the presidency at the national convention of that party held at Omaha, Neb., in July 1892. He declined the honor and made a public statement announcing his purpose of supporting Grover Cleveland's nomination. He was afterward named by President Cleveland as secretary of state.

Gresham's Law, a principle in finance and political economy formulated about the middle of the 16th century by Sir Thomas Gresham, founder of the London Royal Exchange. It may be thus stated and expounded. Bad money drives out good money from the circulation. The good coin of full weight and purity in circulation with worn, light, or depreciated coins, will be hoarded or used for exportation, where it will buy more abroad than the worn out coins, which will be left to pass as counters at home. This law is still a living principle, and especially applicable in controverting the position of those who wish the United States, single-handed, to issue a currency of the double standard.

Gres'well, William Henry, English Anglican clergyman and author. He was educated at Oxford and has been rector of Dodington, Somerset, from 1888. As a writer he is known by 'Our South African Empire' (1885); 'Imperial Federation' (1887); 'History of the Canadian Dominion' (1890); 'Geography of the Canadian Dominion' (1891); 'Geography of Africa South of the Zambesi' (1892); 'The British Colonies and Their Industries' (1893); 'Growth and Administration of the British Colonies' (1897).

Gretna, La., town, capital of Jefferson Parish; on the Mississippi River and the Southern Pacific railroad; opposite New Orleans. A number of the Mississippi River packet lines take on and discharge shipments at Gretna. It was founded in 1835, and has now many of the advantages of a suburb of New Orleans. It manufactures cottonseed oil and its trade is chiefly in cotton and cottonseed oil. Pop. 3,875.

Gretna Green, or Graitney, Scotland, village in Dumfriesshire, on the Solway Frith, eight miles north of Carlisle. It was for nearly a century notorious as the place of celebration of the marriages of runaway couples from England. To conclude a lawful marriage in Scotland, it was then only necessary for an unmarried couple to go before witnesses and declare themselves man and wife. The English marriage service was usually read at these marriages by a pseudo-priest, said to be the blacksmith of the village, who has become in consequence a historical character in fiction. Gretna Green marriages are now at an end, in consequence of a statute which enacts that no irregular marriage contracted in Scotland shall be valid, unless one of the parties resides in Scotland, or has done so, for 21 days next preceding such marriage.

Grétry, André Ernest Modeste, äṅ-drā ėr-nā mō-dĕst grā-trē, French composer: b. Liège 8 Feb. 1741; d. Ermenonville 24 Sept. 1813. After completing his studies at Rome he settled at Paris and there his reputation was made. He was the most prolific composer of his age. He produced forty comic operas, most of which with the exception perhaps of 'Raoul' and 'Richard Cœur de Lion' are now forgotten. His 'Memoires' 1796, and his life by Gregoir and Brenet give the main incidents of his career.

Grev'ille, Henry. See DURAND, ALICE MARY.

Grevy, François Paul Jules, fräṅ-swä pōl zhül grā-vē, French statesman: b. Mont-sous-Vaudrey, Jura, 15 Aug. 1807; d. 9 Sept. 1891. He studied law in Paris, and became prominent as the defender of republican political prisoners. In 1848 he was returned to the Constituent Assembly, where his ability as a speaker soon made him distinguished. After the *coup d'état* he retired from politics, but in 1869 again entered the Assembly as deputy for the Jura. In February, 1871, he was elected president of the National Assembly, and re-elected in 1876, 1877, and 1879. When Marshal MacMahon resigned in 1879 Grevy was elected president of the republic for seven years. In December, 1885, he was elected president for a second term of seven years, but, hampered by ministerial complications, resigned in December 1887.

Grey, Albert Henry George, Fourth Earl, English statesman: b. Howick, Northumberland, England, Nov. 28, 1851. His grandfather, the second earl, was prime minister of England, and influential in securing the passage of the Reform Bill of 1832. The present earl was graduated from Trinity College, Cambridge; in 1880 he was elected to Parliament, as a Liberal, and supported Gladstone in the House until 1886 when the Liberals declared in favor of home rule. He then became a Liberal Unionist, but lost his seat in Parliament. In 1894, as his uncle died childless, he succeeded to the estate and title, and entered the House of Lords. He was a personal friend of Cecil Rhodes, was one of the promoters of the South African Company, and in 1896–97 served as governor of Rhodesia. As an executor of the Rhodes will, he is now one of the trustees of the scholarship fund. He has been an active worker in reform movements, especially in the cause of co-operation and of temperance. On his estate he has organized a co-operative system which has worked successfully; and in 1901 he organized a system for the management of public houses in the interests of the public, known as the Public House Trust. In 1904 he was appointed governor-general of Canada to succeed the Earl of Minto.

Grey, Lady Jane, English princess: b. Bradgate, Leicestershire, 1537; d. Tower Hill, London, 12 Feb. 1554. She was the daughter of Henry Grey, marquis of Dorset, afterwards duke of Suffolk. She displayed much precocity of talent; possessing an acquaintance with the classic and oriental languages, as well as French and Italian. She was married to Lord Guildford Dudley, fourth son of the Duke of Northumberland, in May 1553. Edward VI. was induced at his death 5 July 1553 to settle on her the succession to the crown. The council endeavored to keep his death secret, with a view to secure the persons of the princesses, Mary and Elizabeth. Mary apprised of their design, wrote expressing her surprise that she had not been advised of her brother's death, and commanding them on their allegiance to proclaim her title. The council replied, exhorting her to be quiet and obedient, and proclaimed Lady Jane on the 10th. On the approach of Mary the council, unsupported in their usurpation, meanly deserted their victim Lady Jane, and joined in proclaiming Mary queen on the 19th, and on the 20th Lady Jane was confined to the Tower. On 13 Nov. she and her husband were arraigned, and pleaded guilty of high treason; but they might, perhaps, have been allowed to expiate their imprudence by a temporary confinement, but for the ill-advised insurrection under Sir Thomas Wyatt, in which the Duke of Suffolk, Lady Jane's father, was weak enough to participate. The suppression of this rebellion was followed by the execution of Lady Jane Grey and her husband on Tower Hill.

Greyhound. A long, tall, slender hound, the standard features of which are described under Dog. It hunts by sight, is fitted for the swiftest running and leaping, and is used in the sport of coursing (q.v.). In the United States greyhounds are kept mainly as pets; yet in the West are used in chase of jack-rabbits, prong-horn antelopes and coyotes. Few horses are able to keep up with them, even in a level country, and on an irregular surface they distance horses easily. The modern thin, smooth-haired type, to which the name is now popularly restricted, is a development from a form which arose in western Asia before the Christian era, and was adopted and esteemed in Syria, Egypt and Rome, during the classic period. It was taken west with the Romans in their conquest of Europe, and later became the favorite dog of the nobility, an accompaniment of falconry. At that time black, or black-and-white were the approved colors. There seems to have been little essential change of form or qualities during this prolonged history, and literature and art abound in commemoration of the dog's grace, kindliness and exploits in the field. There arose at an early time a diminutive variety not half the size of its namesake (about 7 pounds in weight) fragile, delicate, and of no use save as an ornamental pet, which is now known as the Italian greyhound. It is of almost any whole color,— black, mouse-grey, fawn or rarely white. Besides these satin-coated "long-dogs," others arose in the colder parts of Europe which differed from the greyhound only in having a "rough," that is long-haired, coat. These are the Irish wolfhounds (see Wolfhound), the Scotch stag or deerhound (see Deerhound), and the Russian wolfhound or psovie (see Borzoi).

Greytown, old name San Juan de Nicaragua, destroyed in 1854 by the United States. (For the general situation, see Clayton-Bulwer Treaty.) In May 1854 the captain of an American steamship had a quarrel with a negro, and shot him dead; the mayor of the city ordered him arrested, and the passengers on the ship, as well as Solon Borland, the United States minister to Nicaragua, took the captain's part and resisted the arrest. The native inhabitants were indignant and mobbed Borland, whereupon the United States war-vessel Cyane, Commander Hollins, was sent to exact reparation. Hollins espoused the cause of an American transit company who were making excessive claims, and ordered the mayor to pay them at once; on their refusal he bombarded and burnt the place. This outrage embroiled the United States with Great Britain.

Gridley, Charles Vernon, American naval officer: b. Logansport, Ind., 24 Nov. 1845; d. Kobe, Japan, 5 June 1898. A graduate (1863) of the United States Naval Academy, he served during the Civil War in the West Gulf blockading squadron, subsequent to the war was on various ships, and in 1875–79 was stationed at the Naval Academy. He was navigation officer in the Boston Navy Yard in 1882–84, was lighthouse inspector in 1887–91 and 1895–97, in 1897 attained the rank of captain and was ap-

ALBERT HENRY GEORGE, THE FOURTH EARL GREY,

GOVERNOR-GENERAL OF CANADA.

pointed to the command of the Olympia, then flagship of the Asiatic squadron. This vessel he commanded in the battle of Manila Bay 1 May (1898). He died at Kobe.

Gridley, Richard, American soldier: b. Boston, Mass., 3 Jan. 1711; d. Stoughton, Mass., 20 June 1796. He served in the British army as lieutenant-colonel of engineers under Pepperell at the capture of Louisburg in 1745; as chief engineer and colonel of infantry in 1755; took part in the expedition to Crown Point under Winslow in 1756; under Amherst in 1758; and under Wolfe at Quebec in 1759. He was appointed chief engineer and commander of the artillery of the American army upon the outbreak of the Revolution, constructed the fortifications on Breed's Hill before the battle of Bunker Hill, and later fortified Dorchester Heights. He was commissioned major-general by Congress on 20 Sept. 1775, and commanded the Continental Artillery till November of that year.

Grieg, Edvard, ĕd'värd grēg, Norwegian composer: b. Bergen 15 June 1843; d. there 4 Sept. 1907. His great-grandfather, Alexander Greig, was a Scotchman who emigrated to Norway after the battle of Culloden (1745) and changed his name to Grieg. Edward's father was British consul at Bergen; he married the Norwegian Gesine Judith Hagerup, a descendant of Kjeld Stub; from her, Edvard inherited his musical gifts; she was a good musician and gave him lessons. By the advice of Ole Bull, Edward was sent to the Leipsic Conservatory at the age of 15; he remained there three years, studying with Plaidy, Wenzel, Moscheles, E. F. Richter, Hauptmann, Reinecke. Their lessons, and the music he for the most part heard and studied, impressed a German stamp on his mind, which characterizes his first compositions. His studies were interrupted by an illness, a severe case of pleurisy, which destroyed one of his lungs and left his health impaired for life. On his return to the North he came under the influence of three Scandinavian musicians: the composer Gade, who gave him many useful hints; Ole Bull, an ardent musical patriot, who made him familiar with the charming folk-tunes of Norway, which he played so entrancingly; and Richard Nordraak, who encouraged him in his natural inclination to get out of the maelstrom of German music and steer into the fjords of Norway. From 1866 to 1873 he lived at Christiania, conducting the Philharmonic concerts and giving lessons. He also gave subscription concerts, with the aid of his cousin, Nina Hagerup, whom he married on 11 June 1867; she was an excellent vocalist, whose art was a great aid in winning favor for his songs. In 1868 Liszt accidentally came across Grieg's first violin sonata (Op. 8), and was so much impressed by the evidence of creative power it gave that he invited him to come and spend some time in his studio. It was in consequence of this flattering letter that the Norwegian Government gave Grieg a sum of money which enabled him to visit Rome. There he repeatedly met Liszt, who became more and more impressed by the boldness and the national traits of his genius; he urged him to persevere in his original course and not to let the critics intimidate him.

In 1874 Henrik Ibsen asked Grieg to write the music for a stage version of his 'Peer Gynt.' The offer was accepted and the play was produced, with much success, in 1876. It is often given in Scandinavian cities; elsewhere it has not succeeded, because of its untheatrical, fantastic character and its grotesque local coloring; but the music, arranged for the concert hall in the form of two suites, soon made Grieg one of the most popular composers in al countries. In the same year that Ibsen invited him to compose the music for 'Peer Gynt,' the Norwegian Government honored him with an annuity of 1600 crowns for life. This relieved him of the drudgery of teaching and enabled him to devote most of his time to composing. For several years he lived at Lofthus, on the Hardanger Fjord. At Bergen, 1880–1882, he conducted a musical society called the 'Harmonien.' In 1885 he built the elegant villa Troldhaugen, overlooking the fjord, about 8 kilometers from Bergen; there he lived till his death. After his fame was well established, about 1880, he left his home frequently for concert tours in Germany, France, and England. Everywhere he was acclaimed as one of the most individual and enchanting of pianists (he played only his own pieces), and usually all the seats for his concerts were sold long before their dates. Sometimes he conducted his orchestral compositions. "How he managed to inspire the band as he did and get such nervous thrilling bursts and such charming sentiment out of them I don't know." wrote Sir George Grove, in 1888. In 1893 a writer in the Paris Figaro said: "Among the most famous living musicians there is none I know of whose popularity equals, with us, that of M. Grieg" In 1899, Colonne invited him to Paris to conduct a Grieg concert; but it was just after the verdict in the Dreyfus case, which had made Grieg so indignant that he refused the invitation. When it was repeated, four years later, he accepted. There was a tremendous crowd; cries of "apologize, you have insulted France!" were heard; but the vast majority was with him, and the concert proved one of his biggest triumphs.

Grieg did for Norway what Chopin did for Poland, Liszt for Hungary, Dvorák for Bohemia: he created a new national art. This great achievement, unfortunately, stood in the way of the full recognition of his superlative genius. It is still commonly assumed that he did little more than transplant to his garden the wild flowers of Norwegian folk-music, whereas, in truth, ninety-five hundredths of his music is absolutely his own. He ranks with Schubert and Chopin both as a melodist and a harmonist. His persistent ill-health prevented him from writing operas and symphonies; most of his works are songs and short pianoforte pieces. The songs, 125 in number, are of striking originality and depth of feeling. The equally numerous short pieces for piano (including 66 "lyric pieces" in one vol.) are as idiomatic as Chopin's. There are also 5 sonatas; one for piano alone, three with violin, one with 'cello, beside a string quartet. The orchestral list includes: Overture, 'In the Autumn'; 'Holberg' suite; 2 'Peer Gynt' suites; 'Sigurd Jorsalfar'; arrangements of Grieg songs and Norwegian dances. Choral works: 'At the Cloister Gate'; 'Landsighting'; 'Olaf Trygvason.' Bergliot' is a poem for declamation, with orchestra. The only books on Grieg and his works are by Schjelderup, in Norwegian, and by the author of this article, in English. The latter contains a list of pamphlets and magazine articles on Grieg.

HENRY T. FINCK,
Musical Director, New York Evening Post.

Griesbach, Johann Jakob, a noted German New Testament scholar, biblical critic and theologian: b. Butzbach in Hesse-Darmstadt, 4 Jan. 1845; d. Jena, 24 March 1812. He was educated at Frankfort-on-the-Main: later studied theology at Tübingen, Halle, and Leipzig; during 1769–70 traveled extensively in England, France and Holland; in 1771 became docent and in 1773 professor extraordinary in theology at Halle; and from 1775 till his death was professor ordinary at Jena. Griesbach's most important work — to which he devoted the best years of his life — was the collecting and classifying of the ancient manuscripts and versions of the Greek text of the New Testament. His critical researches, the result of which appeared in his edition of the Greek New Testament (Halle, 1775–7) one of the first ever printed, are valuable and in the main correct. It was he who first divided the authorities for the text of the Greek New Testament into the three great families — Alexandrine, Latin or Western, and Byzantine or Eastern.

Griffin, Charles, American soldier: b. Licking County, Ohio, 1826; d. Galveston, Texas, 5 Sept. 1867. He was graduated at West Point (1847) and served through the Mexican War. In the Civil War he commanded the 5th artillery at the first battle of Bull Run, and on 6 May 1864 was brevetted lieutenant-colonel in recognition of gallant and meritorious services in the field. He was one of the commissioners to carry out the condition agreed upon by Gens. Grant and Lee.

Griffin, Gerald, Irish novelist: b. Limerick, Ireland, 12 Dec. 1803; d. Cork, 12 June 1840. He will be longest remembered for his novel 'The Collegians' (1829), upon which Boucicault's popular play, "The Colleen Bawn," is founded. Griffin was a poet as well as a writer of tales and the author of various lyrics popular with his countrymen.

Griffin, SIR Lepel Henry, English diplomatist: b. 1840. He entered the Bengal Civil Service in 1860 and since then has been administrator of the civil government in several places, especially in the Punjab. In 1885 he was nominated by Lord Salisbury's government as Envoy Extraordinary to Pekin. He has written 'The Punjab Chiefs' (1865); 'The Rajahs of the Punjab' (1870); 'The Great Republic' (1884).

Griffin, Ga., city, county-seat of Spalding County, on the Southern and the Central of G. R.R.'s. It is the centre of a cotton and fruit region, the chief fruits being grapes and peaches. The city contains cotton-mills, a foundry, and furniture factories; wine is also manufactured. The State Agricultural Experiment Station is located in the vicinity. Pop. (1900) 6,857.

Griffin, or **Gryphon**, in mythology, a fabulous animal, usually represented with the body and legs of a lion, and the head and wings of an eagle, signifying the union of strength and agility. Figures of griffins are frequently used as ornaments in works of art. It is employed as an emblem of vigilance, the animals being supposed to be the guardians of mines and hidden treasurers. Figures of it are met with in tombs and sepulchral lamps, as guarding the remains of the deceased.

Griffis, William Elliott, American clergyman and author: b. Philadelphia 17 Sept. 1843. He was graduated from Rutgers College in 1869, and 1870 went to Japan to organize schools after American methods in the province of Echizan, made a study of the Japanese feudal system, and was professor of physics in the Imperial University in 1872–74. In 1874 he returned to the United States, where he was graduated from the Union Theological Seminary in 1877. He was pastor of the First Reformed Church, Schenectady, N. Y. (1877–86), of the Shawmut Congregational Church, Boston (1886–93), and of the First Congregational Church of Ithaca, N. Y. (1893–1903). In 1891 he was a delegate to the International Congregational Council at London. From 1903 he turned his attention wholly to literary work. An authority on Japan, he also studied the Dutch origins of America and the influence of the Dutch in the formation of the United States. His published works include 'The Mikado's Empire' (1876), his best known volume, which has appeared in many subsequent editions; 'Japanese Fairy World' (1880); 'Corea: the Hermit Nation' (1882); 'Corea, Without and Within' (1884); 'Matthew Gailbraith Perry: a Typical American Naval Officer' (1887–90); 'The Lily Among Thorns' (1889); 'Honda the Samurai' (1890) 'Sir William Johnson and the Six Nations' (1891); 'Japan in History, Folklore and Art' (1892); 'Brave Little Holland' (1894); 'Townsend Harris: First American Envoy in Japan' (1895); 'The Romance of Discovery' (1897); 'The Pilgrims in their Three Homes' (1898); 'The Romance of American Colonization' (1898); 'The Romance of American Conquest' (1898); 'The American in Holland' (1899); 'The Pathfinders of the Revolution' (1900); 'In the Mikado's Service'; 'A Maker of the New Orient'; 'Sunny Memories of Three Pastorates' (1903).

Griffiths, Arthur George Frederick, English soldier and author: b. Poonah, India. He served in the Crimean War, was inspector of prisons 1878–96, edited 'The Fortnightly Review' (1884), and is editor of 'The Army and Navy Gazette.' He is the author of 'The Queen's Shilling' (1872); 'Memorials of Millbank' (1875); 'Lola: a Tale of the Rock' (1878); 'Chronicles of Newgate' (1883); 'A Prison Princess' (1890); 'Secrets of the Prison House' (1893); 'Criminals I Have Known' (1895); 'The Rome Express' (1896); 'Wellington and Waterloo'; 'Mysteries of Police and Crime' (1898); 'A Girl of Grit' (1898); 'Ford's Folley, Ltd.' (1899); 'The Brand of the Broad Arrow' (1900); 'A Set of Flats' (1901); 'A Duchess in Difficulties'; 'Tales by a Government official'; etc.

Griffon, or **Bassett-griffon**, a large grayish-red field-dog, combining the qualities of both pointer and setter, but having a thick hard coat enabling it to work readily in thickets and rough country. It originated in Germany at the end of the 19th century.

Griggs, Edward Howard, American lecturer: b. Owatonna, Minn., 9 Jan. 1868. In 1889 he was graduated from Indiana University (Bloomington), and later studied at the University of Berlin, and was successively instructor in English literature and professor of literature in Indiana University. Subsequently he became professor of ethics, and upon the combining of the departments, professor of ethics and education, in the Leland Stanford, Jr., University. From 1899 he was active as a public lecturer, particularly in connection with the courses of the Brooklyn (N. Y.) Institute of Arts and Sciences. He wrote 'Moral Education' (1905).

Griggs, John William, American politician: b. Newton, N. J., 10 July 1849. He was graduated at Lafayette College in 1868, and was admitted to the bar in 1871, practising in Paterson, N. J. He was a member of the New Jersey General Assembly, 1876–77; a state senator, 1882–88; and president of the state senate in 1886. He became governor of New Jersey 1 Jan. 1896, resigning 31 Jan. 1898 to become attorney-general in President McKinley's cabinet. He resigned in April, 1901.

Grijalva, Juan de, hoo-än' dā grē-häl'vä, Spanish navigator: b. Cuellar 1489 or 1490; d. Nicaragua, 21 Jan. 1527. He was intrusted by his uncle, Don Diego Velasquez, the first governor of Cuba, with the command of a fleet of four vessels, which, on 1 May 1518, sailed from St. Jago de Cuba, to complete the discoveries which Fernandez de Cordova had made in Yucatan the year preceding. Rounding the peninsula of Yucatan, he extended his explorations as far as the province of Panuco, giving his name and that of his companion, Alvarado, afterward famous in the expedition of Cortes, to two rivers on the coast. His communication with the Aztecs was friendly, and so profitable that he was enabled to send back one of the ships well freighted with gold, jewels, and other treasures, the acquisition of which was one of the main objects of the expedition. On his return to Cuba he found an expedition organizing for the conquest of Mexico, with Cortes at the head, and was received by Velasquez with reproaches for having neglected to plant colonies on the coast. Grijalva, a man of integrity and prudence, had, however, acted strictly in conformity with his instructions, and against his own judgment. In the latter part of his life he settled in Nicaragua, and was slain in an outbreak of the Indians in the valley of Ulancho.

Grillparzer, Franz, fränts grĭl'pärt-sĕr, German poet and dramatist: b. Vienna 15 Jan. 1791; d. there 21 Jan. 1872. In 1813 he entered the service of the imperial court, retiring to private life with the title of Hofarth (court councillor), in 1856. In 1861 he was appointed member for life of the imperial council. He became known as a dramatist in 1816 by his 'Ahnfrau,' a tragedy of the fatalistic school, which still keeps the stage. It was followed by the dramas 'Sappho' (1819); 'Das Goldene Vliess' (1822); 'Des Meeres und der Liebe Wellen' (1840), an adaptation of the legend of Hero and Leander. Perhaps the finest of Grillparzer's products is the historical drama of 'König Ottokar's Glück und Ende' (1825).

Grilse, a young salmon (q.v.).

Grimes, James Wilson, American politician and legislator: b. Deering, Hillsboro County, N. H., 20 Oct. 1816; d. Burlington, Ia., 7 Feb. 1872. He was graduated at Dartmouth College (1836), and went west, where he began the practice of the law, was appointed secretary of a commission instituted to negotiate the transfer of lands from the Sac and Fox Indians, and after the organization of Iowa Territory in 1838, he was elected to its legislature. He was elected governor of Iowa in 1854, and after completing his term, was sent to Congress as a Republican Senator. He voted for the acquittal of President Johnson at his impeachment trial.

Grimké, grĭm'kē, **Archibald Henry,** American lawyer: b. Charleston, S. C., 17 Aug. 1849. He was graduated from Lincoln University in 1870, from the Harvard Law School in 1874, and in 1883–85 was editor of the 'Hub,' a Boston newspaper. In 1891–92 he was a special writer for the Boston *Herald* and *Traveller,* and in 1894–98 United States consul at Santo Domingo. His writings include a 'Life of William Lloyd Garrison' (1891), a 'Life of Charles Sumner' (1892), and numerous contributions in periodicals, dealing chiefly with various questions pertaining to the American negro.

Grimké, Thomas Smith, American lawyer and scholar: b. Charleston, S. C., 26 Sept. 1786; d. near Columbus, Ohio, 12 Oct. 1834. He was graduated at Yale College in 1807, studied law at Charleston and rose to eminence at the bar and in the politics of his State. He became widely known by his addresses in behalf of peace, religion, and literature. An early and prominent advocate of the American Peace Society, he held the opinion that even defensive warfare is wicked. Though a superior classical scholar, he maintained that neither the classics nor mathematics should enter into any scheme of general education in this country. In some of his pamphlets he introduced a new system of orthography of the English language. A volume of his addresses was published at New Haven in 1831.

Grimké Sisters, The, Sarah Moore, and Angelina Emily: b. Charleston, S. C., 1792 and 1805; d. Hyde Park, near Boston, 1873 and 1879. They were sisters of Thomas Smith Grimké (q.v.). They liberated their slaves, removed to Philadelphia, entered the Society of Friends, and became known in connection with the Anti-slavery movement. They went to New York in 1836 and in the year following to Boston; were leaders in the American Anti-Slavery Society, and appeared as platform speakers on slavery. In 1854 they established a successful coeducational academy at Eagleswood (near Perth Amboy), N. J. Sarah lectured also on woman's rights. Angelina wrote 'An Appeal to the Christian Women of the South'; Sarah an 'Epistle to the Clergy of the Southern States.'

Grimm, Jakob Ludwig, yä'kōb lood'vĭg grĭm, German philologist: b. Hanau, Hesse-Cassel, 4 Jan. 1785; d. Berlin, 20 Sept. 1863. In 1806 he became librarian to Jerome Bonaparte, king of Westphalia, and from 1816 to 1829 occupied the post of second librarian at Cassel. From 1830 to 1837 he resided at Göttingen as professor and librarian, lecturing on the German language, literature and legal antiquities. Having, with six other professors, resisted the unconstitutional encroachments of the King of Hanover, he was banished, and after his retirement to Cassel, he was, in 1841, called to Berlin as a professor and member of the Academy of Sciences. He sat in the National Assembly of 1848, and in that of Gotha in 1849. From that time till his death, he occupied himself only with his various publications. He wrote on German mythology, German legal antiquities, the history of the German language, and published old German poems, etc. His two greatest works, both unfinished, are his 'Deutsche Grammatik' (1819–37), and his 'Deutsches Wörterbuch' commenced in 1852, in conjunction with his brother Wilhelm (q.v.), and gradually completed by eminent scholars. He also published, in company with his brother, the 'Kinder und Hausmärchen,' one of the most popular collections of juvenile fairy tales.

Grimm, Wilhelm Karl, vĭl'hĕlm kärl, German philologist: b. Hanau, 24 Feb. 1786; d. Cassel, 16 Dec. 1859. He was the companion in study of his brother, Jakob Grimm (q.v.), at the Lyceum of Cassel, the University of Marburg, and again at Göttingen, where in 1830 he was appointed under-librarian and supernumerary professor of philosophy. He joined his brother in the protest against the King of Hanover, shared his exile, and also his call to Berlin. There they labored together, and were commonly known as the Brothers Grimm. Under that name also they have a certain immortality in the affections of the civilized world. His earliest independent work was a German translation of the Danish 'Kœmpe-Viser' (1811–13). He edited many old German texts and collaborated with his brother Jakob in several of his works. His own most important book is 'Die deutsche Heldensage' (1867), and 'Kleinere Schriften,' (1881–86).

Grimm's Law is the name given to the rule which regulates the *Lautverschiebung*, or permutation of certain primitive consonants, which takes place in the Teutonic languages. The law, as finally formulated by Jakob Grimm, is that if the same roots or words exist in Sanskrit, Greek, and generally in Latin, Celtic, Lettic, and Slavonic, and also in Gothic, English, Dutch, and other Low German dialects on the one hand, and in Old High German on the other, the following correspondences are to be expected: (1) Gothic has a soft mute, and High German a hard mute, in place of the corresponding aspirate in Sanskrit and Greek; (2) Gothic has a hard mute, and High German an aspirate, in place of the corresponding soft mute in Sanskrit and Greek; (3) Gothic has an aspirate, and High German a soft mute, in place of the corresponding hard mute in Sanskrit and Greek. Thus, a primitive *th* becomes *d* in Low German, and *t* in High German, as in the words *th*ugatēr, *d*aughter, *t*ochter. A primitive *d* becomes *t* in Low German, and *z* in High German, as in *d*uo, *t*wo, *z*wei; or *d*ens, *t*ooth, *z*ahn; or *d*ecem, *t*en, *z*ehn. A primitive *t* becomes *th* in Low German, and *d* in High German, as in *t*res, *th*ree, *d*rei; or *t*u, *th*ou, *d*u; or *t*enuis, *th*in, *d*ünn. Similar changes affect the labials and gutturals, as in *p*ecus, *f*ee, *v*ieh; *p*ater, *f*ather, *v*ater; *f*agus, *b*eech, *p*uocha; and in *o*culus, *e*ghe ("eye"), auge; *qu*is, *w*ho, *w*er; or *kh*ortos, garden, *k*orto. The normal changes are set forth in the following table:

	Labials			Dentals			Gutturals		
Greek, etc.	p	h	ph	t	d	th	k	g	kh
Gothic, etc.	f	p	b	th	t	d	(h)	k	g
Old High German	b(v)	f	p	d	z	t	g(b)	ch	k

The credit of the discovery of the *Lautverschiebung* is not wholly due to Jakob Grimm. Ihre and Rask had discovered, as early as 1818, the law of the transmutation of consonants in Greek and Gothic, while Grimm, in the second edition of his 'Deutsche Grammatik'; which appeared in 1822, added the corresponding changes in Old High German, and formulated the law as it now stands.

Grimm's Law may be interfered with by the action of other laws, especially by the position of the accent, as formulated in Verner's Law (q.v.). Thus *fráter* is accented on the first syllable and *patér* on the second, consequently, though we have *brother* and *father* in English, we find *bruder* and *vater* in High German. The accent in *patér* has interfered with the regular action of the *Lautverschiebung*, and prevented the normal change of *t* to *d* from taking place.

Thus Grimm's Law may be defined as the statement of certain phonetic facts which happen invariably unless they are interfered with by other facts. The great use of Grimm's Law, in addition to the identification of words in different languages, is in the detection of loan words. Any etymology which violates Grimm's Law, as qualified by other phonetic laws, must be rejected unless it can be explained as a loan word.

The causes which brought about the changes formulated in Grimm's Law are obscure. They are probably due to the settlement of Low German conquerors in central and southern Germany.

See Douse, 'Grimm's Law: a Study of Lautverschiebung' (1876), Max Müller, 'Lectures on the Study of Language,' 2d series, lecture v. (1864), Morris, 'Historical Outlines of English Accidence,' chap. ii. (1872).

Grimsel (grĭm'zĕl) **Pass**, a mountain pass in the Bernese Alps, leading from Meiringen, canton of Bern, to Obergesteln, canton of Valais. It was in this pass that the French repulsed the Austrians in 1799.

Grim'shaw, Robert, American engineer: b. Philadelphia, Pa., 25 Jan. 1850. He is lecturer in the Franklin Institute of his native city and has done much literary work. He has published: 'Saws' (1880); 'Steam-Engine Catechism' (1887); 'Records of Scientific Progress' (1891); 'Hints to Power Users' (1891); 'Fifty Years Hence' (1892).

Grim'thorpe, Edmund Beckett Denison, Lord, English barrister and author: b. Carlton Hall, Nottinghamshire, England, 12 May 1816; d. 29 April 1905. He took much interest in architecture, and designed many churches and houses, but he will be longest remembered for his restorations and rebuildings at St. Albans Cathedral, works which were carried out at his own expense, but from their iconoclastic character met with almost universal disapproval from architects and excited much discussion both in England and America. His works include: 'Origin of the Laws of Nature' (1879); 'A Book on Building' (2d ed. 1880); 'Should the Revised New Testament be Authorized?'

(1882); 'Astronomy Without Mathematics' (7th ed. 1883); 'Treatise on Clocks, Watches, and Bells' (7th ed. 1883).

Grinding, a mechanical process in which certain effects are produced by the attrition of two surfaces. This process is of extensive use in various mechanical arts, as in grinding corn, ores, colors, in which cases the object is to reduce the materials by crushing to a fine powder; or in grinding the metals, glass, and other hard substances for the purpose of giving them a certain figure or polish, or a sharp cutting edge. In the first case the grinding or crushing is effected by passing the material between rough stones, as in the common flour-mill, or as in crushing ores between heavy metal cylinders, smooth or fluted, according to the degree of fineness required, or by a heavy stone or iron cylinder revolving upon a smooth plate. Chicory, chocolate, plumbago for pencils, and a variety of other substances are ground by iron or stone rollers, revolving on a slab in such a manner that they not only merely roll but also rub on the surface of the slab. A knife or scraper follows one roller and precedes the other, scooping the paste into the position required to come fairly under the roller which follows it. Colors are ground in small quantities with a muller and slab. The muller is a heavy piece of stone of conical shape, and which rests its base on the slab and is grasped by the hands; the color is mixed to a pasty consistence with the desired medium of oil or water, and rubbed between the two surfaces until smooth and impalpable. The grinding of cutlery and tools is effected by means of the grindstone; glass lenses and metal specula are ground to shape with emery-powder laid on a metal tool. Ornamental glass is ground into facets or otherwise by means of stones and lap-wheels. Diamonds and other precious stones are cut or ground with diamond dust embedded in soft iron. Large flat surfaces are obtained by first working two pieces of the material nearly flat and then laying the one upon the other and grinding their surfaces together with sand, emery, or other cutting powder. Plate-glass is flattened in this way; also surfaces of cast-iron, where accurate fitting is required. Sockets and other bearings which require to be fitted with great nicety are usually finished by being ground together. For brass or bell-metal pumice-stone is employed in such cases, as emery is apt to embed itself in the metal and give it a permanent abrading action on the bearings. Dry grinding is the term applied to the grinding of steel with dry grindstones. The points of needles and forks are produced by this means, also the finishing of steel pens and the surface of gun barrels. The men and women engaged on this kind of work suffer painfully from irritation of the throat and nostrils caused by the fine, dust-like particles that fly off from the work. These difficulties have been mitigated in recent years by the use of mouth-pieces of damp cloth, and the provision of air-blasts to dispose of the dust. Sand-jet grinding is a remarkable process, in which abrasion is effected by the percussion of small hard particles on a plain surface. Sharp silicious sand, varying in hardness and fineness according to the kind of work to be done, is employed in most cases. This sand is impelled by a blast of steam or of air. A hole 1½ inch in diameter by 1½ deep, has been bored through a solid piece of corundum (the hardest mineral known except the diamond) in 25 minutes by sand driven with steam-power at 300 pounds pressure on the square inch. A diamond has been sensibly reduced in weight, and a topaz altogether dissipated by a sand-jet in one minute. These results are obtained by causing a sand-stream to mix with a steam jet. The sand passes through a central tube, and the steam through an annular tube which surrounds it; a kind of suction acts at the end of the concentric tubes, which draws the sand into the steam jet, and both dash with great force against the stone or other substance to be acted upon, which is placed at about an inch from the mouth of the tube. By the use of flexible jointed connecting tubes the jet can be turned in any direction, and grooves, moldings, letters, etc., can be produced instead of merely straight cuts or cavities. By using an air jet instead of steam, and varying the pressure, a design can be engraved on glass, the parts not to be acted upon being covered with the pattern, made of paper, lace, india-rubber, or oil-paint.

Grindstone Island. (1) A small island lying off the southeastern coast of New Brunswick, Canada, at the head of the Bay of Fundy. It has a number of sandstone quarries, from which a fine quality of sandstone is exported, chiefly to the United States, for the manufacture of grindstones. (2) One of the most important of the Magdalen Islands, belonging to Quebec, in the gulf of St. Lawrence, northeast of New Brunswick.

Grinnell, grĭn-ĕl', **George Bird,** American writer and ornithologist: b. Brooklyn, N. Y., 20 Sept. 1849. He has been an editor of 'Forest and Stream' from 1876. His works deal principally with Indian life and folklore and among them are: 'Pawnee Hero Stories and Folk Tales' (1889); 'The Story of a Prairie People'; 'The Story of the Indian' (1895); 'The Indians of To-day' (1900); 'Jack Among the Indians' (1900).

Grinnell, Henry, American patron of arctic exploration: b. New Bedford, Mass., 1799; d. New York, 30 June 1874. In 1828 he settled in New York and amassed a fortune in business as a ship-owner. This gave him an opportunity to fit out at his own expense the ship which in 1850 sailed from New York in search of Franklin. He also bore a large part of the expense of Kane's arctic voyage (1853–55), as well as of the later American expedition under the command of Hayes and Hall. In recognition of his services to geographical science the American Geographical Society elected him their president and the coast which stretches to the north of Smith Sound was named Grinnell Land.

Grinnell, Josiah Bushnell, American clergyman and politician: b. New Haven, Vt., 22 Dec. 1821; d. Marshalltown, Iowa, 31 March 1891. After studying at Auburn Theological Seminary, he entered the Presbyterian ministry and held pastorates successively at Union Village, N. Y., Washington, D. C., and New York. In 1854 he founded the Congregational Church in Grinnell, Iowa, a town named for him, and preached there several years. Later he became known as a wool grower, sat in the Iowa senate 1856–60, and in Congress as a Republican 1863–67. He frequently aided fugitive slaves and at one time a reward was offered for his head on this account by slave-holders. He gave much assistance to Grinnell University, of which he was president, and laid out five Iowa towns. He was the author of 'The Home of the Badgers' (1845); 'Cattle Industries of the United States' (1884).

Grinnell, Iowa, city in Poweshiek County; on the Chicago, R. I. & P., and the Iowa C. R.R.'s; 115 miles west by north of Davenport. It is the principal trade centre for the county, and manufactures flour, carriages, gloves, and some farming implements. It is the seat of the Iowa College, founded in 1848 and under the auspices of the Congregational Church. In 1882 the city was nearly swept away by a cyclone. Pop. (1900) 3,860.

Grinnell Land, a large tract of land in the Arctic Ocean, separated from Greenland by Kennedy and Robeson channels. The northern part of the explored portion is called Grant Land and the southern part Ellesmere Land. The coast is irregular, and the interior is hilly. The climate of the valleys is mild in summer; in many places there is no snow for several weeks, and vegetation grows rapidly. The fox, wolf, musk-ox, ermine, and hare are found in quite large numbers. Lieut. De Haven, an American, in charge of the Grinnell expedition in search of Sir John Franklin, first saw this land 22 Sept. 1850 and named it after Henry Grinnell (q.v.). Eight months later it was visited by Capt. Penny of the British vessel, Lady Franklin. He not knowing of the previous visit called the country Prince Albert Land. A British expedition under Narses visited it 25 years after De Haven, Greely in 1881, Lockwood in 1882, and Peary in 1898–99.

Gripe. (1) A brake applied to the wheel of a crane or derrick; it generally consists of an iron hoop under the control of a lever, and is drawn closely around the wheel to check its motion. (2) As a nautical term: (a) The fore-foot of a ship, on to which the stem is fastened; the forward end of the keel. It is scarfed to the stem piece and false keel, and is secured by a horseshoe or ring to the stem. (b) A broad plait of rope or bars of iron, with lanyard rings and claws, passing over a large boat, and by which it is secured to the ring bolts of the deck. (c) One of a pair of bands passing round a boat near the stem and stern when suspended from the davits, to prevent the boat from swinging about.

Grippe. See INFLUENZA.

Griqualand (grē'kwa-lănd) **East**, a district of Cape Colony, Africa, lying south of Natal, between Pondoland and Basutoland; area, 7,594 square miles. The capital is Kokstad. Pop. (1891) 152,618.

Griqualand West, a district of Cape Colony, Africa, bounded north by Bechuanaland, east by the Orange River colony, south by Orange River, and west by Orange River and Bechuanaland; area, 15,197 square miles. It is noted for its diamond fields which in 1870 began to attract people from other countries. The country was then claimed by the Orange Free State and by Waterboer, the Griqua chief. In 1871 Waterboer ceded all his rights to the British government, and in 1876 the Orange Free State relinquished all claim for the sum of about $440,000. In 1880 Griqualand West was incorporated as a part of Cape Colony. The chief centre of the diamond mining industry is Kimberley (q.v.), the capital. Pop. (1891) 83,375. Consult: 'Statesman's Year Book'; Reports (British) 'On the Cape and Griqualand West Diamond Mining:' Reunert, 'Diamonds and Gold in South Africa'; Williams, 'The Diamond Mines of South Africa' (1902).

Gris'com, John, American educator: b. Hancock's Bridge, Salem County, N. J., 27 Sept. 1774; d. Burlington, N. J., 26 Feb. 1852. After pursuing his studies at the Friends' Academy in Philadelphia, established by William Penn, he took charge of the Friends' monthly meeting school in Burlington, with which he was connected 13 years. In 1807 he removed to New York, and began there a career of 25 years as a teacher. In connection with his school he lectured on chemistry with much success. He took a prominent part in the formation of the society for the prevention of pauperism (1817), of which he prepared the constitution and an elaborate first report on the causes and remedies of pauperism. He was an organizer of the Rutgers Medical College, in which he occupied the chair of chemistry and natural philosophy, and after the suspension of the college was widely known as a general lecturer on those subjects. Horace Mann quoted him as one of the eight educational authorities for the changes which Mann planned to introduce into the Massachusetts school system.

Grisons, grē-zôṅ (German, *Graubünden* or *Bünden*), the largest canton of Switzerland; area, about 2,773 square miles. It is a mountainous country, more than 20 peaks being above 9,000 feet. The valleys are generally narrow, Upper and Lower Engadine are the broadest. Its chief drainage streams are the Inn, branches of the Adige and the Adda, and the Vorder and the Hinter Rhine which have their rise in this canton, and which belong to the Rhine basin. There are a large number of small lakes. Snow rests on the mountains until the last of May and sometimes into late July, but the climate of the valleys is warm or temperate nearly all the year. Agriculture in the valleys and the raising of cattle and sheep on the mountain sides are the chief occupations. Pop. (1900) 104,510.

Griswold, grĭz'wōld, **Alexander Viets**, American Protestant Episcopal bishop: b. Simsbury, Hartford County, Conn., 22 April 1766; d. Boston, Mass., 15 Feb. 1843. After studying for the ministry he was ordained in 1795. He was rector of St. Michael's Church, Bristol, R. I., 1804–30 and of St. Peter's, Salem, Mass., 1830–35. When what was known as the eastern diocese of the Episcopal Church was organized he was consecrated its first bishop in 1811. He published 'The Reformation and the Apostolic Office' (1843). See Stone, 'Memoirs of Bishop Griswold' (1844).

Griswold, John Augustus, American manufacturer: b. Nassau, Rensselaer County, N. Y., 1822; d. 1872. At Troy, N. Y., he was active successively in the hardware, drug, and iron trades, and established the Albany and Rensselaer Iron and Steel Company. He was a leader in the introduction of Bessemer steel manufacture into the United States, and with C. H. Delamater built the Monitor of Civil War fame. In 1855 he was elected mayor of Troy, in 1863 a Democratic representative in Congress, and subsequently was twice re-elected as a Republican. In 1868 he was nominated for the governorship of New York, but defeated by the Democratic nominee, J. T. Hoffman.

Griswold, Matthew, American jurist: b. Lyme, Conn., 25 March 1714; d. there 28 April 1799. Besides being lieutenant-governor of Connecticut 1771–84, he was governor 1784–85 and became judge of the supreme court in 1769. He also presided over the convention which ratified the Federal Constitution.

Griswold, Roger, American politician: b. Lyme, Conn., 21 May 1762; d. Norwich, Conn., 25 Oct. 1812. He was graduated from Yale College in 1780, and afterward studied and entered on the practice of law. He was a member of Congress, 1795–1805, and became judge of the Connecticut supreme court in 1807. He was lieutenant-governor of his native State, 1809–11, and governor 1811–13. He was a son of Matthew Griswold (q.v.).

Griswold, Rufus Wilmot, American author and compiler: b. Benson, Rutland County, Vt., 15 Feb. 1815; d. in New York 27 Aug. 1857. He was apprenticed to the printing trade, but afterward studied divinity and became a preacher in the Baptist Church. He soon became associated in the editorship of literary periodicals in Boston, New York, and Philadelphia, among which were the 'New Yorker,' 'Brother Jonathan,' and the 'New World.' In 1842–43 he edited 'Graham's Magazine,' in Philadelphia, to which he attracted contributions from some of the best writers in the country, and in 1850 projected the 'International Magazine,' published in New York, and edited by him till April, 1852. The works by which he is chiefly known are collections of specimens from American authors, accompanied by memoirs and critical remarks. His published works include: 'Poets and Poetry of America' (1842); 'Prose Writers of America' (1846); 'Female Poets of America' (1849); 'Sacred Poets of England and America' (1849); 'Poets and Poetry of England in the Nineteenth Century' (4th ed. 1854); 'Curiosities of American Literature,' 'Washington and the Generals of the American Revolution,' with Simms, Ingraham, and others (1847), 'Napoleon and the Marshals of the Empire,' with Wallace (1847); 'Republican Court, or American Society in the Days of Washington' (1854). He edited the first American edition of the prose works of Milton (1845), and was one of the editors of the works of Edgar A. Poe, for whose bad repute Griswold's 'Memoir' is partly responsible.

Griswoldville, Battle of. When General Sherman marched from Atlanta to the sea, his right wing, commanded by Gen. Howard, was under instructions to threaten Macon and strike the Savannah Railroad at Gordon, about 20 miles east. Upon his arrival at Clinton, the cavalry advance made a demonstration on Macon, and 21 Nov. 1864, his entire cavalry force took up an advanced position covering all the roads to Macon, and that day and the next all the troops and trains were closed up toward Gordon, except C. R. Woods' division, which was directed to take up a strong position on the Irwinton road and demonstrate on Macon and Griswoldville, eight miles east. The demonstration was made on the 22d by Walcutt's brigade of 1,513 men and two guns, in co-operation with Kilpatrick's cavalry on the different roads. Some of Kilpatrick's cavalry were in advance of Walcutt and were fiercely attacked by Wheeler; but with Walcutt's assistance Wheeler was driven from the field, and followed by Walcutt beyond Griswoldville. Walcutt was then recalled to a position a little east of Griswoldville, where two miles in advance of his division, he formed line along a slight rise of ground, with his flanks well protected by swampy ground, and with an open field in front. Kilpatrick's cavalry was on either flank. Walcutt had scarcely thrown up a rail barricade, in view of another attack of Wheeler's cavalry, when he was fiercely assailed by infantry. That morning, under Gen. Hardee's order, Gen. G. W. Smith, in command of a considerable body of Georgia militia that had been concentrated at Macon, directed Gen. Phillips, with a division of infantry and a battery, to march from Macon to Gordon and take trains for Augusta. Phillips had been instructed to halt before reaching Griswoldville and wait for further orders, and was cautioned not to engage an enemy if met, but to fall back to the fortifications at Macon. But when he heard of Walcutt's position he moved through Griswoldville and, with more courage than discretion, threw his four brigades against Walcutt, at the same time opening destructively with his artillery. At 2 o'clock, in three compact lines, his militia charged to within 75 yards of Walcutt's line, and were repulsed. The assaults were repeated in front and on both flanks, and continued until sunset, when, everywhere repulsed, he abandoned the field, leaving his dead and wounded. During the action Walcutt was severely wounded by a piece of shell. The Union loss was 13 killed, 69 wounded, and 2 missing. The Confederate loss was 51 killed and 472 wounded. Consult: 'Official Records,' Vol. XLIV.; Cox, 'The March to the Sea'; the Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. Carman.

Griv'et. See Green Monkeys.

Groesbeck, groos'běk, **William Slocomb,** American politician: b. New York, 1815; d. 1897. He was graduated from Miami University, Oxford, Ohio, in 1835, studied law and began practice at Cincinnati. In 1851 he was a member of the Ohio State constitutional convention, and in 1852 a member of the commission appointed for the codification of the State laws. From 1857 to 1859 he was a Democratic representative in Congress, in 1872 was nominated for the Presidency by the Liberal Republicans but met no recognition in the ensuing campaign, and in 1878 was United States delegate to the International Monetary Congress at Paris. He defended Andrew Johnson in the latter's impeachment trial (1868).

Groin, the region where the front of the thigh joins the body. The abdominal muscles end below in a strong tendon which makes a fold across the front of the bony pelvis. The large nerves, arteries, and veins pass through folds of this ligament, and portions of the abdominal contents in case of rupture pass into the scrotum or form a tumorous swelling in the groin.

Gronlund, grōn'lŭnd, **Lawrence**, American socialist: b. in Denmark 1847; d. 1899. He studied in the University of Copenhagen, in 1867 came to the United States, practiced law for a time, but became a writer and speaker on socialism. Among his publications are 'The Coming Revolution' (1880), a forecast of the peaceful changes which he believed might be effected by a national organization operating in every community; 'Ça Ira,' a rehabilitation of Danton (1888); and 'The New Economy' (1898).

Gronovius, grō-nō'vĭ-ŭs (properly Gronov, grō'nōv), the name of several Dutch classical scholars:

(1) Johann Friedrich, yō'hän frēd'rĭh: b. Hamburg 8 Sept. 1611; d. Leyden, 28 Dec. 1671. He studied at Leipsic and Jena, and law at Altdorf, was appointed professor of history and eloquence at Deventer (1642), and, after the death of Heinius, succeeded him as professor of belles-lettres at Leyden (1658). His editions of Livy, Statius, Justin, Tacitus, Aulus Gellius, Phædrus, Seneca, Sallust, Cicero, Terence, Pliny, and Plautus, 'Observationes' (1639), and edition of Hugo Grotius' work, 'De Jure Belli et Pacis' (1642) are justly valued on account of the notes.

(2) Jakob, yä'kōb, son of the preceding: b. Deventer, 1645; d. Leyden, 21 Oct. 1716. He studied at Deventer and Leyden, and published, in 1676, an edition of Polybius, which met with great applause. He received from the grand duke of Tuscany a professorship at Pisa, which he relinquished in 1679 to become professor of Greek literature and history at Leyden. This learned critic edited Tacitus, Polybius, Herodotus, Pomponius Mela, Cicero, Ammianus Marcellinus and other classical writers, and compiled the valuable 'Thesaurus Antiquitatum Græcarum' (1698–1702). He also promoted the publication of the collections of Grævius. He was a violent controversialist.

Groot, grōt, **Groete**, or **Groote**, **Gerhard** or **Gerardus**, founder of the Brothers of the Common Life (q.v.): b. Deventer 1340; d. there 20 Aug. 1384. Educated at Paris, he there became a teacher, later took deacon's orders and was successful as a traveling preacher. He advocated general reading of the Scriptures, assembled a company for the preparation of copies of the Bible, and thus began the formation of the Brothers of the Common Life. To this order, which obtained papal sanction in 1418, belonged Thomas à Kempis (q.v.). Groot was the author of several works.

Gros, Antoine-Jean, aṅ-twän zhōṅ grō, Baron, French historical painter: b. Paris 16 March 1771; d. near Paris, 26 June 1835. At 14 he became a pupil of David, and in 1794 left Paris for Rome. His means, however, were not sufficient for the journey, and he had to depend on what he could earn as a portrait-painter in the various towns he passed through. At Genoa, in 1796, he was drawn for the French army, and soon became a staff-officer. Josephine, afterward empress of France, saw and admired several portraits by the young officer, and he was called upon to paint that of Bonaparte. The result was a picture representing Napoleon leading his troops over the bridge of Arcola. In 1804 he produced his 'Peste de Jaffa,' considered by many to be his masterpiece. He painted the 'Bataille d'Aboukir' (1806); 'Bataille d'Eylau' (1808); 'La Prise de Madrid,' 'Wagram,' and 'La Bataille des Pyramides' (1810). In France his chief work is considered by some to be the cupola of St. Geneviève at Paris, exhibiting the saint protecting the throne of France, represented by Clovis, Charlemagne, St. Louis, and Louis XVIII. This picture covers an immense space, and is correct in design but defective in color and expression. The artist received for it 100,000 francs and the title of baron. The rise of the romantic school bore away from him the tide of popularity, and his last work 'Hercule et Diomède,' was a failure. Adverse criticisms upon it brought on a fit of despondency and he drowned himself in the Seine.

Gros Ventres, grō väntr (Fr. «big bellies»). (1) The Minnetari or Hidatsa Indians, on the Missouri River. (2) A band of the Arapaho, who separated from the main body about 1800; the name was a misunderstanding of their own term, which meant «hungry men» or «beggars.» After conflicts with the Sioux, and being plundered by the Crows, whom they had joined, they settled among the Blackfeet near Milk River about 1824; prospered, and were very hostile to the whites. About 1830 they had some 400 lodges and 3,000 souls. But about 1866 they were decimated by the measles, and thus weakened, received a terrible defeat from the Piegans; reduced to about 1,300 by smallpox in 1870, they were plundered and many killed by the Sioux. Later they were joined by the main body of Arapaho and Cheyennes. In 1868 they were settled among the Blackfeet in Montana.

Grosbeak, grōs'bēk, any of various birds whose beaks seem disproportionately large. They are mainly finches such as the hawfinch and bullfinch in Europe, and their relatives in the Orient. Bird-dealers call «grosbeaks» a great number of African, Asiatic and American line cage-birds, some of which are weaver-birds, or tanagers, etc. The term is more exactly given to certain North American fringilline birds with big swollen bills, such as the cardinal (q.v.), the evening grosbeak (q.v.), and the pine, blue, rose-breasted, and black-headed grosbeaks. The pine grosbeak (*Pinicola enucleator*) is a greenish yellow finch which dwells exclusively in the coniferous forests of northern Europe and America, and is only seen in the United States when forced southward by hard winters; it feeds on the seeds of the pine, spruce, etc., wrenching open the cones with its powerful beak. The blue grosbeak (*Guiraca cærulea*) is a large, richly blue southern and western bird, nearly related to the indigo-finch, which makes its nest in a bush, and lays pale blue eggs, wholly unmarked. The rose-breasted and black-headed grosbeaks represent the genus *Zamelodia*, the former (*Z. ludoviciana*) in the Eastern States, and the latter (*Z. melanocephala*) in the Rocky Mountain region. Both are birds of brushy places, making large, rude nests in bushes and laying greenish, heavily marked eggs; and in the breeding-season both are among the loudest and most brilliant of American song-birds. As in nearly all the grosbeaks the females of these species are inconspicuous in brown tints, while the males are dressed in gay colors. The male rose-breasted has the head, neck and upper parts mostly black, with the rump, wings, tail and abdomen, white; while the breast and lining of the bend of the wing are exquisite rose-red, which the bird is fond of displaying. The male black-head has a wholly black head and upper parts, set off by a collar and other marks of dull orange, which color also suffuses the whole lower parts.

Grose, grōs, **William**, American soldier and politician: b. Dayton, Ohio, 1812; d. 1900. He resigned his position as judge of the court of common pleas in 1861 to recruit and take command of the 36th Indiana regiment of infantry, and commanded a brigade in the battles of Murfreesboro, Chickamauga, and Chattanooga. He was commissioned brigadier-general 30 July 1864 and at the battle of Nashville, 15 and 16 Dec. 1864, he commanded the Third brigade in General Thomas's army. In 1865 he was brevetted major-general of volunteers. He was State senator from 1879 to 1883.

Gross, grōs, **Charles**, American historian: b. Troy, N. Y., 10 Feb. 1857. After graduating from Williams College in 1878, he pursued his studies at Göttingen, and was engaged in literary work in England 1884–87. Since 1888 he has been instructor and professor of history at Harvard University. A frequent contributor to the 'American Historical Review' and other historical journals, he has published: 'Gilda Mercatoria' (1883); 'The Exchequer of the Jews of England in the Middle Ages' (1887); 'The Gild Merchant' (1890); 'Select Cases from the Coroner's Rolls' (1896); 'Bibliography of British Municipal History' (1897); 'Sources and Literature of English History' (1900). In addition he has translated: Lavisse's 'Political History of Europe' (1891); Kayserling's 'Christopher Columbus' (1893).

Gross, Samuel D., American physician and surgeon: b. Northampton County, Pa., 8 July 1805; d. 6 May 1884. He began the practice of medicine in Philadelphia, devoting his leisure to study and to the translation of French and German medical works. His first original work was a treatise on the 'Diseases and Injuries of the Bones and Joints' (1830), in which occurs the first account of the use of adhesive plaster as a means of extension in the treatment of fractures. In 1835 he became professor of pathological anatomy in the medical department of the Cincinnati college, where he delivered the first systematic course of lectures on morbid anatomy that had ever been given in this country, and composed the first systematic treatise upon the subject ever published in the United States, 'Elements of Pathological Anatomy (1839). In 1840 he became professor of surgery in the University of Louisville. Besides the works already mentioned, he was the author of a monograph on 'Wounds of the Intestines' (1843): 'Diseases, Injuries, and Malformations of the Urinary Organs' (1851); 'Foreign Bodies in the Air Passages' (1854); 'System of Surgery, Pathological, Diagnostic, Therapeutic, and Operative' (2 vols. 1859).

Grosse, Julius Waldemar, German poet, dramatist, and novelist: b. Erfurt, Prussia, 25 April, 1828; d. 1902. After obtaining his education at Halle, he entered the field of journalism, for 16 years (1854–70), being associated with the *Neue Münchener Zeitung* (afterward known as the *Bayrische Zeitung*), and in 1870 becoming secretary of the Schiller-Stiftung, at Weimar. His writings are various, including novels, dramas, epics, songs, and ballads, the most important of which are his war songs, 'Wider Frankreisch' (1870); 'Das Volkramslied' (1889); 'Gundel von Königssee,' and 'Das Mädchen von Capri,' all epic poems; 'Pesach Pardel' (1871); 'Hilpah und Shalum,' and 'Der Wasunger Not' (1872), comic epics; the dramas, 'Tiberius' (1875), and 'Fortunat' (1895); the novels, 'Ein Revolutionär' (2d ed. 1871), and 'Tante Carldora,' and several tales and romances, among which is 'Die Novellen des Architekten' (1896).

Grosseteste, Robert, English Roman Catholic prelate: b. Stradbrook, Suffolk, about 1175; d. Buckden, 9 Oct. 1253. He studied law, physics, and theology at Oxford and Paris, and, upon his return to England, attained an enviable reputation as a theologian, so much so that in 1214 he became archdeacon of Wifts, and in 1224 received the directorate of theology and became first *rector scholarum* of the Franciscan school at Oxford. In 1232 he took up the cause of the Jews against the king, defending them with great vigor, and in 1235 was elected Bishop of Lincoln, whereupon he undertook to make radical changes in his diocese and eliminate some of the many abuses prevalent there, the result of which was that though he was possessed of great force of character, his high temper and lack of tact and diplomacy led him into innumerable controversies. The most famous of these was with Pope Innocent IV., who, desiring to fill the lucrative positions in the church with Italians and Provençals, in 1253 sent the Bishop a request that he appoint his (the Pope's) nephew to the first vacant canonry in the cathedral of Lincoln. This Grosseteste flatly refused to do, and, as his clergy stood by him in his fight against this abuse, the matter was finally dropped and it is mainly upon this incident that his fame rests. He was, though, a man of great scholarly attainments, Hebrew, Latin, Greek, French, mathematics, medicine, and music being numbered among them, beside which he was one of the most learned preachers of his time and a voluminous writer. Consult: Perry, 'Life' (London 1871); Luard (editor), 'Roberti Grosseteste Episcopi quondam Lincolniensis Epistolæ' in the Rolls Series (1862).

Grossi, Tommaso, Italian poet and novelist: b. Belluno, on the Lake of Como, 20 Jan. 1791; d. Milan, 10 Oct. 1853. He studied law at Pavia and settled in Milan, where he passed the remainder of his life as a notary, but his political ideas prevented his rise in his profession. His first attempt at poetry was 'La Principe,' written in the Milanese dialect, and this was followed in 1816 by two shorter poems, 'La Fuggitiva' and 'La Pioggia d'Oro,' and in 1820 by 'Ildegonda,' a romance in verse. This poem became popular and set the fashion for that style of writing, the success which it attained encouraging him to write 'I Lombardi alla Prima Crociata' in 1826, a poem remarkable for its patriotic sentiment. Despite the fact that Manzoni gives praise to this last poem in his novel 'I promessi sposi,' and that the cost of printing was defrayed by a generous subscription, it was soon forgotten. This did not dishearten him, however, and in 1834 he published his 'Marco Visconti,' which at once excited public approval and became the pioneer of the historical novel in Italy. His only other work of note was 'Ulrico e Lida,' published in 1837.

Grosso, Matto, mä'tō grō'sō, Brazil (q.v.), a western central state bordering on Bolivia, Argentina, and Paraguay. It has an area of 532,500 square miles and an estimated population in 1900 of 157,000. Capital Cuyabá (q.v.).

Grosvenor, grō'vē-nôr, **Edwin Augustus**, American educator and author: b. Newburyport, Mass., 30 Aug. 1845. He was graduated at Amherst College in 1867 and at Andover Theological Seminary in 1872, was professor of history at Roberts College, Constantinople, in 1873–90; and of European history at Amherst College in 1892–9. In 1899 he was appointed to the newly established chair of modern governments and their administration. His publications include translations from the French of Victor Duruy's 'Modern Times' (1894) and 'General History' (1898); 'The Hippodrome of Constantinople' (1889); 'Constantinople' (1895); 'The Permanence of the Greek Type' (1897); and 'Contemporary History' (1899), extending from 1848 to the present time.

Grote, George, English historical writer: b. Clayhill, Kent, 17 Nov. 1794; d. London, 18 June 1871. After having studied at the Charterhouse, in 1809, he became a clerk in his father's banking house. He kept on with his studies, particularly with philosophy, and his liberal trend of thought gradually drew him into politics. He had written and spoken much in favor of the Reform Bill which was passed in 1832, and in that year he was elected to the House of Commons from London, which seat he continuously occupied until 1841. During all these years he had steadily worked upon his 'History of Greece,' the idea of which was suggested to him by the spirit of partiality displayed in Mitford's 'History of Greece' and which he had severely criticised in an article in the *Westminster Review* (April 1826). He had as early as 1823 devoted himself to the study of Greek history, for a sympathetic interpretation of which his extreme liberality made him admirably suited, and though to a certain extent the spirit of democracy is evident in the 'History of Greece,' yet the facts are placed before the reader with the idea that he will form his own conclusion. His private and public duties had prohibited literary work and it was not until he retired that he completed the first two volumes which appeared in 1845, the last volume of the set, the twelfth, appearing in 1856. Grote also wrote 'Plato and the Other Companions of Socrates' (3 vols., 1865); 'Minor Works,' edited by Alexander Bain (London 1873), and 'Aristotle,' which he left unfinished (2 vols., 1872). He had taken an active interest in educational matters, in 1860 becoming vice-chancellor of the London University, and in 1869 president of the University College, and also was elected a trustee of the British Museum. Consult: Mrs. Grote, 'Memoirs' (London, 1873); Alexander Bain, 'Character and Writings of G. Grote,' prefixed to his 'Minor Works' (London, 1873).

Grotefend, Georg Friedrich, German archæologist and philologist: b. Münden, near Cassel, Prussia, 9 June 1775; d. Hanover, 15 Dec. 1853. He received his early education at Hanover and Ilfeld, and completed his studies at the University of Göttingen (1795–7). He became prorector and later conrector of the gymnasium at Frankfort-on-the-Main (1803–21), and for nearly 30 years (1821–49) was director of the lyceum at Hanover. His research in the field of Latin philology was of great value, but his importance is chiefly due to the fact that he first deciphered the old Persian inscriptions of Persepolis, presenting the results of his labors in a paper before the Academy of Science at Göttingen, 4 Sept. 1802. Chief among his publications are: 'Rudimenta linguæ Umbricæ' (1835–8); 'Neue Beiträge zur Erläuterung der babylonischen Keilinschrift' (1840); 'Zur Geographie und Geschichte von alt-Italien' (1840–2); 'Rudimenta Linguæ Oscæ (1839), etc.

Grotius (gro'chi-us), or De Groot, Hugo, Dutch scholar and statesman: b. Delft 10 April 1583; d. Rostock 28 Aug. 1645. He was a pupil of Joseph Scaliger at the University of Leyden, conducted his first lawsuit in his 17th year; and in his 24th was appointed advocate-general. In 1613 he became syndic, or pensionary, of Rotterdam. In 1615 he was sent to England in order to arrange the difficulties arising from the claims of the English to exclude his countrymen from the Greenland whale-fishery. He declared himself on the side of Barneveldt (q.v.) in the struggle between the Remonstrants and their opponents, and was sentenced to imprisonment for life in the fortress of Loevenstein. He succeeded in escaping by concealing himself in a chest, and after wandering about for some time in the Catholic Netherlands escaped to France, where Louis XIII. gave him a pension of 3,000 livres, withdrawn in 1631. He returned to Holland, but by the influence of enemies, was condemned to perpetual banishment. He later went to Hamburg, and in 1634 to Stockholm, where he was appointed counsellor of state and ambassador to the French court, in which post he remained for ten years. On his return to Sweden by way of Holland he met, in Amsterdam, with a distinguished reception. Most of his enemies were dead, and his countrymen repented of having banished the man who was the honor of his native land. With the talents of the most able statesman, Grotius united deep and extensive learning. He was a profound theologian, excellent in exegesis, his 'Commentary on the New Testament' being still esteemed; a distinguished scholar, an acute philosopher and jurist, and a judicious historian. His writings have had a decisive influence on the formation of a sound taste, and on the diffusion of an enlightened and liberal manner of thinking in affairs of science. As a critic and philologist he seizes the genius of an author with sagacity, illustrates briefly and pertinently, and amends the text with facility and success. His metrical translations from the Greek are executed with the spirit of a poet. Among the modern Latin poets he holds one of the first places, and he also tried his powers in Dutch verse. But the philosophy of jurisprudence has been especially promoted by his great work on natural and national law, 'De Jure Belli et Pacis,' which represented the study of twenty years and laid the foundation of the new science of international law; besides which he wrote 'Annales et Historiæ de Rebus Belgicis' (1657); 'Annotationes in Vetus Testamentum'

(1644); 'Annotationes in Novum Testamentum' (1641–46). 'De Veritate Religionis Christianæ, and Poemata' (1617). See Butler, 'Life of Hugo Grotius' (1826); Hély, 'Etude sur le Droit de la Guerre et de la Paix de Grotius' (1875).

Gro'ton, Conn., town in New London County; on the Thames River, the New York, N. H. & H. railroad; opposite New London. In 1637 Capt. Mason stormed the fortress held by the Pequots, and many lives were lost, both whites and Indians. A more disastrous fight occurred here 6 Sept. 1781, when 800 British troops under Benedict Arnold attacked Fort Griswold (q.v.), which was garrisoned by 150 soldiers. The Americans heroically resisted, but were overwhelmed by numbers, and Arnold and his force entering the fort butchered 85 men and wounded 65. Soon after 35 of the 65 died from the effects of their wounds. This battle is known in history as the "Massacre of Fort Griswold." Groton contains ship-building yards, several manufactories, and the Bill Memorial Library. Consult: Caulkins, 'The Stone Records of Groton' (1903); 'History of New London County'; 'Magazine of American History,' 'The Massacre of Fort Griswold.'

Grouchy, groo-shē, **Emmanuel**, Marquis de, French marshal: b. Paris 23 Oct. 1766; d. St. Etienne 29 May 1847. He acquired distinction in the revolutionary armies, and in the campaign of 1800 fought in the army of the Rhine under Moreau, and rendered important service at the battle of Hohenlinden. In the war with Prussia in 1806, and with Russia in 1807, he acquired new fame, and was sent to the army of Italy under Prince Eugene. At the battle of Wagram his masterly manœuvres contributed greatly to the victory. On the restoration he was banished, but allowed to return in 1815. On Napoleon's return from Elba he immediately joined him, was made a marshal, and obtained first the command of the army of the Alps, and then the command of the cavalry in the grand army. After the battle of Ligny he was sent on the following day with 34,000 men and 100 cannon to follow the retreat of the Prussian army under Blücher. While he here on the 18th engaged with Thielemann, Napoleon gave battle at Waterloo, the disastrous issue of which has been sometimes laid to Grouchy's charge, from having failed to observe how three divisions of the Prussian army were advancing to Waterloo to take Napoleon in flank and rear, while Thielemann alone remained at Wavres. Being again banished, he came to the United States, where he lived five years, but was permitted to return in 1819. After the July revolution he was elected to the chamber of deputies by the department of Allier, supported the new dynasty, and was appointed in 1831 marshal, and in 1832 a peer.

Ground Beetles. The family *Carabidæ*, predatory beetles of various sizes and appearance. It contains upwards of 1,200 described species, nearly all of nocturnal habit, and, consequently, dark, mostly black in color. Some species, however, are metallic green or blue, or beautifully variegated. The family contains many beneficial species, which roam fields, meadows and gardens, destroying many injurious pests. They fly freely at night, and seek concealment in the daytime under stones and logs and in other convenient hiding-places. Most species are terrestrial, but a few forms, such as species of *Calosoma*, known as 'caterpillar-hunters,' climb the trunks of trees in search of noxious caterpillars which they destroy. A remarkable genus is that of the bombardier beetles (q.v.). A very few are occasionally injurious, among them *Agonoderus pallipes*, which burrows into newly planted seeds of corn; and two species of *Harpalus* which are destructive to strawberries. These latter insects are interesting because of their dual habit of being carnivorous as well as herbivorous. They attack, in the beetle stage, the seeds of Ambrosia, and also eat insects of various kinds.

Ground-cherry, herbaceous plants of the potato family, constituting the genus *Physalis*, scattered through most of the world. About 35 species are natives of the United States, and some are known as 'tomato strawberries,' and are cultivated for the sake of their berry-like fruit, which is hidden within a persistent red calyx.

Ground Cuckoo, a coucal (q.v.).

Ground-dove, any of various species of pigeons which live mainly on the ground and seek their food there. The name is especially given to the genus *Columbagallina*, small birds of the warmer parts of America, of which one gentle and familiar species (*C. passerina*) is well known in the South Atlantic States, along the coast. The bronze-wing pigeons of Australia, and the large pigeons of the genus *Goura* (q.v.) are also so called.

Ground Ivy, a familiar European labiate plant (*Glechoma hederacea*), allied to mint, with a creeping stem and purple flowers. The leaves are crenate-reniform and the flowers are in threes. It was formerly employed to flavor ale and also medicinally.

Ground-nut, a climbing plant (*Apios apios*) of the pea family, which puts out dense clusters of dull purple flowers after most other plants have stopped blooming; these are velvety within and sweetly fragrant. The tuberous rootstock is edible, whence the name.

Ground-rent, in law, is the rent paid to the landlord by a person for the use of ground on which he intends to build. The usual arrangement is for a specified time, generally for a period of ninety-nine years. On the expiry of this period the whole of the building becomes the property of the ground-landlord. The ground-landlord is able, when his rent is in arrear, to distrain all the goods and chattels found on the premises, to whomsoever they may belong; and as the ground-rent is generally a small sum compared with the furniture of a tenant, he is always certain of recovering its full amount. This power of distress exists whether the tenant has paid his house-rent to his landlord or not, but the tenant may deduct the amount from the next rent he pays. See Landlord; Rent; Tenant.

Ground-sloths, a family (*Megatheriidæ*) of extinct edentates, related to the modern sloths, but of terrestrial habits, and, in respect to many of them, of gigantic size, which are of special interest because some survived into the human period. They exhibit the head and teeth of a sloth, associated with the vertebræ, limbs and tail of an ant-eater. They were chiefly South American, but spread as far as North America in the Pliocene and Pleistocene epochs, and became extinct in very recent, but probably prehistoric times. *Megatherium* (q.v.) is the largest and most familiarly known genus: it almost equalled an elephant in size, and surpassed one in its massive proportions. *Lestodon*, *Mylodon* (q.v.), *Scelidotherium*, and *Megalonyx* were smaller but more common forms. The discovery of part of the hide of one of these animals, genus *Glossotherium*, in a cave at Last Hope Inlet, Patagonia, showed that their skin was thick, studded with small embedded bony nodules, and thickly covered with long, coarse, yellowish-brown hair, as well preserved as are the feathers of the moas in New Zealand. The skin, says the discoverer, Dr. Moreno, of Buenos Ayres, shows patches of red color, suggesting of course blood-stains; and when small bits were chemically analyzed they yielded serum and the substances of glue. In view of this it seems impossible to believe that the skin can be of any great age, for bacteria would have finished their work upon the serum and gelatine long ago. An equally fresh-looking skull was found, as though in a small stone enclosure, and wounded in such a way as only man could have inflicted; and there are legends among the Indians that such creatures were known to their ancestors. Dr. Moreno is of the opinion, from evidences found in this cave and elsewhere, that these animals had been domesticated by man, but to what extent and for what purposes is unknown.

Consult Beddard, 'Mammalia' (1902), where further references are cited.

Ground-snake, one of the little, burrowing worm-shaped snakes of the genus *Carphophiops*, which abound in tropical America. One species (*C. amœnus*) is numerous under stones and logs in the Southern States, and is glistening chestnut in color above and salmon-yellow beneath. A larger, more purplish species (*C. vermis*) is called "ground-worm" in Louisiana. These snakes are perfectly harmless, and are the least specialized of the *Colubridæ*.

Groupers (Anglicized form of Spanish name "Garrupa"). Tropical and semi-tropical sea-bass of the genera *Epinephelus*, *Promicrops*, *Mycteroperca* and their allies. All are valuable food-fishes and most of them of large size, bright coloration and high quality as game-fishes. About a dozen species enter the waters of the Southern States or California, the most common along the Atlantic coast being the red grouper (*E. morio*), called "Cherna" and by many other local names. It is a large fish (20 to 40 pounds), is particularly abundant on the west coast of Florida, keeps near the bottom and is a voracious carnivore, consuming large quantities of small fishes, as well as crabs, etc. It is a favorite with market-fishermen, because it bears so well the hardships of transportation. The yellow-finned grouper or rockfish (*M. venenosa*); yellow grouper (*M. olfax*); and black grouper of the Florida Keys (*M. bonaci*), are also large and important; while another black grouper (*Promicrops*) is the famous jewfish (q.v.) of sportsmen. Several other species are elsewhere described under particular names, as CABRILLA, MERO, SCAMP, etc. Consult 'American Food and Game Fishes,' by Jordan and Evermann (New York 1902).

Groups, Theory of. Everywhere in mathematics are encountered systems of *operations*, possessing definite laws of combination. Thus, two geometric motions compound into a single motion, two algebraic transformations into a single transformation, under laws as definite as the primordial 2×2 of arithmetic but otherwise capable of infinite variety of simplicity and intricacy. Consider, for example, the 12 rotations of a regular tetrahedron into itself. Any two of these rotations compound into a third one among them, easily identified on a model. By a simple convention, these various combinations can be registered in algebraic form. The several rotations may be designated by the marks $a, b, c, \ldots$; the symbol ab may indicate that a is followed by b, and at the same time designate their resultant effect. This resultant ab is called the *product* of a and b in the order written: it is itself one of the 12 rotations, say c, and we write $ab = c$. It is an instructive exercise to tabulate the products of two or more of the 12 rotations, identifying each product with one of the 12 original rotations. It is possible to express all the 12 rotations as products of two of them, say of the rotation a through 120° about an axis through one of the four vertices of the tetrahedron and the rotation b through 180° about an axis joining the middle points of two opposite edges. It may be noted that the products ab and ba are here not the same rotation: a and b are not *commutative* as in ordinary algebra. On the other hand aa, which is a rotation through 240° about the axis of a, is conveniently denoted by a^2; a^3 and b^2, both of which restore every point to its initial position, may appropriately be equated to 1 (identity), which is included among the 12 rotations. The three rotations b_1, b_2, b_3 about the (trirectangular) axes joining the middle points of opposite edges of the tetrahedron will be found to be commutative: in fact $b_1b_2 = b_2b_1 = b_3$, $b_2b_3 = b_3b_2 = b_1$, $b_3b_1 = b_1b_3 = b_2$; $(b_1^2 = b_2^2 = b_3^2 = 1)$.

The tetrahedral rotations furnish a simple instance of an *algebra of operations*. Any system of operations possesses such an algebra, of greater or less extent. And as many different systems of operations, taken from widely separated mathematical fields, often present one and the same algebra, these algebras are worthy of study by themselves, as generalizing and unifying instruments. Since each algebra is completely defined by the laws of combination of the symbols $a, b, c, \ldots$, we may abstract the idea of operation entirely and deal with the pure algebra. This position having been reached, it is inevitable to the mathematical mind to reverse the order of thought and to devise algebras *à priori*, leaving their concrete interpretation for secondary consideration. In constructing such algebras, choice among the infinite possibilities will be dominated by the two principles of generality and usefulness. The two qualities are combined in high degree in the algebra of *groups*.

Definition of Group.—A system of symbols, or *elements*, $a, b, c, \ldots$ (finite or infinite in number), conceived as capable of multiplication with each other, is said to form a *group* if the following conditions are fulfilled:

(1) The product of any two elements of the system is a third element of the system.

(2). The multiplication is associative: $(ab)c=a(bc)$, (but not necessarily commutative: ab and ba need not be equal).

(3). Equalities $ab=ab'$ or $ab=a'b$ require $b=b'$ or $a=a'$, respectively.

(Conditions (2) and (3) evidently hold for any ordinary kind of *operations;* (1) traces a significant boundary).

The *order* of a group is the number n of its elements. A group is briefly called finite or infinite, according as its order is finite or infinite.

The defining conditions (1)–(3), classic in their simplicity, possess a most extraordinary fecundity. From them alone proceed, by pure logical deduction, the vast and intricate systems which make up the algebra of groups.

As a primary deduction it may be noted that every finite group G contains one and only one element, identity (denoted by 1), such that for every element x of G $1x=x1=x$. A proper power x^m of any element x of G is equal to this element 1; the lowest exponent m for which this is true is called the order of x; every power of x is equal to one of the m powers $x, x^2, x^3, \ldots, x^{m-1}$, 1. The *inverse* x^{-1} of x is defined by $x^{-1}x=1=x^{m-1}x$, whence by (3) $x^{-1}=x^{m-1}$; then $x^{-2}=(x^2)^{-1}=x^{m-2}$, etc. The analogy to ordinary algebra (of mth roots of unity) is here perfect. These elementary principles may be illustrated by reference to the tetrahedral group G of order 12 above.

An infinite group does not necessarily contain the element 1 nor the inverse elements. Thus all the motions of a point along a line in *one* direction form an infinite group, but this does not contain the reverse motions nor the case of no motion. The prevailing tendency is, however, to restrict the name group to systems which contain the inverse of their elements, and consequently the element 1.

A part of the elements of a group G, taken by themselves, may form a group H, which is then called a *subgroup* of G. Thus the powers of any element x of G form a cyclical group H which is either G itself or a subgroup of G. The tetrahedral group has a subgroup of order 4 composed of b_1, b_2, b_3 and identity. The order h of a subgroup H of G is always a divisor of the order g of G. If p^i, where p is a prime number, is a divisor of g, G has one or more subgroups of order p^i, and the total number of these subgroups is of the form $kp+1$, where k is an integer. If p^a is the *highest* power of p that divides g, $kp+1$ is also a divisor of g. These theorems of Sylow and Frobenius are of great assistance in the analysis of groups of finite order. Thus a group of order pq, where p and q are prime numbers, has a single subgroup of order p; it has also a single subgroup of order q, unless p is of the form $kq+1$. Thus the order $15=5.3$ presents only one case, while the order $21=7.3$ presents two. For a further example, the icosahedral group of rotations, which is of order 60, contains subgroups of orders, 2, 4, 3, 5, and also 6 and 10. The 15 lines joining middle points of opposite edges of the icosahedron form five sets of trirectangular axes, each of which sets is converted into itself by a tetrahedral group contained as subgroup in the icosahedral group. There are no subgroups of orders 15, 20, or 30 present.

Isomorphism and Transformation.—Groups which have the same algebra are called isomorphic. Written in the same symbols, isomorphic groups are by definition identical. But in the practice the isomorphism requires to be detected, being veiled under dissimilarity of notation. Once detected among groups derived perhaps from quite different mathematical fields, isomorphism constitutes the unifying principle already mentioned. For example, the tetrahedral group is isomorphic with the group of 12 substitutions (rearrangements) which it produces among the four vertices of the tetrahedron; and the icosahedron group is isomorphic with the corresponding group of substitutions of the five trirectangular axis systems mentioned above. These isomorphisms contribute materially to the theory of equations of degrees four and five.

One instance of isomorphism is expressible by a universal formula. Let G be any group, with elements $a, b, c, \ldots$, and let t be any element whatever capable of combination with $a, b, c, \ldots$, under conditions (1)—(3); then the elements $a'=t^{-1}at$, $b'=t^{-1}bt$, $c'=t^{-1}ct, \ldots$ form a group $G'(t^{-1}Gt)$, and this group G' is isomorphic with G. For if $ab=c$, for example, then $a'b'=t^{-1}at \cdot t^{-1}bt=t^{-1}abt=t^{-1}ct=c'$, so that not only a', b', c' form a group, but the algebra of this group is identical with that of G. The process of deriving G' from G is called *transformation* of G by t; G' is called the *transform* of G by t. All transforms of a group G (by $t, s, \ldots$) are isomorphic with G and with each other.

Transformation has a very simple concrete significance. Suppose that G is a group of *operations*, $a, b, c, \ldots$ performed on a field of objects A, and that t converts A into a second field of objects B; then $t^{-1}Gt$, *i. e.*, t reversed, followed by G, followed by t, produces among the objects B an effect precisely parallel to that produced by G on the corresponding objects A. For example, if A is a plane, G a group of operations in A, t a projection of A on a second plane B, then $t^{-1}Gt$ is the projection of the group G on B. Or again, if G is a group of rotations about an axis A, and t a rotation which moves A into the position B, then $t^{-1}Gt$ is a second group of rotations, precisely similar to G, performed about the new axis B. In general, transformation in the present sense is the concomitant, for operations, of transformations in the ordinary sense as affecting objects.

Group Analysis.—If G is any group and H any subgroup of G, all the transforms of H with respect to the elements of G are contained in G. These transforms are called the conjugates of H in G. Thus the subgroups of order 3 of the tetrahedral group are conjugate in that group. A noteworthy general example is that of the subgroups of order p^a (a a maximum) of a group G; these $kp+1$ subgroups are always conjugate. The number of conjugates of any subgroup H of G is a divisor of g. In the important case where its conjugates all coincide, H is an *invariant* subgroup of G. Every group G has two invariant subgroups, itself and the identical operation. If it has no other invariant subgroups, G is *simple;* otherwise G is *compound.* Thus the four rotations $1, b_1, b_2, b_3$ of the tetrahedral group form an invariant subgroup, this being in fact the only subgroup of order 4, of the tetrahedral group.

A *maximum* invariant subgroup H of G is not contained in any larger invariant subgroup of G. A *principal series of composition* of G consists of G and a series of subgroups, H, I, J, ..., 1 of G, each of which is a maximum invariant subgroup of the preceding one. The ratios of the orders g, h, i, j, ..., 1 of these subgroups is a principal series of *factors of composition* of G. Apart from their order of succession, these factors of composition remain the same for every principal series of composition of G. They play an important part in the theory of algebraic equations.

Every compound group G is reducible to a sequence of simple groups, whose orders are the factors of composition of G. Only simple groups present new problems. The chief problem of the pure theory of groups is therefore the determination of all simple groups. This problem awaits solution. All groups of prime order are simple. Simple groups of composite order are of rare occurrence, the only cases below order 2000 being one group for each of the orders 60, 168, 360, 504, 660, 1092. The number of different prime factors in the order of a simple group not of prime order is at least three, and the total number of prime factors is at least six (orders 60, 168, 660, 1092 being the only exceptions). No simple groups of odd order have as yet been found. Several series of orders of simple groups are known, for example, $\frac{1}{2}n!(n \neq 4)$, $\frac{1}{2}p^n(p^{2n}-1)$, $(p^n>3)$, etc.

A group whose elements are commutative is called an *abelian* group. Every subgroup and every element of an abelian group is invariant. The factors of composition are here the prime factors of the order.

Example of Group Construction.—Let a and b be two elements of prime orders p and q $(a^p = 1 = b^q)$ and subject to the further condition $b^{-1}ab = a^i$. We find successively $b^{-1}a^2b = b^{-1}ab \cdot b^{-1}ab = a^i \cdot a^i = a^{2i}$, $b^{-1}a^3b = a^{3i}$ .... $b^{-1}a^jb = a^{ji}$; $b^{-2}a^jb^2 = b^{-1}(b^{-1}a^jb)b = b^{-1}a^{ji}b = a^{ji^2}$, $b^{-3}a^jb^3 = a^{ji^3}$, ..., $b^{-k}a^jb^k = a^{ji^k}$, ..., $b^{-q}a^jb^q (= 1a^j1) = a^j = a^{ji^q}$, ... $i^q \equiv 1 \pmod{p}$. If $p-1$ is not divisible by q, i must be 1, $b^{-1}ab = a$, $ab = ba$, that is, a and b are commutative, and their various products ab form an abelian group of order pq. (This group consists of the powers of one element, say ab.) But if q divides $p-1$, the congruence $i^q \equiv 1$ has roots i different from 1. Any one of these roots i having been chosen, the conditions $a^p = 1 = b^q$, $b^{-1}ab = a^i$ are consistent and lead again to a group of order pq composed of the distinct products a^kb^l; the last group is non-abelian. For $p = 3$, $q = 2$, the second group presents the *multiplication table*

1	1	a	a^2	b	ab	a^2b
a	a	a^2	1	ab	a^2b	b
a^2	a^2	1	a	a^2b	b	ab
b	b	a^2b	ab	1	a^2	a
ab	ab	b	a^2b	a	1	a^2
a^2b	a^2b	ab	b	a^2	a	1

Substitution Groups.—The permutations or *substitutions* of n given letters x_1, x_2, ..., x_n form a group (the symmetric group) of order $n!$. The order of any group of substitutions of n letters is a divisor of $n!$. An individual substitution is written in cycles: thus $(x_1x_2x_3)(x_4x_5x_6x_7)$, or simply $(1\,2\,3)(4\,5\,6\,7)$, signifies that x_1, x_2, x_3 are to be replaced by x_2, x_3, x_1, and x_4, x_5, x_6, x_7 by x_5, x_6, x_7, x_4. Every finite group is expressible as (isomorphic with) a substitution group. Thus in the case of the group of order 6 above, if we denote the elements $1, a, a^2, b, ab, a^2b$ for convenience by $x_1, x_2, \ldots, x_6$, the six lines of the table are obtained from the first line by the six substitutions 1, (123)(456), (132)(465), (14)(26)(35), (15)(24)(36), (16)(25)(34), which form a substitution group isomorphic with the original group.

Those substitutions of n letters $x_1, x_2, \ldots, x_n$ which leave a given function of $x_1, x_2, \ldots, x_n$ unchanged in form, form a group. Thus the function $\phi_1 \equiv x_1x_2 + x_3x_4$ is unchanged by the eight substitutions G_1 : 1, (12), (34), (12)(34), (13)(24), (14)(23), (1324), (1423). The substitution t : (23) converts ϕ_1 into $\phi_2 \equiv x_1x_3 + x_2x_4$ and *transforms* the group G_1 of ϕ_1 into the group $G_2 = t^{-1}G_1t$: 1, (13), (24), (13)(24), (12)(34), (14)(23), (1234), (1432) of ϕ_2.

Interesting examples of substitution groups may also be obtained by determining those substitutions of n letters $x_1, x_2, \ldots, x_n$ which transform the substitution $(12\ldots n)$ into its powers. If n is a prime number, the order of this (metacyclic) group is $n(n-1)$.

For further discussion of substitution groups see the article GALOIS THEORY OF EQUATIONS.

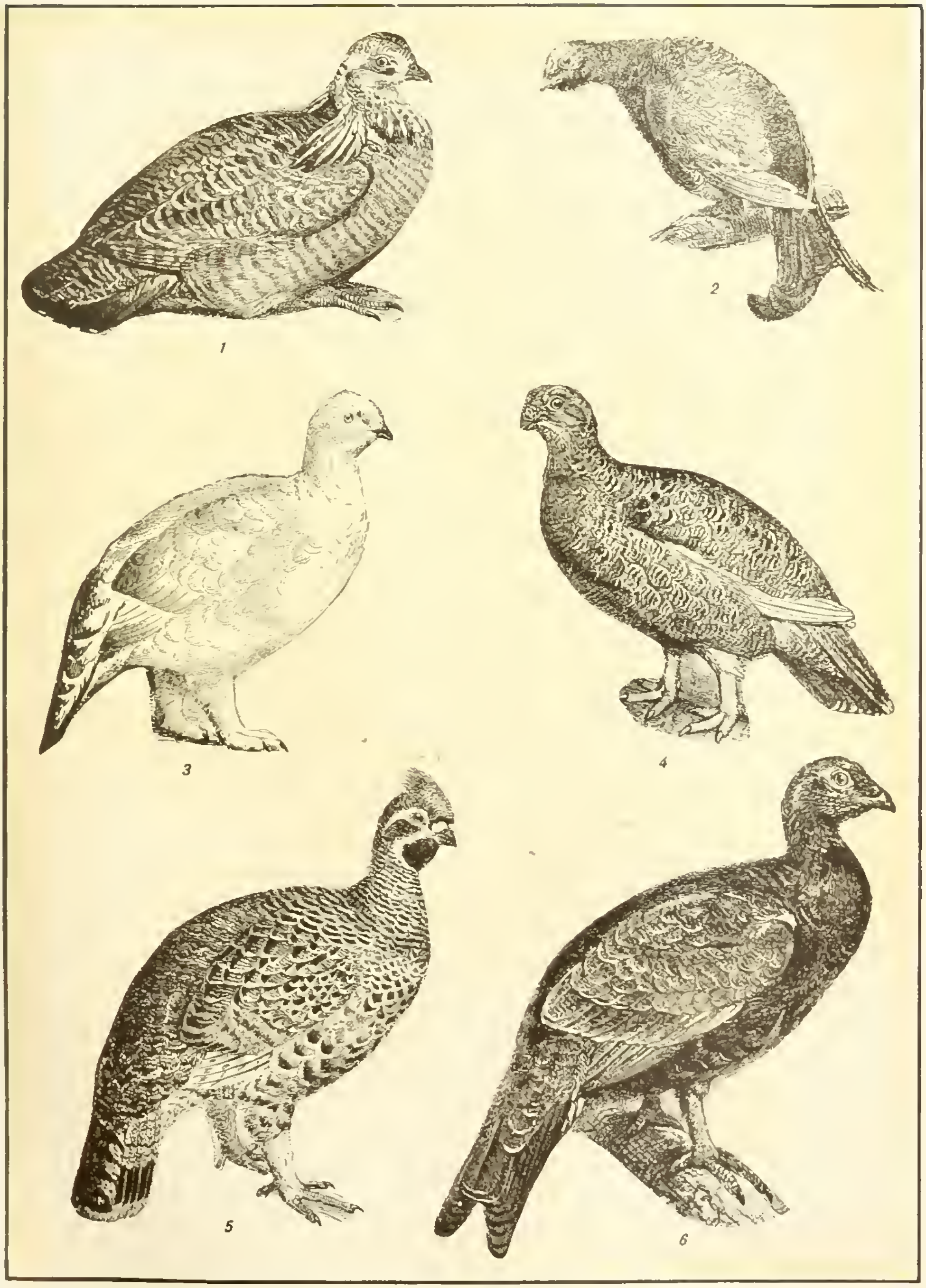
Groups of Linear Transformations.—All the linear transformations of a complex variable z, $z' = (\alpha z + \beta)/(\gamma z + \delta)$, for which $\alpha\delta - \beta\gamma \neq 0$, form a group. For two of them in succession evidently amount to a third linear transformation. Thus $S: z' = 1/z$ and $T: z = 1 - z$ give $ST: z' = 1 - 1/z = (z-1)/z$, $TS: z' = 1/(1-z)$. The group of all linear transformations of z is both infinite and *continuous*. If $\alpha, \beta, \gamma, \delta$ are restricted to integral values, the resulting group is still infinite but discontinuous. The *modular* group is subject to the still further condition $\alpha\delta - \beta\gamma = 1$; this is the group connecting the values of the ratio ω of the two periods ω_1, ω_2 of the elliptic integral $u = \int (4z^3 - g_2z - g_3)^{-\frac{1}{2}}dz$.

There exist only a finite number of non-isomorphic types of finite groups of linear transformations of z. If z is represented on a spherical surface, every rotation of the sphere produces a linear transformation of z. Those rotations of the sphere which convert into itself a regular solid inscribed in the sphere, or a regular polygon of n sides inscribed in a great circle (equator), form a group. These groups are of orders 60 (icosahedron, dodecahedron), 24 (octahedron, cube), 12 (tetrahedron), $2n$ (dihedron), n (cyclical). They give all the non-isomorphic types of finite groups of linear transformations of z. The octahedral group is also isomorphic with the symmetric substitution group of four letters, the tetrahedral and icosahedral groups with (alternating) substitution groups of four and five letters, respectively.

A simple example of a (dihedral) group of order 6 is generated by the transformations $S: z = 1/z$ and $T: z' = 1 - z$ above.

The linear transformations of z written in homogeneous form $z'_1 = \alpha z_1 + \beta z_2$, $z'_2 = \gamma z_1 + \delta z_2$ furnish *homogeneous* linear groups. Increasing the number of variables, we arrive at the general homogeneous linear groups $z_1' = a_{11}z_1 + a_{12}z_2 + \ldots + a_{1n}z_n$, $z_2' = a_{21}z_1 + a_{22}z_2 + \ldots + a_{2n}z_n$, ..., $z_n' = a_{n1}z_1 + a_{n2}z_2 + \ldots + a_{nn}z_n$ identified, for example, with projective geometry. Curves, surfaces, etc., frequently

GROUSE.



1. Prairie Hen (Tympanuchus Americanus).
2. Blackcock (Tetrao urogallus).
3. Moor-hen or Ptarmigan (Lagopus albus) in winter dress.
4. Scotch Red Grouse (Lagopus scoticus).
5. Ruffed Grouse (Bonasa umbellus).
6. Hybrid between Blackcock and Capercailzie.

have linear transformations into themselves, these always forming a group. Thus a plane cubic curve has in general such a group of order 432. Linear *congruence* groups should also be mentioned. An example is the *simple* group of order $\frac{1}{2}p(p^2-1)$ $(p>4)$ composed of the linear transformation $z' = (\alpha z + \beta) / (\gamma z + \delta)$ when $\alpha, \beta, \gamma, \delta, z', z$ are integers taken mod. p

Continuous Groups.—These are groups of transformations involving continuous parameters, such as the entire group of linear transformations of z, or the entire group of motions in a plane or in space. The theory of these groups, which has been extensively developed by Sophus Lie and his followers since 1870, has important applications to geometry, and especially to the theory of differential equations.

Historical.—The theory of groups was originally developed by Galois, Cauchy, and their successors under the particular guise of substitution groups. It was with Sylow's memoir in the 'Mathematische Annalen,' Vol. V. (1872) that the theory began to assume its independent abstract form. Among those who contributed to this movement are Cayley, Klein, Dyck, and others. But it is to Frobenius, above all others, that we owe the great developments of the pure theory which have been accomplished in the last fifteen years. The theory of group *characteristics*, recently created by Frobenius, is destined to produce brilliant results in the near future.

Other historical elements are traceable in the accompanying bibliography.

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Grouse, a family (*Tetraonidæ*) of gallinaceous game birds with feathered feet or tarsi, inhabitants of the northern hemisphere. In North America our best known species is the ruffed grouse (*Bonasa umbellus*); the "partridge" of New England and the "pheasant" of the Middle States. This bird, in one or other of its races, ranges all across the continent from Canada to Washington and southward in the higher ground, and is one of our best esteemed game birds. The rumbling drumming of the male is a familiar sound in the woods in early spring, and is effected by rapidly beating the wings against the body. On the prairies of the central and western States are several varieties of pinnated grouse or prairie chickens (q.v.). In the northwest occur the blue or dusky grouse (*Dendragapus fuliginosus*) and the sage hen (q.v.). In Canada and the northernmost part of the United States occurs the Canada grouse or "spruce partridge" (*Canachites canadensis*) with the allied Franklin's grouse (*C. franklini*) in the northern Rocky Mountains. The species to which the name grouse was originally applied, namely the red grouse or moorfowl (*Lagopus scoticus*) of England, is the only bird absolutely restricted to the British Isles. It is plentiful in suitable parts of Wales and northern England, but is especially numerous in the highlands of Scotland, where it is bred and preserved on moorlands of great extent, large areas of which are kept barren of other occupation for this purpose. This, then, is the bird whose shooting, permitted for a period following the 12th of August, attracts so large numbers of sportsmen annually to Scotland for the "grouse-shooting." The sport may be followed in the ordinary method of shooting on the wing over dogs; but in many places is conducted as a battue. Grouse-moors are owned and rented in large numbers, and have a status similar to that of deer-forests (q.v.). This grouse is a ptarmigan, other species of which exist in the artic regions (see Ptarmigan). Other European grouse of importance are the blackcock and capercailzie (q.v.). Among works dealing especially with grouse and grouse-shooting are Lloyd, 'Game Birds and Wildfowl of Sweden and Norway' (London, 1867); the volumes on 'Shooting' in the 'Badminton Library' (London, 1889); Alflalo, 'Sport in Europe' (London, 1901); Sandys and Van Dyke, 'Upland Game Birds' in the Sportsman's Library (New York, 1902); Coues, 'Birds of the Northwest' (Washington, 1874).

Grove, Sir **George**, English engineer, author, and musical critic: b. Clapham, near London, 13 Aug. 1820; d. Sydenham 28 May 1900. After completing his studies in the grammar schools of Clapham, he learned civil engineering, and for two years worked in Napier's factory near Glasgow. In 1841 he went to the West Indies, erecting in that year the Morant Point lighthouse in Jamaica, and in 1845 the Gibb's Hill light in Bermuda. He was appointed secretary to the Society of Arts in 1849, and in 1852 to the Crystal Palace. While in the latter position he exerted all his influence toward giving the music-loving public the best music obtainable, and endeavoring especially to create a taste for the compositions of Beethoven and of the German Romantic School. From 1868–83 he was editor of 'Macmillan's Magazine,' and from 1878–89 edited the famous 'Dictionary of Music and Musicians.' In 1882 he was made the first director of the Royal College of Music, at the same time being knighted, and in 1894 was made a Commander of the Bath. He contributed to Smith's 'Dictionary of the Bible' (1864), and to Stanley's 'Sinai and Palestine' (1865).

Grove, Sir **William Robert**, English physicist; b. Swansea, 1811; d. 1896. He was graduated at Oxford in 1832, began the practice of law in 1835, but eventually applied himself to the study of physics. He was elected professor of experimental philosophy to the London Institution, 1840–47, and received the Royal medal from the Royal Society for his paper on the 'Gas Voltaic Battery.' Returning to the law he was knighted and made a judge of the High Court of Justice. He was one of the first to grasp the law of the "conservation of force." He is the author of 'The Correlation of Physical Forces' (1846).

Grove City, Pa., borough in Mercer County, on the Pittsburg, B. & L. E. railroad; 58 miles north of Pittsburg. It is the seat of the Grove City College, a coeducational school opened in 1884. The chief manufactures are carriages, brooms, gas-engines, and machinery. Pop. 1,015.

Grover, Cuvier, American army officer: b. Bethel, Me., 24 July 1829; d. Atlantic City, N. J., 6 June 1885. He was graduated at the United States Military Academy in the class of 1850, and on the outbreak of the Civil War was appointed captain of the 10th infantry. Returning East, in April 1862, brigadier-general of volunteers, was assigned to duty with the Army of the Potomac, with which he participated in the various battles of the Peninsular campaign in Virginia, and in the second battle of Bull Run. In 1864 he commanded the 19th corps, and in the Shenandoah campaign was engaged in the battles of Opequan, Fisher's Hill, and Cedar Creek. He was mustered out of the volunteer service in 1865, and in 1875 became colonel of the 1st cavalry.

Grover, Lafayette, American politician: b. Bethel, Me., 29 Nov. 1823. He was admitted to the bar in Philadelphia in 1850, and settled in Salem, Ore., in 1851, where he became prominent in his profession, and was made prosecuting attorney of the second judicial district, and auditor of public accounts. In 1853 he was elected to the territorial legislature, serving there three years, and being speaker in his last term (1856). He fought in the Indian wars in 1853 and 1855–6, and was later made United States commissioner to audit spoliation claims. In 1857 he was a member of the Oregon constitutional convention, and when Oregon was admitted as a State, he was member of Congress (1858–9). He was chairman of the Democratic State committee (1866–70); served as governor of the State 1870–7; and was United States senator 1877–83.

Groves. See Ashera.

Groveton, Va., Battle of. See Bull Run, Second Battle of.

Grow, Galusha Aaron, American statesman: b. Ashford (now Eastford), Windham County, Conn., 31 Aug. 1823; d. Glenwood, Pa., 31 March 1907. He was graduated from Amherst College in 1844, was admitted to the bar of Susquehanna County, Pa., in 1847, was elected to Congress in 1850, and was six times re-elected. During his first three terms he was a Free-Soil Democrat, during the last three a Republican. He was chairman of the committee on the Territories in the Thirty-fourth and Thirty-sixth Congresses, and speaker of the Thirty-seventh Congress, whose five-weeks' session of 4 July — Aug. 6 1861 largely defined the government attitude toward the Confederacy and voted $500,000,000 for war purposes. He introduced the Homestead bill (see Homestead Laws) into the House, fought for it 10 years, finally obtained its enactment, and signed it as speaker. In 1879 he declined the mission to Russia, in 1894 was elected from Pennsylvania as congressman-at-large, and was successively re-elected to the Fifty-fourth, Fifty-fifth, Fifty-sixth and Fifty-seventh Congresses. His plurality in 1896 was 207,446, the largest given up to that time in any State of the United States to a candidate for any office. He was also a delegate to the national Republican convention of 1864, 1884, and 1892, and chairman of the Pennsylvania State Republican committee in 1868. In 1871–6 he was the president of the International and Great Northern railway company of Texas. His long record of conspicuous service is almost unparalleled in the political annals of the United States.

Growth, increase in size or volume. It may be divided into inorganic and organic growth. As an example of the former is the increase in size of minerals. Living beings or organisms grow by adding to the substances (protoplasm, etc.) forming their bodies similar matters as food, which are digested, assimilated, and thus taken into the body of the plant or animal by interstitial deposit. Organic growth is thus fundamentally a physico-chemical process together with a form of constructive energy as yet quite incomprehensible to us. The result of this absorption of food is that the body increases in size, that is, grows. All growth is attended by movement; and growth-movements are, as Verworn states, common to all living bodies, but they take place so slowly that they can scarcely be followed with the eye. Growth goes on more freely and the size of the body increases most rapidly in those organisms in which the body presents a large raying surface, in distinction from the microscopic bodies of the one-celled plants or animals. The simplest phenomenon of growth is seen in cells, which during growth rapidly multiply by self-division, which causes the increase in volume in the embryo.

The physical agents or factors in the growth of plants and animals are abundance of food, together with the influences exerted by heat, light, etc. During growth the simple molecule of living proteid continually attracts elements to itself from the food (Hatschek). Growth is most rapid in a well-fed plant or animal. The health, size, and stature of children depend on good nutritious plain food and plenty of fresh air.

Food and Chemical Agents.— As digestion and assimilation are chemical processes, they require certain materials to work with. These are called food. The elements which constitute food and which occur in protoplasm and flesh are carbon, oxygen, nitrogen, lime, phosphorus, potassium, sodium, chlorine, magnesium, sulphur, silicon and iron. All or any of these enter the body in various combinations, each playing a definite part in growth. Phosphorus is especially abundant in the tissues of embryos; potassium appears to be of great importance in imbibition, while iron is essential in the early processes of cell-division. Besides these inorganic substances, organic food, as flesh or vegetables, are essential to the growth of animals. Water is also essential, and embryos develop most rapidly in moist places or in water.

Light.— Without light there would be no growth, indeed no life. Light may retard or hasten growth, under different circumstances. Young growing plants and embryos of animals need to be protected from too direct sunlight.

Temperature — Organisms need sufficient heat in order to grow. The requisite amount for normal, maximum growth is called the optimum temperature, for at such a degree of warmth growth takes place faster than at any other. If the temperature be lowered, the rate of growth gradually diminishes; if the temperature be raised too much above the optimum, the rate of growth diminishes more rapidly. Excess of cold dwarfs both plants and animals.

Space and Movement.— If too much crowded, plants become slender and weak; snails become dwarfed if reared in too small vessels; mankind when confined to too narrow quarters in large cities tend to become undersized, from not having sufficient space and good air to live in; small trout live in small brooks and large ones in larger streams. All organisms need room to move or at least to grow.

Heredity.— Besides the factors already mentioned heredity has its share as an agent. Growth, development and reproduction are now in the plant and animal world proceeding as it were in grooves, or along more or less definite paths, in accordance with long established laws or relations, and the mechanism of growth is subject to heredity.

Growth and Longevity.— The elephant and whale attain a colossal size because they grow throughout life and live long. The large size of man as compared with many other mammals, is due to the fact that he grows for a longer period; while many mammals get their growth in one, two or three years, man does not stop growing until he is thirty.

It is to be observed that individual growth is not only dependent upon a suitable amount of food, but on proper environment and favorable conditions of life, and all these agencies also are the primary factors of organic life. It is the changes in the conditions of life, coupled with heredity and selection, that have caused the evolution of the world of plants and animals. Thus we see that the fundamental causes of the evolution of species are the same as those which determine the growth of any individual organism; we by no means understand all the phenomena of simple growth; there are unexplained laws and causes, as there are in general evolution; both in this respect are of a piece and are similar in their nature and results. The origin of species is as natural a process as the growth of the individual, and both in many respects are alike inexplicable by the science of the present day.

Growth and Development of the Human Being. In this article growth refers to an increase in size, and development to an increase in capacity. The body begins in a microscopic cell, and passes through the various stages of birth, growth, development, decline, and death.

The life of an individual may be studied in various periods, the embryonic and fœtal (which do not concern us at this time) and those of infancy, childhood, youth, maturity, and old age. The above division is convenient, but not physiologically exact. The various periods are not sharply limited. From birth to maturity, with a gradual increase in size of various organs, there are progressive modifications of functions. Toward old age, decline begins and the modifications retrogress.

The Period of Infancy is variously limited by different writers, extending from birth to the end of the fourth, fifth, or even the seventh year, the last considered by law as the beginning of responsible life. Probably the best limitation is from birth to the end of the first dentition, about the end of the second year. At birth, connection with the mother suddenly ceases, and a new existence begins with the first inspiration. Then the vegetative functions, digestion, circulation, respiration, secretion, excretion, and assimilation, are soon established. The infant performs all the functions of adult life except reproduction and volition. But in order to have them at their best they should be intelligently supervised by the parents. The young baby is the most helpless and dependent of all creatures. The care it receives influences its future life. With no care it must perish.

The period of infancy is characterized by frailty, active nutrition, rapid growth, and commencing development. It is especially prone to convulsions from improper food, or from high body temperature, whatever the cause, to rickets and scurvy from improper nourishment, to spasmodic affections such as false croup, to hydrocephalus, meningitis, whooping cough, diphtheria, diarrhœa, bronchitis, pneumonia, and to the eruptive diseases, measles, chicken-pox and scarlet fever.

The rate of infantile mortality is very high. From one fourth to one half of the children born in our large cities die within the first year; in small towns and in the country the rate is much lower. Many of the new-born are enfeebled by vices of formation, such as cyanosis, spina bifida, hydrocephalus, or meningocele, by an hereditary syphilitic, scrofulous, or tuberculous taint, or by chronic affections in the mother. All infants are exposed to the risks of an improper dietary, impure air, and the extremes of heat and cold.

The bones of the infant are very vascular, quite elastic, have but little firmness, and their epiphyses are cartilaginous. They are therefore readily inflamed, as in scurvy, may be distorted by pressure, or incompletely broken by apparently slight injuries, or the epiphyses may be separated by such injuries. To forcibly lift a young child by one arm is always dangerous. The skull at birth is not fully ossified and can be readily compressed. The anterior fontanelle begins to close about the 9th month and is usually closed about the 18th. Depression of this fontanelle is one of the evidences of general debility. Premature closure of the skull is a cause of epilepsy or idiotism. The vertebral column is straight, lacking the curves of later life, and is quite flexible, but this flexibility tends to backward, forward, or lateral distortions of the spine, as the result of rickets, inflammation (caries) of the vertebræ, or of sitting, standing, or reclining in strained positions. Allowing infants (especially feeble ones) to sit, stand, or walk too early tends to produce bow legs and knock knees, as well as spinal deformities. It is many weeks before a baby can hold up its head. Even by the twelfth week it is not properly balanced. It may be at the sixteenth. The first attempt to sit is about the sixteenth week, and sitting is accomplished about the fortieth. About the thirty-eighth week, the child attempts to stand, and should be able to stand alone by the eleventh or twelfth month, and to walk unaided by the fifteenth or seventeenth month. Some children never creep. If they do, the attempt is made about the ninth month.

The muscles of an infant are soft and not capable of great effort. Not till after the sixth month are they felt firm and resisting. To develop them the clothing should be loose, and the child, in a nude state, should at times be allowed free play of them. To swathe the feet and limbs in bandages "to make the child straight" is hurtful.

The abdomen and chest (in its lower portion) are prominent, due to the very large liver, the small pelvis, and the distention of the stomach by food, and to large size of the heart and lungs. All of these organs must have free movement, in order to carry on their important functions. Tight bandaging of chest or abdomen hampers movement and compresses important blood vessels. The size and weight of the heart of the new-born explains the rapid growth of the body and those organs in most direct communication with the heart, especially the brain. The small size and the vertical position of the stomach account for the ease with which infants throw up their food when the stomach is distended. Repeated acts of vomiting are injurious. The practice of jolting babies tends to produce vomiting. Each child must be studied by itself as to its powers of digestion, and what is the proper food for each. The substitution of artificial feeding for maternal nursing, and the indiscriminate use of baby foods are responsible for much sickness and many deaths. But natural feeding is not always possible, owing to the dictates of fashion or the poor health of mother or child.

The nervous system of infants is very excitable, especially toward the end of the first year, and is out of proportion with the slow development of the inhibitory centres. Convulsions and spasmodic affections are therefore readily produced by various causes, such as undigested food, eruptive fevers, impure air, fright, or excessive heat. Most of the movements and actions of early infancy are reflex, such as stretching, crowing, and sighing, for example. About the fourth month evidences of will power appear and gradually increase. Good habits, as to regular times for feeding, sleep, etc., can often be inculcated at this early age, or even before, to the advantage of both mother and child. The brain is relatively large at birth and grows rapidly up to the seventh year, and after that time more slowly.

During this formative period care should be observed not to excite the brain unduly, else nervous disorders may result. Repeatedly urging a young child to "show off" is, to say the least, very unwise.

The senses of taste and smell seem to be partially developed at birth. After the third month the quick closure of the eyes on the approach of an object seems to indicate the establishment of true vision. A very bright light may be appreciated by the second or third day, or may be followed by the eyes, if moved slowly, after the sixth week. It is usually weeks before there are associated movements and convergence of the eyes. The eyes of the new-born frequently move independently of each other, producing "squint," but squinting in the course of a severe disease is a bad sign. As to colors, yellow, red, pure white, gray, and black, in the order named, are said to be the first recognized, gradually after the sixth month.

All children are born deaf, but may notice sharp sounds six hours after birth, though usually not until a number of days. Toward the end of the first year the infant begins to imitate vocal sounds in its attempt to speak.

The circulation of blood is very rapid; the blood vessels are large and thin. Congestions, inflammations, and hemorrhages, therefore, are quite common. The pulse is irritable and slight causes disturb its rate and sometimes its regularity. The rate in the new-born is 130–140, during the first year 105–150 per minute, during the second 110–120, then gradually diminishes until at the fifth year it is about 90; from the seventh to the fourteenth year 80–90, and afterward 70–80. The respirations of the new-born are from 30 to 50 per minute, and at the end of the first year from 25 to 35. The breathing of healthy children is noiseless and through the nose. The habit of mouth breathing usually caused by enlarged tonsils and by adenoid growths, is productive of deafness, change in facial expression and distortion of the chest (pigeon breast). The relatively small size of the pharynx, larynx, and trachea frequently cause throat affections to be serious ailments in infants.

The average temperature of the infant is 100° F., but it is subject to many fluctuations. It is raised by ingestion of food, struggling, crying, etc., and lowered by sleep, inactivity, and insufficient food. Sponging with cool water or oiling the skin will frequently lower a high body temperature, which, if unchecked, might cause convulsions.

In man there are two sets of teeth. The first or temporary teeth are 20 in number, 10 in each jaw. The first tooth appears about the seventh month, the last about the twenty-fourth month. The dangers of dentition are much exaggerated. Well-nourished children of healthy parents cut their teeth earlier, easier, and more regularly than do feeble children. If the first tooth is not cut before the 14th month there is some serious defect. About the 6th year (and before the temporary teeth are shed) the jaws contain all the temporary teeth and all the rudimentary permanent teeth except the wisdom teeth. At birth, when the teeth have not appeared and in old age when they have disappeared the lower jaw is obtuse. During the growth of the teeth, the lower jaw increases in depth and length. To admit of these changes, the temporary as well as the permanent teeth should be taken care of, and filled if need be. Food requiring mastication should not be given until there are several teeth. The permanent teeth are 32 in number, 16 in each jaw. The first one appears about the 6th year, the last from the 18th to the 24th or later. The thymus gland appears in the new-born, attains its full size by the end of the 2d year, then gradually diminishes until at puberty it has almost disappeared. It is supposed to be one of the sources of the red blood corpuscles.

For the first few months of life tears and perspiration are rare. After three months they are freer. In rachitic infants perspiration is often profuse. Up to the end of the first year the sebaceous glands are very active, especially upon the scalp. The saliva and pancreatic juice are small in amount until about the third month and therefore starchy foods cannot safely be given to young infants. The gastric secretion at birth can as a rule readily digest the casein of mother's milk, but has difficulty in disposing of other food. Mucus in the infantile intestines is copious, often ferments and may neutralize the feebly alkaline intestinal juices, and the pancreatic juice and saliva.

Both the small and large intestine are comparatively long, and digestion and peristaltic action are rapid. These facts together with the small size of the stomach and the rapid growth of the body, require that the young baby be fed every 2 or 3 hours. The great length of the sigmoid flexure of the colon impedes the passage of fæces and induces constipation, which should be relieved by *light* laxative medicines or, better still, by change in the diet.

The lymphatic glands are numerous and large in the infant and the communication between them and the general system is more marked than at any other period of life. They are readily congested and enlarged in affections of the throat, scalp, etc., and in scrofulous and syphilitic ailments.

The average weight of the male new-born child is 7 lbs. 11 oz.; of the female 7 lbs. 4 oz. For the first few days there is a loss in weight, then the weight gradually increases. Generally it is doubled by the 5th month and trebled by the 12th in breast-fed infants; in hand-fed, later. Usually a healthy child gains 20 lbs. in weight and 10 inches in height in first 2 years of life; in the 3rd year 4 lbs. and 4 inches. During next 6 years there is an annual increase of 4 lbs. and 2 or 3 inches; after the 10th year about 8 lbs. a year. About the 9th year in girls and the 11th in boys there is a diminution in the rate of growth, and at puberty (13th year in girls and 16th in boys) the activity of growth is the greatest. Between 12 and 15, girls grow heavier and taller than boys, but at 15 the boys again lead and maintain it through life. Growth usually continues to about the age of 25 in males and there may be a slight increase for 5 or 10 years afterwards. Girls usually attain adult stature at about 21 years. Weight usually increases in the male and frequently in the female to the 50th or 60th year, due to an accumulation of fat.

The Period of Childhood may be said to extend from the end of the second year to puberty or youth. By the end of infancy, the anterior fontanelle is closed, the temporary teeth are cut and the child is beginning to talk and walk, to use judgment and memory and to display independence. Childhood is characterized by active growth and development of the body and mind. Arrest of growth and loss of weight indicate malnutrition. On the other hand, while a very thin baby is abnormal, a very fat child or youth is, as a rule, one whose nutrition is at fault, or whose diet is too rich or generous.

The preparation of boys and girls for the duties and responsibilities of manhood and womanhood, requires especially that their brains, muscles, and digestive apparatus shall be strong. Nerve force must be stored not dissipated, and coddling is wrong. Their nervous systems are normally very active and sensitive to impressions, hence nervous disorders and exhaustion are readily induced by over-stimulation of the brain, through excitement, too much study, etc. Physical and mental training must go together. A vigorous child is almost constantly in motion, either at work or play, and this is as it should be. The same amount of exercise would exhaust an adult. It is well understood that systematic muscular exercise besides hardening the muscles improves the mental strength, that well developed children take a higher rank in school than those of the same age less developed. Abundant out of door exercise also develops the co-ordinating power of muscles and the special senses, induces a greater respiratory range, better oxidation, and an increased power of the heart. Thus nutrition is stimulated and a symmetrical development obtained. And this is just as necessary for girls as for boys. Children need sleep oftener and longer than adults. A healthy young baby sleeps nearly two thirds of the time and a healthy child of seven will often sleep quietly for twelve hours or more. Disturbed sleep and sleeping with the mouth open indicate some nervous gastric or intestinal disturbance or the presence of enlarged tonsils.

After the first few years of life the special senses seem to acquire an acuteness, more marked than in later life when the perceptions are associated with more complex mental processes. Children require much food and the diet should be nutritious, but overloading the stomach, especially with sweets and fruit, may excite general convulsions, vomiting, diarrhœa and alarming fever. A vigorous, healthy boy often eats, and may require about as much food as the average man. A variable appetite or the habit of eating mainly one class of foods is indicative of innutrition. A properly mixed diet is necessary for health. Sugar (candy, etc.), valuable in reasonable amount, should not be eaten in such quantity as to interfere with the appetite for regular meals. Children, especially those who eat but little sugar, should be taught to eat fat. In childhood the lymphatic system is still active, the glands readily enlarge as the result of irritation or of general disease, especially scrofula. The respiration in early childhood as in infancy is mainly diaphragmatic — the abdomen moves freely. The temperature normally is about 100° F. A sudden high temperature is much less significant than in the adult, so also is an increase in the rapidity of the pulse. Young children lose heat readily from the surface of the body, and are susceptible therefore to "taking cold" when insufficiently clad. The line should be carefully drawn between overdressing and the "hardening" process, and woolen garments except in the hottest weather are advisable.

Owing to the large amount of food consumed and the detritus resulting from the activities of the body — a free discharge of waste by the skin, kidneys and bowels should be facilitated by frequent bathing, the drinking of considerable pure water and the use of fruit, graham bread and green vegetables.

The stomach in children is straighter and more vertical than in adults, but less so than in infants. Vomiting is still easily produced. The small intestine is relatively much longer than in adults, due to the fact that much nourishment is to be digested.

Children are susceptible to nervous disorders such as chorea and certain forms of paralysis, and to whooping cough, mumps, measles, etc., which last are often classed as "children's diseases." Spinal deformities are readily induced. Certain diseases, such as tuberculosis, are likely to affect a large number of organs at the same time. The recuperative power of a normally healthy child is very great, even in severe diseases.

The mortality of young children in general is enormous but decreases with age. It is greatest among those whose hygienic conditions are bad, who suffer from poor or insufficient food, impure air, etc. Diphtheria, scarlatina, measles, croup, pneumonia and intestinal disorders are the chief causes of death.

The Period of Youth, Adolescence or Puberty, is that period of life between childhood and maturity: in law, "that period from 14 in males and 12 in females till 21 years of age." It occurs earlier in hot climates than in cold, is hastened by luxurious living and habits of idleness and is retarded by severe labor, hardship, privation and ill health. It is that period when the individual becomes fitted for reproduction by the development of the sexual organs. The voice is unsettled, due to a rapid general enlargement of the laryngeal cartilages and a lengthening of the vocal cords. Hair appears in the pubic region, in the axillæ and on the face in the male. In the female particularly, fat is rapidly deposited in the subcutaneous cellular tissue of the breast and extremities, adding to the comeliness of the form. The function of menstruation is established, preceded in a varying degree by headache, backache, physical and mental lassitude, palpitation, bleeding from the nose, nervous irritability and hysteria. Sexual maturity is evidenced by awakened sensibilities towards individuals of the opposite sex, of attraction, of repulsion or of timidity and shyness. In youth there is a pronounced development of the limbs, an increase in the size of the chest and a diminution in the size of the head and abdomen. The spine now forms a double curve, and the pelvis widens especially in the female. Mental faculties mature. A girl becomes a woman earlier than the boy a man.

Inasmuch as the rapid nutritive changes are prone to be attended by more or less grave disturbances of the nervous functions, it is essential, in order to have a sound mind in a sound body (that is, health), to carefully regulate physical and still more, mental exertion. The habit of self control must be encouraged, and exaggerated language discouraged. School duties should not be imposed beyond, or even up to the limit of tolerance of the individual, and social functions should not interfere with an abundance of sleep and outdoor exercise, else the result will be a wreck of the nervous system, and prolonged nervous and muscular prostration. Recklessness as to the laws of health are responsible for much of the sickness at this period of life Purity of thought and action are great safeguards against the temptations which beset growing youth, which if yielded to they impair or destroy both mind and body. Animal impulses are to be subordinated to aspirations of the mind The continued fevers such as typhoid, severe inflammations, as pneumonia and acute rheumatism, tuberculosis and heart affections, are the principal diseases of youth Scarlet fever, measles and other eruptive diseases may affect the individual, but not commonly. Alcoholism is a dangerous condition, easily acquired. Neurotic conditions, especially in the female, too frequently occur

The Period of Maturity begins at about the end of the 21st year, and extends in men to about the 60th, when the power of reproduction wanes, and in women to about 40 or 45, when the menopause occurs: the breasts and reproductive organs diminish and ovulation ceases. In women, at this time (as in the onset of puberty), the organic functions may be irregular: dyspepsia, palpitation, sweating, vertigo, neuralgia, irritability and melancholy may occur. The "change of life" is in reality therefore attended with a severe nervous shock. Manhood and womanhood begin when the individual has reached the full stature, when the skeleton is firmly ossified, the jaw is square, the chest fully expanded, and the limbs well developed. Gradually from this time onward in most instances fat begins to accumulate, especially upon the abdomen, towards the end of maturity.

Popularly it is believed that man is in the "prime of life" from 35 to 50, but there are many instances of farmers, professional and business men and women being successful and at active work and in good health at 60 or more. The fact is, that the ability to do hard work, mental or physical, at an advanced age, depends upon habits of industry and method, and upon the care of the health which have been inculcated in earlier life, and are continued into and through adult life.

Gradually as adult life advances, the inclination and sometimes the power for active exercise fails. These are evils to be guarded against. Out-door games, horse-back riding, and vigorous walking, for example, may be pursued advantageously as a rule to 45 or 50 years of age. At about this time degenerative changes occur in the body and care is necessary that the heart and blood vessels be not overstrained. During the prime of life the body enjoys a maximum of vigor and power of endurance, and there is reason to believe that this is also true of the mind. But the self-consciousness of power that the individual possesses is frequently a menace, for it induces him to struggle for wealth or fame in the turmoil and bustle of modern life, to neglect recreation, to resort to alcoholics and other stimulants to keep up his energy, and to indulge in general high living. It is especially true at this time of life that no one should work up to the full measure of his ability. Such work is dangerous and has been responsible for the "breaking down" of the health and the death of many otherwise intelligent persons. The principal diseases of adult life are alcoholism, gout, cancer, urinary and venereal diseases, rheumatism, pneumonia, tuberculosis, affections of the brain and nervous system, of the heart and blood vessels and of the digestive system.

The Period of Old Age or Senility usually commences about the 60th year and is characterized by a waning of the vital powers and by atrophic and degenerative changes, the natural consequences of decay. While death frequently results from local accidents of the brain and nervous system (apoplexy, sclerosis, etc.) and of the heart, blood vessels and urinary organs irredeemably damaged in the course of decay, it is normally but the ending of a natural life, and not a pathological fact as in earlier life. The stature of the old is less, the shoulders rounded, bones are more fragile, the cartilages are hardened, the lower jaw resembles that of the infant, the chin is prominent, the skin is wrinkled owing to the absorption of fat, and loses its elasticity, the teeth decay and fall out, urination is frequently difficult, the respirations and heart beats are reduced in frequency, the arteries have a tendency to ossify, the veins to dilate. The muscles fail in their tension, the voice becomes a "childish treble," the digestion is weakened, the eye no longer sees clearly, and hearing is dulled. The mind may preserve its freshness for a long time. Usually the senses fail first, next the faculties of memory, reason and volition. Towards the close of life the organic or vegetative phenomena prevail. The natural death occurs when the breath becomes fainter and fainter and the heart beats are weaker and fitful — and then gradually cease.

Old people require an abundance of sleep. They need also to be kept warm, for heat is generated in them in smaller amount than in robust health. Hence they are easily chilled. Food should be plain, largely liquid, and that which is easiest digested. Exercise in the open air every day is desirable but it should be gentle in character. With these precautions old age may be made comfortable. JEROME WALKER, M.D.,
Author of 'Walker's Physiology.'

Grub, the larva of an insect, especially of a beetle or fly. In reference to cattle it usually means the maggot of a flesh-fly or warble. See BOT-FLY; LARVA.

Grubb, SIR **Howard**, Irish optician and telescope-maker: b. Dublin 28 July 1844. The largest telescope of his construction is the 27-inch of the Vienna Observatory. He was the first to suggest a movable floor for an observatory dome, which has been adopted in the dome of the great 36-inch telescope of the Lick Observatory. He has been vice-president of the Royal Dublin Society from 1893, and was knighted in 1887.

Grübel, grü'bel, **Johann Konrad**, German poet: b. Nuremberg 3 June 1736; d. Nuremberg 8 March 1809. He was a saddler and harness-maker, and passed his youth in privation; but he possessed genuine poetic gifts, as shown in the pictures he has given of the lives and manners of his countrymen in the three volumes of 'Poems in the Nuremberg Dialect' (1802). Another volume appeared in 1808.

Gruber, grö'ber, **Johann Gottfried**, German author: b. Naumburg, on the Saale, 29 Nov. 1774; d. 7 Aug. 1851. He studied at Leipsic, and in 1811 was appointed professor at the University of Wittenberg, and in 1815 professor of philosophy at Halle. His chief work was that of editing, first with Ersch, and after his death, alone the first section of the 'Universal Encyclopædia.' His independent works include: 'Herder's Characteristic' (1805); 'History of the Human Race' (1805); and Lives of Wieland (1815–16), and Klopstock (1832); he also edited 'Wieland's Complete Works' (1818–28).

Grün'berg, Germany, capital of the circle of Grünberg in the Prussian province of Silesia; on the Oder, 15 miles east of Giessen. It is surrounded by vineyards, and large quantities of wine are made here and in the vicinity. Pop. 21,268.

Grundtvig, groont'vig, **Nikolai Frederic Severin**, Danish theologian, historian and poet: b. Udby, island of Seeland, 8 Sept. 1783; d. Copenhagen 2 Sept. 1872. He was educated at the University of Copenhagen, and in 1822 went to Copenhagen as chaplain. He made a fierce attack on the rationalism of the time in his 'The Answer of the Church' (1825), a reply to Professor Clausen, and for the violent expression of opinion in this work was severely censured and resigned his position. For a time he devoted himself to literary work, and through his writings exercised a great influence on the religious and political thought of Denmark. In 1839 he became pastor at the hospital church of Vartov, Copenhagen, and held that position till his death, being made a bishop in 1861. He was for a time a member of the Danish diet, and took an active part against Germany and German influence. His most important work is 'Northern Mythology'; he also wrote a number of poems, among them some very popular national songs, and translated 'Beowulf.'

Grundy, Felix, American jurist: b. Berkeley County, Va., 11 Sept. 1777; d. Nashville, Tenn., 19 Dec. 1840. Studying law, he was admitted to practice in 1798, and soon acquired a high reputation as an advocate in criminal cases. He was a member of the Tennessee legislature 1799–1806, and in the latter year was appointed one of the judges of the supreme court of errors and appeals. In 1811 he was elected representative to Congress, and re-elected in 1813. In 1829, and again in 1833, he was elected to the senate of the United States, where he was among the most prominent of the supporters of President Jackson. In 1838 President Van Buren appointed him attorney-general of the United States; but in 1840 he resigned that office, and was re-elected to the senate.

Grundy, Sydney, English dramatist: b. Manchester 23 March 1848. He was called to the bar in 1869 and practised till 1876, but has since become known at home, and in the United States, as a successful and popular playwright. Among his very numerous plays are: 'The Glass of Fashion' (1883); 'A Fool's Paradise' (1890); 'A White Lie' (1893); 'Sowing the Wind' (1893); and 'The New Woman' (1894); 'Slaves of the Ring' (1894); 'The Degenerates' (1899); 'Frocks and Frills' (1902).

Grundy, Mrs., a personage constantly appealed to in the phrase, 'But what will Mrs. Grundy say?' in Morton's play, 'Speed the Plough' (1800), but who never appears among the *dramatis personæ*. The phrase has now come to stand for the judgment of society in general upon actions or conduct.

Grunt, or **Croaker**, a drumfish (q.v.).

Gruson, groo'sōn, **Hermann**, German inventor and manufacturer: b. Magdeburg 13 March 1821; d. 1895. He studied at Berlin; became chief engineer of the Wöhlert machine shops in Berlin in 1851, and in 1854 went to Buckau as director of the Hamburg-Mecklenburg steamship company. There he established a shipyard of his own and built a small iron foundry, where he invented a process of chilled cast iron, which was much used in the manufacture of machinery, as well as for armor. His establishment consequently grew rapidly, and in 1886 was incorporated, manufacturing armor for most of the states of Europe. Gruson was manager of the company until July 1891, when he retired and devoted himself mostly to study and experiments in physics. In 1893 the works were sold to Krupp.

Grützner, Eduard, ed'oo-ärd grüts'nĕr, German painter: b. Gross Karlowitz, Schlesien, Germany, 26 May 1846. He began the study of art without a master, and his talent having been recognized by the architect, Hirschberg, he was taken by the latter to Munich, 1864. He was there admitted to the school of Piloty. He first appeared before the public as a humorous painter, Shakespeare's Falstaff being his favorite subject. He is, however, known all over the world for his pictures of monks, in the cellar, tailor's shop, kitchen, etc. Well-known also is his 'Mephistopheles Behind the Scenes in the Dressing Room of a Ballet Dancer.'

Gryllidæ, gril'ĭ-dē, a family, the crickets, of saltatorial orthopterous insects, distinguished from the grasshoppers and locusts by the fact that the tarsi are three-jointed and the ovipositor, when exserted, is spear-shaped; the wings, when present, fit closely to the body. The family includes three types: (1) the true crickets, such as the common field cricket, or the hearth cricket of Europe, which are of the genus *Gryllus*; (2) the burrowing, curiously modified mole-crickets (q.v.); (3) the tree-crickets, pale-colored nocturnal forms which lay their eggs in the twigs of different plants, and which sometimes are so abundant that by their egg-laying alone they do considerable damage to vineyards and to raspberry and blackberry plantations. The black field-crickets, of which the commonest American species is *Anabrus simplex*, inhabit burrows in the ground and come abroad to feed on grass and herbage at night, and sometimes in daylight. They deposit eggs in the ground in the autumn, but these do not hatch until the following spring.

Gryphon. See GRIFFIN.

Guadalajara, gwä-dä-la-hä'rä, Mexico, capital of the State of Jalisco, and second only in population and importance to the City of Mexico, from which it is 380 miles distant by the line of the Mexican Central railway. Its altitude above sea level is 5,054 feet. The city possesses a great advantage in the nearby Falls of Juanacatlan which supply electric energy for its industries, street railway and lighting. In recent years Guadalajara has become a very important mining centre or headquarters for a district in which are many valuable properties, now being developed. Guadalajara is noted for its beautiful pottery and skilfully wrought "retratos" or figures in clay, and its drawn work. In the immediate vicinity is an inexhaustible deposit of clay the elastic qualities and pleasing color of which especially adapt it to the two purposes first above mentioned. Among other industries are manufactories of cotton goods, twine, and cordage, paper and leather articles. The hospitals include a Civil Hospital for both sexes, a Military Hospital, the Hospital of the Sacred Heart, for women, the Hospital Guadalupano, also for women, and the Beata Margarita Hospital, and Santissimo Trinidad Hospital for men. The city's educational facilities include a college of law, a college of medicine, a normal school, a young ladies' seminary, a lyceum, a high school, and a number of primary schools. The Cathedral, or most notable church of the city, is one of the grandest in the Republic, architecturally and in its dimensions, decorations, and ornamentation. The penitentiary of the State, an imposing structure, is located here, as also the various other public institutions. Located in the city are two public libraries,— the State Library, with over 50,000 volumes,— and the Seminary Library with over 12,000 volumes; an Industrial Museum, a theatre, and the Governor's Palace. The principal public parks, some of which are exceptionally beautiful, are the Alameda, Plaza de Armas, Botanical Garden, Alcalde Park, and the Calzada de San Pedro. The banking facilities are supplied by the Bank of Jalisco, a local institution with a capital of $6,000,000, the Guadalajara Banking Company, and branches or agencies of the National Bank, and the Bank of London and Mexico, of Mexico City; the Bank of Aguascalientes, and the Central Bank, of Mexico City. Pop. (1906) 102,000.

Guadaloupe-Hidalgo, gwä-dä-loo'pä-ē-däl'-gō, a village of the federal district of the United States of Mexico, at the foot of the Guadalupe Mountains, three miles north of the city of Mexico. The treaty of peace between the United States and Mexico was signed here 2 Feb. 1848.

Guadalupe-Hidalgo, Treaty of, 2 Feb. 1848; the treaty which closed the Mexican War. While the war was in progress, Polk sent Nicholas P. Trist of Virginia, then chief clerk of the State Department, to negotiate a treaty of peace; the conditions to include the cession of Upper and Lower California and New Mexico and the Rio Grande for boundary between Mexico and the United States. Trist went to Scott's headquarters, an armistice was arranged, and in August 1847 the three Mexican commissioners and Trist met and exchanged proposals. The former would not yield to such terms, demanded the Nueces as the boundary (giving them Corpus Christi and a large triangle at the south), and offered much less other territory. Trist was recalled, but remained at headquarters; Santa Anna declared that he was tricked in the proposals, war operations went on, and the city of Mexico was captured not long after. In January 1847 negotiations were resumed, Trist still acting as principal, and the treaty above was agreed on. The Senate, however, refused to accept it, and insisted on harsher terms; Mexico was forced to accept them, and the Senate ratified the treaty 10 March. Formal proclamation was made 4 July 1848. The land cession was of Upper California and New Mexico, and the Rio Grande was made the boundary. The United States paid Mexico $15,000,000, and assumed $3,250,000 of claims made by United States citizens against Mexico prior to the treaty, besides any claims to which under the conventions of 1839 and 1843 Mexico was adjudged liable. Of the 252 claims put in under this treaty, 182 were finally allowed. See MEXICAN WAR.

Guadeloupe, gä-da-loop' (Fr. gwäd-loop), West Indies, an island of the inner chain of the Caribbees. (See ANTILLES.) It lies in lat. 16° N. and lon. 61° W. and, with its dependencies, has an area of 583 to 600 square miles. A strait divides it into two parts, called Basse-Terre and Grande-Terre. The former is very mountainous, and its volcanic character has been manifested most impressively by the eruption of La Soufrière in 1797 and the disastrous earthquake in 1843. The eastern division, or Grande-Terre, on the contrary, is a calcareous plain, which at no point attains an elevation of more than 450 feet. The mean temperature of Guadeloupe is 78° F., the maximum being 101° and the minimum 61°. The dependencies referred to above are the adjacent islands, Maria Galante, Les Saintes, and Désirade. The chief products are sugar, coffee of the finest quality, and cocoa. Revenues amount to about $1,300,000 to $1,400,000 annually; expenditures, including the appropriations made by France from time to time, are somewhat in excess of that sum. Guadeloupe is a department of France, represented in the French chambers by one senator and two deputies. Its local interests are directed by a governor and a general legislative assembly of 30 members, the jurisdiction embracing one half of St. Martin, besides the islands which have been mentioned. There are nearly 100 elementary schools, with 11,000 pupils, and one *lycée,* with 350 pupils. The chief seaport, Point-à-Pitre, with about 17,000 inhabitants, is situated on the eastern side of Basse-Terre. Several times its buildings have been destroyed or severely damaged; in 1903 minor earthquakes were reported to be of frequent occurrence; and a fresh outbreak from La Soufrière was thought to be not improbable. Le Moule, the principal town of Grande-Terre, resembles Point-à-Pitre in size and situation. After the discovery, Guadeloupe belonged to Spain until 1635; in that year it was taken by the French; in 1794 England seized it, freed the slaves, and retained possession until 1802; then it passed again into French hands, together with Martinique, England taking St. Lucia in exchange; the restoration of slavery by the French was resisted by the negroes, and was attended with great suffering and loss of life; for a brief period in 1810 England once more held Guadeloupe, but returned it to France; emancipation was declared in 1848. The inhabitants are largely French mulattoes, with perhaps 15,000 coolies. Total population, including dependencies, about 167,000. Consult Hill, 'Cuba and Porto Rico, with the other Islands of the West Indies.'

Marrion Wilcox,
Authority on Spanish America.

Guadiana, gwä-thē-ä'nä, a river of Spain and Portugal, which rises in the plateau of New Castile, flows first northwest, then circuitously southwest into and across Estremadura, and on reaching Badajoz turns southwest and forms part of the boundary between Spain and Portugal. Entering Portugal it flows past Monsaraz, Moura, and Serpa, to Mertola, again forms the boundary between the two kingdoms, and falls into the Atlantic between Castro Marim on the Portuguese, and Ayamonte on the Spanish side. Its course is about 515 miles, of which only 35 are navigable. Its chief tributaries are the Gigüela, Bullaque, Valdehornos, and Rubial on the right, and the Azuel and Jabalon on the left.

Guagua, gwä'gwä, Philippines, a pueblo of the province of Pampanga, island of Luzon, on one of the main channels of the Pampanga delta, 3 miles southwest of Bacolor. It is the port for Bacolor, has steamboat communication with Manila, and has an extensive business in groceries and drugs. Pop. 10,700.

Guaiacum, gwī-a-kŭm, a genus of trees of the natural order *Zygophyllaceæ,* natives of tropical America, remarkable for the hardness and heaviness of their wood, known as *lignum vitæ,* or Brazil-wood; also the peculiar resinous product of the common species (*G. officinale*). This is a tree 30 or 40 feet high, usually growing with crooked stem and knotty branches. The wood and resin have been obtained chiefly from Cuba, Jamaica, and San Domingo, but the tree is becoming scarce there. Guaiacum-wood is remarkable for the direction of its fibres, each layer of which crosses the preceding diagonally. It sinks in water. It is much valued and used for pulleys, casters, mortars, bowling balls, and other purposes requiring an extremely firm and durable wood. It is pale yellow on the outside but blackish brown near the heart, where it abounds in resin. Stimulative and other medicinal properties reside in the bark, leaves and resin of this tree.

Guaira, La, lä gwä-ē'rä, Venezuela, a seaport on the Caribbean Sea, five miles in a direct line (29 miles by rail) north of Caracas, of which it is the port. It is situated on a narrow coast strip between high mountains and the sea, and has an unhealthful climate. There are modern harbor works including a breakwater, and a considerable export and import trade is carried on. In 1901 the exports of coffee amounted to 7,290 tons; of cocoa, 3,776 tons; and of hides, 782 tons; the imports include manufactured goods, provisions, wines, etc. The town dates from an ancient Spanish settlement in 1588. In 1903 the port was blockaded by British and German fleets to enforce a settlement of commercial claims. Pop. 14,000.

Gual, gwäl, **Pedro**, South American patriot: b. Caracas 31 Jan. 1784; d. Guayaquil, Ecuador, 6 May 1862. He was graduated from the University of Caracas; joined the patriots in 1810, and was elected as a member of the legislature in 1811. In 1812, when the republicans surrendered, he escaped to New York, but in a few years returned, was made governor of Cartagena, and later sent as ambassador to the United States. He was admitted to the bar in Washington, and began the practice of law, but in 1816 joined Bolivar, was made governor of some of the conquered provinces, and was for a time minister of finance and foreign affairs. In 1858 he joined the revolt against Monagas, and was made president of the provisional government; in 1859 he was elected vice-president of Venezuela, and in 1860 became president, but resigned the next year, retiring to private life.

Gualeguay, gwä-lā-gwī', Argentine, South America, city in the province of Entre Rios; on the Gualeguaychu River. It is a trade centre for a region in which cattle raising is the chief industry. Pop. 7,810.

Gualeguaychu, gwä-lā-gwī-choo', Argentine, South America, city in the province of Entre Rios, on the Gualeguaychu River, 11 miles from its mouth. Its chief industries are connected with the raising and shipping of cattle and wheat. Pop. 14,000.

Guam, gwäm or goo-äm', or **Guajan**, gwä-hän', one of the Ladrone Islands, the southernmost and largest, and the only one with much population; east of the Philippines; occupied by the United States in 1898, the remainder of the group belonging to Germany. It is 29 miles long by 3 to 10 wide, and about 150 square miles in area; high and precipitous on the eastern side, and forming a low plateau in the northern part, but mountainous in the south. About half the soil is arable, but only about one per cent cultivated. Except for the native clearings, most of it is thick and pathless jungle. Some of the trees are valuable hardwoods for ship-building or ornamental cabinet-work; others are useful for food, as the cocoanut (the finest here of all the tropics), pineapple, breadfruit, sour-sop and custard-apple, etc.; the hau (*Hibiscus tiliaceum*) makes strong cordage, not affected by water; the pandanus' long leaves are braided into mats and hats; and the ylang-ylang is famous for perfume. Rice, sugar, tobacco, hemp, coffee, cacao, bananas, melons, etc., have been introduced and are cultivated. The only native mammals are rats, flying foxes, and bats; but the deer and wild goat, of European origin, have thriven plentifully, and cows and pigs are raised. There are no snakes; there are centipedes and scorpions, but none dangerous. The climate is very rainy, but mild except in midsummer, when the conflict of trade-winds produces a dead calm, oppressive heat, and storms, with some hurricanes. Earthquakes are frequent. The island is volcanic, with bordering coral reefs. The east side has but two good harbors, Pago and Tarofofo; the latter is the only one, except San Luis d'Apra on the west, which is safe for vessels all the year round. The island contains about 9,000 people; Chamorros with a mixture of Tagal and Malay, and some Anglo-Saxons from whaling ships, producing half-breeds with copper skins and light hair. They are nearly all in the villages; those with ranches build rough huts on them, where the family spend part of the time. Agaña (San Ignacio d' Agaña) is the only large town; it is a neat place with houses half of stone and half of wood or bamboo, and contains 6,400 people. Its best port is Apra (above), on a deep bay formed by a peninsula; its own harbor being dangerous in a storm from the anchors dragging on the coral bottom, and the landing bad from breaking reefs. There is a mission school, endowed in the 17th century by Maria Ana, queen of Philip IV of Spain. Umata, on the west, was the former capital. Agat, 400 people, is next in importance to Agaña; but the next largest in size are Suwai, 000, and Ynarajan, a fair port on the southeast, 550. Merigo has 300. (Wheeler, Report on Guam, 1900, War Dept. doc. 123.)

Guan, gwän, a gallinaceous bird of the family *Cracidæ*, genus *Penelope*, characterized by the front of the throat being naked and wattled, specifically *P. cristata*. It is about 30 inches long, nearly half of which is due to the tail. The color is a shining reddish-green, with rump and belly chestnut, neck and chest white-spotted, and the feet and throat red; the female is of a more reddish tint, with the crest, neck and mantle bordered with white. Though the guans have most of the habits of the curassow (q.v.), they are far less gregarious, noisy and restless. They take to trees when alarmed, roost there at night and often make their nests among the branches. They inhabit the American tropics, one species, the chachalaca (*Ortalis vetula*) ranging into Texas. Guans have long been domesticated in South America.

Guanabacoa, gwä-na-bä-kō'a, Cuba, a town well situated on high ground near the city of Havana. The number of its inhabitants shown by the United States War Department census of 1899 was 13,963 (that is, 8,232 native white; 1,091 foreign white; 2,173 negro; 2,408 mixed; and 61 Chinese). The total population of the district of Guanabacoa was 20,080.

Guanaco, gwa-nä'kō. See Huanaco.

Guanahani, gwa-nä-ä-nē. See Cat Island.

Guanajay, gwä-na-hī', Cuba, town in the department of the same name in the province of Pinar del Rio, about 30 miles west of Havana. It is situated in a hill region of much salubrity, and is a popular health resort. Here is the terminus of the Havana and Guanajay Railroad. Pop. about 9,000.

Guanajuato, gwä-nä-hoo-ä'tō, Mexico, a state bounded by the states of San Luis Potosi, Queretaro, Michoacán, and Jalisco. Area 20,276 square kilometres, or 7,806.26 square miles. The principal cordilleras traversing the state are the Sierra Gorda, in the northeast, and the Sierra de Guanajuato in the centre, which are formed by the junction of the Codorniches, San Antonio, and Santa Rosa mountain ranges. The highest peaks are the Gigante (2,346 metres) and the Llanitos (2,815 metres). In the south and west are the valleys of San Judas, San Felipe, and Santiago, and the fertile plain of El Bajo Rivers are: the Lerma, with its affluents the Laja and the Turbio, the Irapuato, and a number of smaller streams. There are many mineral springs, and one lake, 37 1-3 square miles in extent, called the lake of blood (Yuririapundaro). Five mining districts merit special mention; namely, the Sierra Gorda, Allende, Santa Cruz, Guanajuato, and Leon, the principal mines being those which produce silver and gold, silver, mercury or cinnabar, tin, iron, lead or argentiferous lead, and copper or argentiferous copper. On 31 Dec. 1897 there were 550 claims registered, of which number 80 were in process of development. (See statistics given in connection with the department and city of Guanajuato.) The climate, except in the higher parts of the mountain ranges, is not unfavorable (mean annual temperature about 70°). The rainy season extends from the middle of May until the beginning of July. During those months the rainful is heavy in the valleys, but only moderate in the mountains. See Mexico — The States of.

Guanajuato, Mexico, capital of the State of the same name. Elevation 6,830 feet above the sea. Distance from the city of Mexico 252 miles, and 1,000 miles by the Mexican Central railway from the United States border at El Paso, Texas. It is situated in the heart of the Guanajuato mountains, in a picturesque ravine, six miles from the main line of the above named railway and overlooking a rich and beautiful region, while itself surrounded and honeycombed by mines hundreds of years old, which have produced unknown millions of precious metals and are still productive. Mining began here 300 years ago, developing as it proceeded, some of the richest deposits ever discovered. Over $600,000,000 of gold and silver have been mined under and in the immediate vicinity of the city, fully two-thirds of which was gold. The buildings of the business centre are quite commodious and imposing and are very substantial, unlimited quantities of very superior building stone being immediately at hand. Among the prominent public buildings are the Government Palace, or State House, in which the legislature holds its sessions and the State officers have their offices, and the Opera house or Theatre, a magnificent stone structure copied from the Grand Opera House of Paris. In a remote part of the city are the famous Catacombs, wherein are stored the mummified remains of some 30 or 40 human beings representing both sexes, and several tons of human skulls and bones. At the opposite extremity of the city is the great dam of modern construction which contains the community's water supply. Another notable structure is the principal church of the city, built of the peculiar colored stone or marble which exists in great quantities in the immediate vicinity. It is surmounted by a dome of large proportions and exceptional beauty. There are several other churches, the ancient Mint, the State College, the Market de la Reforma, and the Castle of Granaditis. There is a street railway, and a thorough system of electric lighting. The Bank of Guanajuato, a local institution of $3,0000,000 capital, and branches of the National Bank and the Bank of London & Mexico compose the financial institutions of the city. There are a State College and a Normal School for young women; two museums,— one connected with the State College and devoted to natural history and mineralogy, and the other — the Museum of Ramon Alcazar — devoted to "Antiquities, Minerals, and Precious Objects." Two public libraries contain over 13,000 volumes. In 1905 the city was flooded and much valuable property destroyed. Pop. about 40,000.

Guanare, gwä-nä'rā, Venezuela, city, capital of the State of Zamor, near the Guanarito River, about 220 miles southwest of Caracas. Coffee and sugar-cane are some of the chief agricultural productions; but the city is the centre of an extensive cattle trade. Pop. about 11,500.

Guanes, gwä-nās', or **Guane**, Cuba, town in the province of Pinar del Rio; about 10 miles from the sea, and 120 miles southwest of Havana. The district court holds its sessions here. The trade in the products of the surrounding country, cotton, tobacco, and cattle, is extensive. There is also a large trade in lumber. Pop. (1899) 14,760.

Guan'idin, a basic organic substance, having the empiric formula CH_5N_3, and the constitutional formula $H.:C(NH_2)_2$. It may be prepared by heating an alcoholic solution of cyanamide and ammonium chlorid to 212° F. Guanidin is a crystalline, deliquescent substance, with strongly alkaline properties, and it absorbs carbon dioxid from the air. It forms numerous salts, and urea is evolved in many of its reactions. In fact, it is this close relation with urea that gives guanidin its chief interest, many authorities holding the opinion that guanidin is an intermediate product in the formation of urea from proteid bodies, in the normal physiological chemistry of the body.

Guanin, gwä'nĭn, a yellowish-white, amorphous substance, which derives its name from being a constituent of guano; but it also forms the chief constituent of the excrement of spiders, has been found attached to the scales of fishes, and seems to be a normal constituent of the mammalian liver and pancreas. With regard to its occurrence in guano, as it has not been found in the recent excrement of sea-birds, there is every reason to believe that it is formed by slow oxidation (from atmospheric action) of uric acid, much as uric acid can be made to yield urea and oxalic acid. And in the pancreas and liver it probably represents one of those transitory stages of disintegrated nitrogenous tissue which are finally excreted by the kidneys in the more highly oxidized form of urea. Guanin is a diacid base, but also forms salts with metals, and combines with salts. When heated with hydrochloric acid and potassium chlorate, it is oxidized to carbon dioxide, guanidin, and parabanic acid.

Guano, gwä'nō, Spanish *guano huano*, from Peruvian *huanu*, dung, is the name for deposits of the partially decomposed and dry excrementitious matter of sea-birds, but it has been also extended to accumulations of a similar kind from land-birds, and even from bats in caverns. Deposits from sea-birds are got wherever there is good feeding-ground in the neighborhood of unfrequented islands and rocky cliffs, and such may be seen around many shores. But to render them of practical utility atmospheric conditions are requisite which are only found in certain localities, and all the great guano deposits exist in the hottest and driest parts of the tropics, as on the islands of the South Pacific Ocean. The most important of all were the deposits on the Chincha Islands off the coast of Peru, which for years yielded a considerable revenue, but are now quite exhausted. The guano which was found there was from 60 to 80 or 100 feet in thickness, and was entirely due to the droppings, accumulated for many ages, of the innumerable sea-birds which make these islands their resting-place and breeding-ground. The excrement which is at first pasty, rapidly dries by exposure to the sun in a part of the world where a fall of rain takes place once in a lifetime, and is looked upon as an historical event, and thus, while putrefaction is almost entirely arrested, the soluble salts of which guano to a great extent consists are retained. This guano, called technically Peruvian, is the most highly prized, and is regarded as a type of the substance; but quantities are or have been got from other localities, as Patagonia, various points of Bolivia, Mexico, and Chile, Malden Island and numerous other Pacific islands, new deposits being opened up as the older become less productive.

Guano varies extremely in composition, even in the same deposit considerable differences will be found; and when deposits from different localities are compared, there is sometimes no analogy except in the kind of substances present. Thus, some consist mainly of phosphate of calcium and other fixed salts, while others contain much volatile matter, with a large proportion of ammonia. To the latter belongs Peruvian guano, which is a very light, dry, non-cohesive pale-yellow powder, with a characteristic ammoniacal odor, and sometimes containing lumps, made up of different salts. It is a very complex mixture, containing the urate of ammonium, the oxalates of ammonium and calcium, the phosphates of sodium, ammonium, calcium, and magnesium, the sulphates of potassium, sodium and ammonium, the chlorides of sodium and ammonium, and the carbonate of calcium. There is always some moisture, organic matter of different kinds, sand from the rock on which the deposit lies, and this is sometimes considerable. These may be regarded as the possible constituents of guano, but the ingredients which are especially prized are the ammoniacal salts, the phosphoric acid, in combination with the alkalies and alkaline earths, and the alkalies themselves, particularly the potash. It is the remarkable abundance of these constituents and their fine intermixture which makes genuine Peruvian guano so much esteemed as a manure. It contains almost all the inorganic matter required by a plant, and that in a highly available form, so that it is one of the best of all fertilizing agents for different crops. Its use as a manure was known to the native Peruvians centuries ago, but no attention was paid to the accounts by modern travelers of its wonderful efficacy until A. von Humboldt took some to Europe, in 1804, and had it analyzed. It was not exported on a large scale till about 1850, and from that time the quantity sent to foreign countries, including large shipments to the United States, was very great, but the supply has latterly much fallen off.

As a substitute for ordinary guano, what is known as fish-guano has been in use for a considerable number of years. This consists essentially of fish and fish offal dried and powdered. In the case of oily fish, such as herrings, it is necessary to extract as much of the oil as possible before the operation of powdering; and it will thus be understood that different kinds of fish differ greatly as regards their value for manurial purposes. But all sorts of fish-guano contain a large percentage of ammonia and phosphate of lime, and are thus valuable as fertilizers.

Guanta, gwan-tä', **Venezuela**, a modern seaport on the north coast, in the state of Bermudez, 12 miles west of Barcelona, by rail.

Guantanamo, gwän-tä'nä-mō, Cuba, a town in the province of Santiago, situated at the head of the most important harbor east of the city of Santiago on the southern coast. Its surroundings were favorably known before 1898, for the beauty of the groves of lime-trees and lemon-trees, the coffee plantations, and the residences of wealthy planters, who made the heights overlooking the bay a favorite place of resort. Since the Spanish-American war, Guantanamo has been famous as the scene of certain military operations. On 19 May 1898 an unsuccessful attempt to cut the cable in the bay was made by the St. Louis and the Wompatuck. On 10 June a force of 600 marines landed from the transport Panther on the eastern shore of Guantanamo Bay, and undertook to make the outer harbor a secure place for the use of American vessels when coaling, or as a rendezvous and a refuge in stormy weather. The marines established their camp ("Camp McCalla") on a small hill, where they sustained the attacks of the Spanish troops for several days, and the courage and endurance displayed at this time must be regarded as memorable features of the war. The Marblehead and Texas lent assistance, the latter on 12 June sending 40 marines with two automatic guns. In the course of that week the camp was protected by earthworks; other warships arrived and shelled the thickets in which the Spaniards were concealed, the forts, and the town; the garrison was strengthened by accessions of bluejackets and Cuban insurgents familiar with the country; and thus, when ten days had passed, the outer harbor was practically in the possession of the American forces. In July 1901 the United States government selected Guantanamo for one of the four naval stations on the Spanish coast. The number of inhabitants of the town of Guantanamo, according to the United States War Department census of 1899, was 7,137. The total population of the district was 28,063, comprising native white, 7,028; foreign white, 1,843; negro, 8,988; mixed, 10,025; and Chinese, 179.

Marrion Wilcox,
Authority on Spanish America.

Guaporé, gwä-pō-rā', or **Itenez**, ē-tä-nāz', a South American river which rises in the Serra Aguapehi, in the state of Matto Grosso, Brazil, flows south, nearly parallel to the Jauru, passes the town of Matto Grosso, whence it is navigable downward for light draught vessels, then with a northwesterly trend forms part of the boundary between Brazil and Bolivia, and finally after a course of over 900 miles, unites with the Mamoré to form the Madeira.

Guarana, gwä-rä'nä, a dried paste consisting chiefly of the crushed or pounded seeds of *Paullinia sorbilis*, a climbing shrub, native of South America. The seeds are obtained largely from the cultivated plants, and in South America guarana is used much as tea or coffee is used in other countries. It is the staple drink of millions of people. Guarana is found in the drug market in the form of flattened cakes or cylinders of a dark reddish-brown color and showing on fracture numerous coarse angular fragments of seeds. The taste is astringent and somewhat bitter, becoming sweet on chewing. Guarana contains four to five per cent of caffeine, making it twice as strong as coffee. Its action, however, resembles more closely that of tea because of the high percentage of tannic acid it contains. In medicine it has been used in the treatment of sick-headache.

Guarana-bread, the seeds of the *Paullinia sorbilis* (a South American tree), pounded, made into cakes, and dried in the sun. It is extensively used in Brazil and other parts of South America as a stimulant and restorative, and as a material for making a refreshing beverage. The active principle of guaranine, is said to be identical with theine or caffeine (q.v.); and no known substance yields it so abundantly. Other species of *Paullinia* possess poisonous properties.

Guarantee, gär-an-tē', or **Guaranty**, in law, an undertaking to answer for the failure of another. The statute of frauds provides that no person shall be liable on any special promise to answer for the debt, default, or miscarriage of another person, unless a written agreement, or some memorandum in writing for such purpose, shall be signed by the promisor or some other party lawfully authorized by him. In the construction of a guarantee it is a general rule that the surety shall not be bound beyond the express words of the engagement. By the mercantile Law Amendment Act (England and Ireland), no special promise made to answer for the debt, default, or miscarriage of another is deemed invalid to support an action, by reason that the consideration for such promise does not appear in writing, or by necessary inference from a written document. By a similar statute applying to Scotland, and passed in the same year, all such guarantees must be in writing, and if for a firm will cease upon a change of the members, unless intended by the parties by express stipulation or implication to be binding notwithstanding the change in the firm. Every person who becomes surety for the debt or obligation of another, and discharges his liability, is entitled to the assignment of all securities held by creditors. In the United States the common law on the subject of guarantee or suretyship was the same as that of England and a guarantee was equally forcible whether written or oral, but see SURETYSHIP.

Guard, National. See MILITIA.

Guardafui, Cape. See CAPE GUARDAFUI.

Guardi, Francesco, frän-chĕs'kō gwär'dē, Italian painter: b. Venice 1712; d. there 1793. He was a pupil and follower of Canaletto; his work shows less exactness in detail than his master's, but is superior in use of color. His paintings are mostly of scenes in Venice; they include 'Procession of the Doge'; 'Fete of Corpus Domini'; 'Grand Hall of the Palazzo Ducale' (in the Louvre, Paris); 'Church and Piazza of San Marco' (National Gallery, London); and 'The Rialto' (Metropolitan Museum, New York).

Guardian Angel, an angel who watches over a particular individual. It is the general belief, in the Roman Catholic and Greek Churches that every man has a guardian angel who defends him from evil, suggests good thoughts and wise counsels, and helps him in prayer. This belief is based on the words of Christ in Matt. xviii. 10: "Their angels do always behold the face of my Father which is in heaven"; the Fathers of the Church strongly inculcate it, and in the lives of the saints instances are given of the active interference of guardian angels. The belief is shared by some Anglican high churchmen. The Roman Catholic Church celebrates the Feast of Guardian Angels on 2 October. See also ANGEL; GUARDIAN SPIRIT.

Guardian Spirit, a spirit that watches over the welfare of an individual or household. The belief in guardian spirits finds expression in some form in all primitive religions, and in many which have reached a higher stage of development. The Australian native believes that when a warrior kills his first foe the spirit of the slain enters the body of the slayer, and becomes his guardian; in Tasmania a native has been heard to ascribe his deliverance from danger to the care of his deceased father's spirit; and the most important religious rite of a North American Indian is to obtain a patron genius. In Asia, in Africa, and among the Indians of South America, the belief in guardian spirits obtains, as it did formerly among the Aryans of Northern Europe. Greeks and Romans believed that each individual was under the protection of a spirit who prompted him to good deeds, and guided him throughout his life; gradually there arose a belief in an evil spirit who was at war with the good spirit, and instigated every evil deed. These spirits were called in Greece, Dæmons, in Rome, Genii. The Romans also believed that the spirit of the founder of each family was the guardian spirit (the Lar) of the family and worshipped the Lares with special rites. For the Christian form of the belief see GUARDIAN ANGEL.

Guards. A guard, in the primary sense, is one who watches or protects a person or persons, a place, property, etc., against loss, danger, or harm; as a body-guard, a prison-guard, etc. Body-guards have been an inseparable accompaniment of monarchy from the earliest ages; the Assyrian and Persian kings employed them, and the corps of "Argyraspides," or silver-shields were selected by Alexander out of the bravest men of his army. The Roman emperors had their Prætorian guard. Napoleon I. first created a small troop of bodyguards, with the title of Guides, while he was yet only general, in his first Italian campaign. From this arose by degrees, the great institution of the Imperial Guard, consolidated in 1804, which 10 years later comprised 102,708 men, and after being disbanded by Louis XVIII. in 1815, was restored by Napoleon III. in 1854. It consists of infantry, cavalry, and artillery. In England, the Guards, otherwise called household troops, consist of two regiments of Life Guards, the royal regiment of Horse Guards, and three regiments of Foot Guards. Many of the European sovereigns before the French Revolution had small corps of foreign troops which served in this capacity. Thus the French had, in former times, the Guard of Scottish Archers, and at a later period, a body of Swiss guards, called the Cent Suisses. The Cent-Gardes formed by Napoleon III. are founded upon the latter. The Pope still retains his Swiss guards. In Prussia there is both infantry and cavalry of the guard, and the Russian imperial guard forms an entire corps d'armée 50,000 strong.

In general military use the term guard is of various distinct applications and denotes functions of great importance. It means a sentry on duty, and also a body of soldiers assigned, under the proper officer or officers, to the duty of guarding or protecting a camp, post, or any place where military control is established. Company and regimental details for guard duty are made according to circumstances — the number of men required or available, etc.,— rank of officers being also regarded as far as convenient. Guard-mounting or inspection and review before the old guard is relieved, is a ceremony of much detail and is usually carried out with strict military observance.

Guasa, gwä'sä, or **Warsaw,** a name given in the Gulf of Mexico and West Indian region to various large groupers (q.v.), especially the jewfish (q.v.). "Warsaw" is an anglicized form of the Spanish word.

Guatemala, Republic of (República de Guatemala), the largest country in Central America; bounded on the north by Mexico, British Honduras, and the Gulf of Honduras; on the east and southeast by British Honduras, the Gulf of Amatique, Honduras, and Salvador; on the south and southwest by the Pacific Ocean; and on the west by Mexico. Its area is estimated at 47,810 or 48,290 square miles; its territory extending from lat. 13° 42' to 17° 49' N., and from lon. 88° 10' to 92° 30' W.

Political Divisions.— Guatemala is divided into 22 departments, and each department subdivided into municipal districts, the total number of the latter being 331. Again, for electoral purposes, the whole republic is divided into 38 *distritos electorales.* The following list of the departments and chief towns shows the population and altitude of the latter. The figures given for the number of inhabitants are those of 1903 in the case of Guatemala City, Cobán, and Totonicapam; otherwise the statement is based upon a table carefully prepared in 1897.

Northern departments are: Baja Verapaz (chief town Salamá, population 10,608, altitude 2,827 feet); Alta Verapaz (chief town Cobán, population 24,475, altitude 4,047 feet); El Petén (chief town Flores, population 1,671, altitude 482 feet); El Quiché (chief town Santa Cruz, population 11,914, altitude 5,543 feet); and Izabal (chief town Livingston, population 1,978).

Central departments are: Guatemala (chief town Guatemala City, population 72,102, altitude 4,854 feet); Sacatepéquez (chief town Antigua, or Antigua Guatemala, population 10,150, altitude 4,464 feet); and Chimaltenango (chief town Chimaltenango, population 3,749, altitude 5,666 feet).

Eastern departments are: Jutiapa (chief town Jutiapa, population 11,023, altitude 2,847 feet); Jalapa (chief town Jalapa, population 12,246, altitude 4,625 feet); Chiquimula (chief town Chiquimula, population 12,562, altitude 1,167 feet); and Zacapa (chief town Zacapa, population 11,964, altitude 511 feet).

Southern departments are: Escuintla (chief town Escuintla, population 12,343, altitude 1,269 feet); Amatitlan (chief town Amatitlan,* population 8,408, altitude 3,614 feet); and Santa Rosa (chief town Cuajiniquilapa, population 3,062, altitude 3,254 feet).

Western departments are: Huehuetenango (chief town Huehuetenango, population 10,270, altitude 7,118 feet); Totonicapam (chief town Totonicapam, population 25,196, altitude 7,067 feet); San Marcos, chief town San Marcos,* population 6,036, altitude 7,216 feet); Quezaltenango (chief town Quezaltenango,* population 22,265, altitude 7,419 feet); Retalhuleu (chief town Retalhuleu, population 6,327, altitude 977 feet); Suchitepequez (chief town Mazatenango,* population 6,970, altitude 1,005 feet); and Sololá (chief town Sololá,* population 7,027, altitude 5,940 feet).

The Capital.— Guatemala City, or New Guatemala, which was built after the destruction of Antigua Guatemala in 1776, has a temperate climate, owing to its elevation above the level of the sea. It is a well-planned town, covering a large area; the streets are wide and straight, lighted by electricity, and have lines of street railways. Principal buildings: the palace of the president, city hall, court-house, post and telegraph office, artillery barracks, custom-house, liquor and tobacco bureau, national theatre, college of medicine and pharmacy, university, school of arts and trades, polytechnic school, palace of the archbishop, the cathedral and several other fine churches, the penitentiary, and the hotels. The city has public gardens, telephone and telegraph service, and is connected by rail with the port of San José. Pop. 74,527.

Topography and Physical Geography.— The mountains of Guatemala are commonly referred to as "Cordillera of the Andes," "Guatemalan Andes," or simply "Andes," though there is no propriety in those names. The Andes terminate in northern Colombia, and have no genetic connection with the mountains of Central America. In order to understand the independent character of the latter (so far as the great continental ranges are concerned), we must realize that they are also in their geologic history totally distinct from the Rocky Mountain system, or North American Cordilleras, which terminate in southern Mexico. If the trends of the Andean and Rocky Mountain systems were protracted from their termini (in 70° W. and 97° W., respectively), they would not connect with each other, but would pass the latitude of Guatemala in parallel lines nearly 2,000 miles apart. (See CARIBBEAN SEA; CENTRAL AMERICA; and consult: Hill, 'Cuba and Porto Rico,' Chap. I.). The Guatemalan mountains belong to the Antillean system, which lies between the termini just referred to; its ranges, composed of folded sedimentaries, in eastern Guatemala have an east-and-west trend. But the ranges near the Pacific coast of the republic, crossing the western ends of the Antillean corrugations diagonally, or with a northwest-and-southeast trend, must be assigned to still another class; they form a part of the volcanic chain which extends along the entire western coast of Central America, and is continued in Mexico. The Sierra Madre is the principal range of the west and south; in the central and eastern districts are the Sierra de Chama, Sierra de las Minas, Sierra de Santa Cruz, and the Sierra de Copán — the last named on the frontier of Honduras. The highest points of the Cordillera are given as: Tajumulco volcano (12,600 feet), Tacaná volcano (12,400 feet), both in the southwest; Acatenango volcano (11,100 feet), south-central; and the volcano de Fuego (11,400 feet), also south-central.

Hydrography.— Rivers emptying into the Gulf of Mexico are: the Usumacinta, on the Mexican frontier, and the Cuilco and Salequa, which are also tributaries of Mexican streams. The following empty either into the Gulf of Honduras or Izabal Lake (Golfo Dulce): the Montagua, Rio Hondo, the Dulce, the Belice, the Sarstoon, and the Polochic. Those which flow into the Pacific are: Rio de los Esclavos, Rio de Paz, the Michatoya, Guacalate, Coyelate, Patulul, Nagualate, Samalá, Tilapa, Naranjo, and Suchiate. Steamship navigation has been established on the Dulce and Polochic rivers; seven or eight of the others are navigable for small boats. The most important lakes are: Atitlán and Izabal (both navigated by steamers), Petén, Amatitlán, Ayarza, and Güija (on the frontier of Salvador). Ports on the Caribbean side of the republic are: Puerto Barrios, Livingston, and Santo Tomás — the first two being ports of entry and delivery, while the last is a "minor port," at which importation and exportation are restricted to certain articles. On the Pacific coast the most important ports are: San José, 74½ miles from Guatemala City; Champerico, and Ocós — all ports of entry and delivery, provided with iron piers, etc.

Geology.— The calcareous formations of the Antillean ridges and, generally, the eastern and

*Towns damaged or destroyed by earthquakes in 1902.

central regions, deserve special mention. Volcanic products characterize the Pacific slope and Sierra Madre, where they occur in connection with granitic rocks, porphyries and trachytes. See also CENTRAL AMERICA.

Mineral Resources.— Gold and silver are found near the Montagua River and elsewhere: salt in the departments of Alta Verapaz and Santa Rosa. Other minerals reported to exist are: coal, lignite, manganese, lead, tin, cinnabar, copper, kaolin, opals, slate, alum, antimony, marble, alabaster, sulphur, ochre, asbestos, plumbago, chalk, and bitumen. A belt of country extending from the coast range of mountains on the western frontier, near the Pacific, across the Sierra Madre to the coast range of the Caribbean slope, is regarded as essentially a mineral territory, in which there has been comparatively little exploiting or prospecting, though enough to reveal the presence of the precious and base metals.

Climate.— The lowlands of the Pacific and Atlantic coasts are torrid; interior table-lands, at an altitude of 2,000 to 5,000 feet, have an agreeable climate; and the high districts, where the elevation is more than 5,000 feet, are decidedly cool. As is shown in the list of places given under "Political Divisions," the larger towns are built in the temperate or cool zones. The rainy season, beginning in May, lasts until October in the interior, but sometimes until December, on the coast. December and January are the coldest months; March and April the hottest. Snow sometimes falls (in December or January) on the uplands of the cool zone.

Flora and Fauna.— The very name of the country signified in the Indian language "the land covered with trees." The rich soil and varying climatic conditions favor a wide range of products in the vegetable kingdom; no systematic classification of these, however, has yet been made. The extent of the forest land, which abounds in mahogany, is estimated at 1,300,000 acres. The fauna and avifauna resemble those of Costa Rica in general, but especially characteristic of Guatemala are the aquatic birds on its rivers and lakes, and the quetzal. Mexican deer are quite numerous. The tapir, honey-bear, armadillo, wild pig, cougar, jagua, etc., are found as in other parts of Central America. The over-abundance of insect life is particularly noteworthy.

Land Tenure.— The most interesting provisions of the Guatemalan laws, to be considered under this heading, are those which relate either to the public lands or more particularly to the aid which the government desired to extend to the cultivators of certain crops. The latter will be stated in the paragraph entitled *Agriculture.* As for the former, the agrarian law of 1894 provided for the sale, lease, and gratuitous concession of the public lands, and created a board of government engineers to survey the said lands and divide them into lots of not more than 15 caballerias each. (One caballeria in Guatemala = 113⅝ acres.) These lots can be purchased from the government at prices ranging from $250 to $500 per caballeria, but no alien is allowed to hold lands situated on the frontier of the republic; or they may be leased (under certain restrictions as to area, duration of lease, and use of the lands) at a rental not to exceed 5 per cent of the selling price; or they may be granted by the president of the republic, in tracts not larger than two caballerias each, to poor persons applying for them, to immigrants, to educational institutions, as a reward for the construction of new roads, etc. Real estate, the value of which does not exceed $1,000, is exempted from taxation. Transfers of unimproved city lots, or of real estate in the country the price of which does not exceed $100, cannot be taxed; and no foreigner can be required, during the first year of residence in the country, to contribute money or personal service for making or repairing roads.

Agriculture.— Coffee grows in the regions between 1,000 and 6,000 feet above the sea-level; sugarcane, between sea-level and 6,200 feet; cacao in the lowlands or those regions having an altitude of less than 3,000 feet. Tobacco, wheat, maize, and beans, are also produced in large quantities. Coffee exports in one year have amounted to 85,373,223 pounds, with a value of $7,390,477 gold. The ordinary annual yield of tobacco is given as 1,000,000 pounds; of cane-sugar, 41,000,000 pounds; bananas, 1,000,000 bunches; and cacao, 200,000 pounds. Stock-raising has been encouraged in the departments of Izabal, Zacapa, Petén, and Alta Verapaz, by decrees authorizing the political chiefs of those departments to make grants of land to persons who establish ranches. Money premiums have been offered to cultivators of india rubber, cacao, sarsaparilla, and hemp; grants of land to those who engage in the cultivation of wheat and bananas. Proprietors of large cotton or tobacco plantations, and reliable day laborers on large plantations of coffee, sugarcane, bananas, or cacao, are exempted from military service. No tax of any kind is levied for 10 years upon plantations of hemp, flax, ramié, cotton, grapes, and one or two other products. Large cash premiums to encourage the production of grapes, hemp, cotton, flax, wheat, and tobacco were offered, particularly during the decade 1886–96; in 1899 the government offered 113⅝ acres of the public lands as a reward for every 20,000 rubber-plants, four years old, planted after 14 Jan. 1899.

Commerce.— Exports to the United States in the fiscal year ending 30 June 1902 were valued at $2,600,000; imports from the United States at $1,680,000. The principal exports for 1901 were: Coffee, 673,344 hundred-weight, sent to Germany, the United States, and Great Britain; sugar, 55,200 hundred-weight, sent to other Central American countries and to the United States; bananas, 262,691 bunches, sent to the United States; hides, 7,018 hundred-weight, sent to Germany and the United States; india rubber, 4,420 hundred-weight, sent to the United States and Germany; timber, 2,155,696 feet, sent to Great Britain and the United States; and other articles valued at $55,000. Of the imports, about one half in value are supplied by the United States, and one quarter by Great Britain, the chief imports being flour, cotton goods, machinery and manufactured iron, and preserved meats and other articles for food. Both exports and imports have increased in value during recent years.

Manufactures.— For the partial supply of local needs a number of small establishments are maintained, the chief industries being the preparation of ramié fibre and the manufacture of coarse textiles, hats, shoes, pottery, cigars, foundry products, musical instruments, furniture, agricultural implements, and liquors.

Shipping and Navigation.— Steamers of the Pacific Mail Steamship Company call at San José three times each month on the voyages from San Francisco southward. From New York to Puerto Barrios (via Haiti and Jamaica) passengers and freight are carried by two steamship lines. The steamers of the American Fruit Company ply between New Orleans and Puerto Barrios; and in 1903 announcement was made of a new steamship service, the "Guatemala Northern Steamship Line," to operate chiefly between ports on the gulf coast of the United States and Puerto Barrios.

Railways, Roads, Telegraph, etc.— The Central Railway, the first line built in the republic, was completed in 1882. It connects the port of San José with Guatemala City. The Champerico Railway runs from the Pacific port of that name to Retalhulen and San Felipe, a distance of 41 miles. The Ocos Railway, 15 miles in length, connects the wharf at Ocos with the town of Ayutla, near the Mexican frontier. The Ixtapa Railway connects Overo with the old port of Ixtapa (12 miles). The Patulul-Mazatenango Railway has as its terminal points Santa Maria station, on the Central, and San Felipe, passing through Patulul and Mazatenango. The Northern Railroad, which is to connect Puerto Barrios with Guatemala City (and thus, in conjunction with the Central, to supply railway transportation from coast to coast), had completed 159 miles of its road in March 1902. An important highway from Sanarate has been completed, giving access to the northern agricultural districts. The republic has in operation more than 3,000 miles of telegraph wires, 137 kilometres having been added in 1901-2; and the telephone system extends over 250 miles. Receipts from telegraph and telephone lines were greater by $130,042.97 in 1902 than in 1901. The operation of the postal system in 1902 left a considerable surplus in the treasury.

Weights, Measures, and Money.— The French metric system is used, concurrently with the old Spanish system of weights and measures. The latter has: *Onza* (ounce), *libra* (pound, strictly 1.043 pounds), *arroba* (25 *libras*), *quintal* (100 *libras*), *tonelada* (ton 20 *quintals*), and *fanega* (1½ bushels). The monetary unit is the silver *peso* (value in United States gold or silver, $0.384). The money in actual use is paper currency and fractional nickel coins.

Banking.— Six banks are authorized to issue paper, namely: International Bank of Guatemala (Banco Internacional de Guatemala), Columbian Bank (Banco Colombiano), Western Bank (Banco de Occidente), Commercial Bank of Guatemala (Banco Comercial de Guatemala), American Bank (Banco Americano), Guatemala Bank (Banco de Guatemala). All of these, except the Banco de Occidente, have their headquarters in Guatemala City.

Government.— The legislative power is vested in the National Assembly (a single house), whose members (deputies) number one for every 20,000 inhabitants, and are elected for four years by popular vote. The executive power is vested in a president, elected for six years by direct vote of the people. He is responsible for his acts to the assembly, and cannot be re-elected until after an interval of at least one term. The administration is carried on, under the president, by six "secretaries of state," each of whom has charge of a separate department (*ministerio*). These departments are: Government and Justice, Foreign Relations, Public Instruction, Promotion of Public Welfare (*Fomento*), Finance and Public Credit, and War. The council of state is an advisory board, of which certain members are chosen for the assembly and others appointed by the president.

Finances.— The national revenue in 1901 is shown in the following table:

Customs	$8,513,260.88	
Expenditure	7,855.85	
		$8,505,405.03
Liquor excise and government monopolies........	$3,775,892.98	
Expenditure	117,687.15	
		$3,658,205.83
Taxes	$1,651,246.55	
Expenditure	72,588.45	
		$1,578,657.10
Total		$13,742,268.96
Deficit from post-office....	$110,617.48	
Deficit from telegraph office	193,541.32	
		$304,158.80
Net total.................		$13,438,110.16
Revenue in 1900...........		7,974,435.40
Increase in revenue....		$ 5,463,674.76

The sum of $14,547,246.72 was appropriated for administrative expenses in the fiscal year extending from 1 July 1902 to 30 June 1903, with the following distribution: Government and justice, $1,874,392; foreign relations, $256,180; treasury, $1,199,980; public credit, $6,000,000; development, $1,458,279; war, $2,006,154.40; public instruction, $1,442,900; other expenditures, $309,376.32. The revenue for the year was estimated at $14,555,000. The total amount of the foreign debt liquidated to 30 June 1902, according to an official statement, was:

Principal on 30 June 1898.................	$7,216,046
Half of interest from 1898 to 1901, convertible in bonds..........................	432,063
Half of interest to 30 June 1901...........	288,642
Interest for 1901 to 1902..................	288,642
Total	$8,226,293

On 31 Dec. 1900 the outstanding amount of the gold debt was $9,231,202, and of the currency debt $27,700,666.

Army.— The army consists of about 7,000 men in regular service; effective army, 56,900 men between the ages of 18 and 30; reserve, 30,000 men from 30 to 50 years of age.

Population.— Full-blooded Indians are much more numerous in Guatemala than in other Central American countries; in fact they, with the Indians of mixed blood, *ladinos* and *mestizos* make up the bulk of the population. The natural increase among these people is indicated in the report of the secretary of public works for 1901, which shows 66,728 births in that year against 35,618 deaths, a gain of 31,110 persons. The total number of inhabitants in 1903 was about 1,700,000, including 11,000-12,000 foreigners.

Education.— Public instruction, supported by the government, is secular and gratuitous; primary instruction is obligatory; free education is guaranteed by the Constitution. In 1901 there were 1,030 schools in the republic, 455 being for males, 379 for females, 146 mixed, and 50 night schools. In Guatemala City there were 53 schools, of which number 25 were public, under government inspection; and among the private institutions was a school for boys and girls of the German colony only, endowed by the German government. Higher instruction was given in the capital at the National Institutes (one for men and one for young women), to which normal departments were attached; and similar institutes existed at Quezaltenango (before its destruction) and Chiquimula. There is a separate normal school for young women at Guatemala City, and normal schools for young men at Antigua, San Marcos, and Mazatenango. Schools of law, medicine, and engineering are mainly supported by private funds, but receive aid from the public treasury. Education in music is supplied at the National Conservatory and a number of local schools. There are also trade schools (including one for women) a commercial college, and an art school. The national library contains 30,000 volumes and many valuable unpublished documents. Other libraries accessible to the public are those of the professional schools, the supreme court, national institute for men, and academy of teachers. Public libraries are maintained in the larger towns. The national printing-office at the capital is regarded as one of the best establishments of its kind in Latin-America. More than 30 daily papers and other periodicals are published in the country.

Religion.— The Constitution guarantees liberty of conscience. The government recognizes no creed. The prevailing religion is Roman Catholicism.

Judiciary.— The supreme court of justice consists of a chief justice and four associates, elected by the people. There are six courts of appeal, each consisting of a chief justice and two associates, also elected by the people. Courts of the first instance are 29 in number: their judges are selected by the president among the candidates approved by the chief justice of the supreme court.

Local Government.— The "Political Chief" (*Jefe Politico*) of each department of the republic is appointed by the president, whose authority he exercises in provincial matters. The local officials locally elected are: the *Alcaldes* (one or more for each municipal district) and the *Regidores* (members of the municipal council). *Alcalde* and *Regidor* correspond to mayor and alderman; the *jefe politico* takes the place of a governor, and his relation to the chief executive in a centralized republic fairly indicates the limits within which local self-government is permitted.

History.— Pedro de Alvarado, one of the lieutenants of Cortés, in 1523-4 conquered the country, and on 25 July 1524 proclaimed the sovereignty of Spain at Almolonga, the native town which was afterward to be known as Santiago de los Caballeros. The important fact in connection with this conquest is that it did not lead to the extermination of the natives. Two explanations of this circumstance are offered. Mr. Bancroft says that the Indians, after fighting desperately in defense of their homes, maintained a sullen resistance, and therefore both here and in the adjoining state of Chiapas "the natives probably retain to the present day their original traits with fewer modifications than elsewhere in the Pacific States." But this theory is at variance with the Central American records in general. A suggestion which may be preferred is that the natives of Guatemala were essentially peace-loving agriculturists, not uninfluenced by that civilization which had survived here, as in southern Mexico and Honduras, from very ancient times; that they were allowed to remain undisturbed after the first resistance ceased, while the more warlike tribes, such as those inhabiting Costa Rica and Veragua, were gradually being exterminated. And their descendants in great numbers still possess the land. After the conquest all of the territory now divided up among the Central American countries was included in the captain-generalcy of Guatemala. Independence was proclaimed 15 Sept. 1821; annexation to the Mexican empire under Iturbide followed (5 Jan. 1822). An assembly of representative citizens of Guatemala and the other Central American provinces on 1 July 1823 declared the whole country to be independent, with reference to Mexico, Spain, and all other nations, "whether of the Old or of the New World." Accordingly the United Provinces of Central America came into existence. Guatemala seceded from this union 17 April 1839. The name República de Guatemala was assumed 21 March 1847. Between 1839 and 1851 there was a series of bitter struggles with Salvador for supremacy, fortune favoring the smaller republic; but in the year last mentioned Guatemala began to be successful, and, under the leadership of Rafael Carrera (president until 1856, and subsequently life-president or dictator), carried the war into Salvador (1863) and regained the controlling position in Central America. Carrera appointed his own successor, and died in 1865. The next significant administration was that of Gen. Justo Rufino Barrios, who was put in office by the Liberals, after their onslaught upon the Jesuits. Barillas was elected to the presidency in 1886. In 1890 and 1891 the progress of the country was checked by epidemics of cholera and smallpox. On 15 March 1892 José Maria Reina Barrios was inaugurated as president, and by a decree of the National Assembly (30 Aug. 1897) his term was extended to 15 March 1902 — in direct violation of the Constitution, which was proclaimed in 1879 and modified in 1885, 1887, and 1889. He was assassinated 8 Feb. 1898 by a British subject of German origin. Dr. Manuel Estrada Cabrera was proclaimed acting president, and received the support of the army. An insurrection begun under Gen. Castillo's leadership 28 July was put down, but only to be quickly followed by another revolutionary movement. Insurgent forces commanded by Morales offered a stubborn resistance in the southwest, until Morales was captured. When peace had been restored, Cabrera was the only candidate for the presidency, and his election was announced 25 Sept. 1898. In the following year the government of Guatemala made a proposition which was equivalent to repudiation of a part of its foreign debt, but yielded to Germany's protest — or threat to use force — and withdrew the discreditable suggestion. Earthquakes which occurred in April 1902 caused great damage in several districts. Amatitlan, Mazatenango, San Marcos, Sololá, and San Felipe suffered severely, and Quezaltenango, in importance the second city of the republic, was totally destroyed. An eruption of the volcano Santa Maria followed on 24 October, and there were outbursts from new craters in November. Several thousand persons lost their lives through these disasters, and the injury to property (plantations, buildings, machinery, and cattle) has been estimated at $5,000,000 to $10,000,000. Taxes for the relief of the earthquake sufferers were imposed by the Legislative Assembly 24 April 1902. A convention between the United States and Guatemala relating to the tenure and disposition of real and personal property was signed 27 Aug. 1901, and ratifications exchanged at Guatemala 16 Sept. 1902.

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MARRION WILCOX,
Authority on Spanish America.

Guava, gwä'vä, the name of several tropical plants of the myrtle family which yield delicious fruits. The common guava (*Psidium guava*, or *pyriferum*) is a low bushy tree, bearing long, fragrant white flowers on solitary axillary stalks, from each of which develops a fruit larger than a hen's egg, roundish or pear-shaped, smooth, yellow; the rind thin and brittle; the pulp firm, full of bony seeds, aromatic, and sweet. The jelly or preserve made from it is highly esteemed, and pleasantly mingles tartness with sweetness. The rind is stewed with milk, and is also made into marmalade. This fruit is rather astringent than laxative. Guava buds, boiled with barley and licorice, make a useful astringent drink in diarrhœa. This guava is now naturalized in all the warmer parts of the world, and in many, especially Ceylon, has run wild. Two cultivated varieties are known, the preferable "white," and the more showy but less agreeable "red." Several other species are cultivated; as the mountain guava of the West Indies (*P. montanum*) and the marangaba, a dwarf species (*P. pygmæum*) of Brazil, with fruit no larger than gooseberries.

Guaviare, gwä-vē-ä'rä, or **Guayabero**, gwī-ä-bä'rō, a river of Colombia, South America, which rises in the Cordillera Oriental near Bogota, flows eastward for 750 miles, forms the boundary between the departments of Cundinamarca and Cauca, and joins the Orinoco near San Fernando de Otabapo. It is navigable for nearly five hundred miles.

Guayama, gwī-ä'mä, Porto Rico, town in the southeastern part of the department of Guayama; five miles from the sea. Pop. 5,400.

Guayaquil, gwī-a-kēl', Ecuador, a seaport city, the capital of the province of Guayas, on the river Guayaquil, 25 miles above its mouth in the Gulf of Guayaquil, on the Pacific Ocean. The site is low and unhealthful, but the sanitary conditions have been improved by a modern system of waterworks, and of drainage. Other modern improvements include street railways, gas-lighting, and telephone service, while a railroad connects with the interior. The chief buildings are the custom-house, town-hall, a college, technical school, and the cathedral. Vessels of 18 feet draught reach the town, and the river and its tributary, the Daule, are navigable for smaller vessels, a considerable distance above the town. The export trade averages $6,500,000 annually, cocoa representing nearly five-sixths, the rest being, coffee, ivory-nuts, rubber, hides, and specie. Cottons, hardware, and other manufactured articles are imported. The industrial establishments include steam saw-mills, foundries, machine-shops, ice factories, and a large brewery. The town was founded 25 July 1531 on St. James' day, whence its official title Santiago de Guayaquil. It has had an eventful history, being attacked by pirates, Dutch, French and English, and suffering from disastrous conflagrations, on the last occasion in 1896. Pop. (1903) 55,000.

Guayaquil, a gulf of the Pacific, in the republic of Ecuador. It has a wide entrance, narrowing as it extends inland, and receiving at its head the Guayaquil River. It contains a number of islands.

Guaymas, gwī'mäs, Mexico, city in the state of Sonora; on the Gulf of California, the terminus of the Sonora Railroad, and the chief Pacific port of Mexico. The principal exports are gold, silver, and hides. Pop. 6,100.

Guayrá (gwī-rä') **Falls**, Brazil and Paraguay, a cascade of the Paraná River, on the boundary between the countries mentioned; the result of a contraction of the river-bed from a width of 4,470 yards into a narrow gorge, 65 yards wide, the waters making a plunge of 56 feet. "These falls, situated in the midst of a desolate region, far from human habitation, and rendered almost inaccessible by virgin forests, rapids, and other obstacles, have been visited by very few, though they are said to form one of the grandest spectacles in the world. The volume of water which passes over them is twice that of Niagara." Consult 'Paraguay' (2d ed. revised by J. S. Decoud, Honorary Corresponding Member of the International Union of American Republics; Washington: Government Printing Office, 1902).

Gubat, goo'bät, Philippines, a pueblo of the province of Sorsogon, Luzon, on the east coast of the Bay of Gubat, 11 miles southeast of the provincial capital Sorsogón. The waters of the bay were formerly infested by pirates, who terrorized the surrounding region. Pop. 13,300.

Gubernatis, Angelo de, än'jä-lō dā goo-bĕr-na'tēs, Italian Orientalist: b. Turin 7 April 1840. He founded the Italian Asiatic Society in 1886 and has written much in various departments. Among his works are 'The First Twenty Hymns of the Rig-Veda' (1865); 'Death of Cato' (1863), a metrical drama; 'King Nala,' an Indo-Brahmin play; 'Gabriel,' a novel; 'Zoological Mythology' (1872); and 'Dictionnaire International des Ecrivains du Jour.'

Gudgeon, gŭj'ŏn, a small European freshwater fish (*Gobio fluviatilis*) of the carp family. It swims in shoals, and affords great sport to anglers from its greediness in seizing upon any bait presented. Its name has therefore come to mean a person easily "fooled" to his hurt.

Gudrun, goo-droon', or **Kudrun**, an old German epic, built up out of the popular songs and traditions of the seafaring people who lived on the shores of the North Sea between the Elbe and the Seine. It was put into permanent form by an unknown poet of Austria in the latter part of the 12th or early 13th century; and ranks second to the 'Nibelungenlied' in the history of early German literature. It relates the history of three generations of the kings of the Hegelings or Frisians, and in the third part tells how Gudrun, the daughter of Hetel, king of the Hegelings, was carried off from her home by Hochmut, son of the king of Normandy, how she preferred to work like the lowest maidservant in the house of Hochmut's mother, and endure the greatest indignities, rather than break her troth pledged to Herwig, king of Zealand, and how finally she was rescued by her brother and her betrothed.

Guebers, gē'bėrz, also **Ghebers, Gabers, Ghavers, Gebirs** (Turkish Ghaur or Ghiaur, infidel, generally but probably wrongly derived from the Arabic kâfir), a name applied by Mohammedans to the adherents of the ancient religion of Zoroaster, who reside in Persia. They originally were subjected by the Mohammedans to much cruelty, but are now permitted a great degree of religious freedom. Those who fled to India are known as Parsis (q.v.).

Guelder (gĕl'dėr) **Rose,** or **Snowball,** a cultivated variety of the *Viburnum opulus,* or water elder, of the order *Caprifoliaceæ.* In the European wild form, the inflorescence is a dense cyme whose outer flowers are barren and enlarged, but in the cultivated form all the flowers are neuter and consequently the plant can never set seed. A yellow dye is obtained from it, and the wood is sometimes employed in making tobacco-pipes and other articles.

Guelders, gĕl'dėrz, or **Guelderland.** See Gelderland; Netherlands.

Guelfs, gwĕlfs, or **Guelphs,** and **Ghibellines,** names of rival political parties in Italy during the Middle Ages. The words are of German origin, derived respectively from Welf, the name of a princely family in Bavaria (from which is descended the royal Brunswick line and the line of Este), and Waiblingen, the name of a castle in Würtemberg belonging to Conrad of Hohenstaufen, the German emperor. In the great battle of Weinsberg, 1140, the war-cry of the partisans of Conrad was "Hie Waiblingen," that of the adherents of the Duke of Saxony (of the house of Welf) was "Hie Welf." Some years after when the effort was made by the popes and various states and princely houses of Italy, among them the house of Este, to consolidate opposition to the Emperor, the two German words, changed to Guelfo, Guelfi (plus), and Ghibellino, Ghibellini, were adopted as party designations by the Italians. At first and for a long time after the assumption of these names by the great parties in Italy, Guelf and Ghibelline, did really designate two opposing national policies — the policy of the dependence of the several states of the Peninsula on the Empire, and the policy of Italian independence of Germany, and of resistance to imperial absolutism. The states of northern and of central Italy were divided in their allegiance and they were continually passing from one side to the other, but they were predominantly Ghibelline; the states of southern Italy were always Guelf. The popes were the mainstay of the Guelf party and thus were the assertors of the policy of Italian independence and home rule. As usual with party designations, "Guelf" and "Ghibelline" continued in use as the names of factions in no wise concerned with the question of imperialism.

Guell y Rente, Jose, hō-sā' goo-ely' ē rān-tā', Cuban author: b. Havana, Cuba, 14 Sept. 1818; d. Madrid 20 Dec. 1884. He studied law in Havana and Barcelona and practised his profession in his native city. In 1848 he went to Spain where he married Josepha de Bourbon, sister of the king. Besides several novels he published 'Philippe II. et Don Carlos devant l'histoire' (1878), and other works.

Guelph, gwĕlf, Canada, city and county-seat of Wellington County, Ontario; on the river Speed, and on the Grand T. and Canadian P. Rys., 48 miles west of Toronto; founded by John Galt (q.v.). The river affords abundant water power and the city, in a rich agricultural and cattle-raising district, enjoys a large trade. It is an inland port of entry and is the seat of a United States consulate. It has breweries, large flour, saw, and planing-mills, and manufactories of foundry products, machinery, pipe and tubing, musical instruments, sewing-machines, agricultural implements, woolen goods, carpets, furniture, carriages, leather, soap, boots and shoes, etc. Good building stone is quarried in the vicinity. Guelph has in addition to the county buildings, 4 colleges, 16 churches, substantial business blocks, banks, a library and reading-room, and daily and weekly newspapers. The city owns and operates its electric light, gas and power, its water-works and street railway. It is the seat of the Ontario Agricultural College (q.v.) and the Provincial Experimental Farm. Pop. (1901) 11,496; (1904 est.) 12,500.

Guelphs, Order of, frequently styled the **Guelphic Order,** an order of knighthood instituted for the kingdom of Hanover in 1815 by the prince-regent of England and Hanover, afterward George IV. of England, and conferred by the kings of Hanover until the absorption of that kingdom by Prussia in 1866.

Guemal, gwā'mäl, either of two species of small Andean deer (*Cervus chilensis* or *C. antisensis*), whose antlers have only one forking — a long brow-tine projecting straight forward; which have tusks in the upper jaws in both sexes; and whose fawns are not spotted.

Guerber, Helene Adeline, American author. Her books include: 'Empresses of France'; 'Legends of the Middle Ages'; 'Legends of the Rhine'; 'Myths of Greece and Rome'; 'Myths of Northern Lands'; 'Story of the Thirteen Colonies'; 'Story of the Great Republic'; 'Story of the Greeks,' etc., etc.

Guercino da Cento, gwĕr-chē'nō dä chĕn'tō, Italian painter: b. Cento, duchy of Ferrara, 1590; d. Bologna 1666. His proper name was Giovanni Francesco Barbieri, and he was called Guercino from a squint in his eyes. In 1621, having already acquired renown as a painter, he was invited by Pope Gregory XV. to Rome, but the premature death of this pontiff induced him to return to his native town two years after. About 1642 he went to Bologna, where Count Aldovrandi received him in his palace and entertained him with the most magnificent hospitality. Guercino adopted three different manners of painting, the first in imitation of Caravaggio, which being very dark, he quitted for that of the Caraccis, and latterly for a style still more light and sketchy; but his middle style is his best. His chief pictures are at Rome. The most celebrated is that of the 'Martyrdom of Saint Petronilla,' which has been copied in mosaic to adorn one of the panels in Saint Peter's between the 'Transfiguration' by Raphael, and the 'Communion of St. Jerome,' by Domenichino. His other chief pictures include a 'St. Anthony' at Padua; an 'Annunciation' at Milan; 'St. Peter' at Modena; 'Cephalus and Procris,' and a scene from the 'Pastor Fido' in the Dresden gallery; the 'Parting of Priam and Hector' at Marseilles. The galleries of Bologna, Florence, and Paris, besides some of those of England and Germany, also possess specimens of this master.

Guereza, gĕr'ē-za, or **Guerza,** gĕr'za, (*Colōbus guerza*), an Abyssinian monkey remarkable for its beauty. Short, glossy, jet-black fur covers its limbs, back and head, while a long fringe of silky white hair depends from the flanks. It frequents lofty trees and is much sought for the sake of its valuable fur.

Guérin, Eugénie de, ē-zhā-nē dė gā-răṅ, French writer: b. Cayla, Languedoc, 1805; d. 31 May 1848. She was a sister of G. M. Guérin (q.v.) and much of her life was devoted to taking care of him. Her 'Journals and Letters,' of which an English translation appeared (1865–6), have been widely read in America, both for their charm of style and their devotional spirit. See Parr, 'Maurice and Eugénie de Guérin' (1870).

Guérin, Georges Maurice, zhŏrzh mō-rēs, French poet: b. Languedoc 4 Aug. 1810; d. Paris, 19 July 1839. He was for a time a member of a religious house in Brittany, but in 1833 went to Paris and taught in the Collège Stanislas. His verse has been greatly admired by critical readers. Sainte Beuve in 1860 edited his 'Reliquæ' with critical notice, and the poet forms the subject also of one of Matthew Arnold's 'Essays in Criticism' (1865). See Parr, 'Maurice and Eugénie de Guérin' (1870).

Guernsey, gĕrn'zĭ, **Alfred Hudson,** American editor: b. Vermont, 1825; d. 17 Jan. 1902. He was for several years editor of 'Harper's Magazine,' and he was also associate editor of the 'American Cyclopædia' (1872–6). With Henry M. Alden he was author of 'Harper's Pictorial History of the Great Rebellion,' writing the Eastern campaigns (1862–5); and 'The Spanish Armada' (1882).

Guernsey, Egbert, American physician: b. Litchfield, Conn., 8 July 1823; d. Fishkill Landing, N. Y., 19 Sept. 1903. He was graduated from the medical department of New York University in 1846, founded the Brooklyn *Daily Times*, and in 1872 became editor of the 'Medical Times.' He was also president for many years of the Metropolitan Hospital of New York, and published 'Domestic Practice' (1855), which has passed through 11 editions.

Guernsey, the second largest and westernmost of the Channel Islands (q.v.), 46 miles southwest of Cherbourg, France, and 68 miles from Start Point, Devonshire, England. It is triangular in form, nine miles long and from three to four miles broad. The picturesque south coast is lofty and abrupt, the island sloping towards the north which is low and level. Guernsey is noted for its healthful climate, for the fertility of its soil, for its horticultural and floricultural products grown chiefly under glass, and for its magnificent breed of cattle. The chief towns are St. Peter Port (q.v.), the capital, and Saint Sampson, the latter with an important export trade in blue granite. With the adjacent islands of Sark, Alderney, Herm and Jethow, Guernsey forms an autonomous bailiwick. Pop. (1903) 41,000.

Guerrero, Teodoro, tā-ō-dō'rō gĕr-rā'rō, Cuban dramatist: b. Havana 9 Nov. 1824. He was educated in Spain, returning to Cuba in 1845, in which year his first volume of poems, 'Teordorelas,' was published. His comedy, 'La Cabeza y el Corazon' ('The Head and the Heart'), was successfully performed at Havana in 1861, and 'Lecciones do Mundo' ('The Lessons of the World'), didactic verse, reached many editions. The author published other dramas and several works of fiction and was active in Cuban educational affairs.

Guerrero, Mexico, a state bounded by the states of Morelos and Mexico on the north, Puebla on the northeast, Oaxaca on the east and southeast, and by the Pacific Ocean on the southwest. Its area is given as 64,756 square kilometres, or 24,926 square miles. It is mountainous throughout almost its entire extent, the northern section being occupied by the spurs of the ranges of Morelos and Mexico, and the southern by the Sierra Madre del Sur (highest peaks 2,800 metres). Between these two sections runs the Mexcala or Balsas River, to which all the streams of the state are tributary. The principal lakes are Pazahualco, Chantengo, San Marcos, and Nexpa. The Pacific coast line is low and sandy, and has excellent harbors. The bay of Acapulco, the chief port, is deep and spacious. The mineral resources of the state have been as yet very imperfectly developed. Gold, silver, lead, mercury, iron, coal, sulphur, marble, granite, opals, topazes, and diamonds are mentioned among its products. The climate is unhealthy. On the coast the heat (from 95° to 96.80° F.) and rainfall are both excessive; and in the belt above 6,500 feet, the cold is sometimes severe. Fevers, leprosy and affections of the respiratory and digestive organs are the prevailing diseases. The annual value of the agricultural products is about $2,200,000, and the total value of live stock is estimated at $3,000,000. Manufactures are limited to sugar-cane products, mescal wine, palm-oil, cotton fabrics, and leather. Plans for a number of railways have been made, but have not been carried out. There are, however, telegraph and telephone lines, and a few wagon roads. Steamers of the Pacific Mail and the Mexican International Company touch at Acapulco. The state is divided into 14 districts: La Unión, Mina, Alarcón, Hidalgo, Alvarez, Zaragoza, Morelos, Abasolo, Allende, Tabares (chief town Acapulco de Juarez, with population of 5,780), Galeana, Chilpancingo (principal town and capital of the state Chilpancingo de los Bravos, with population of 6,321), and Guerrero. Total population of the state 420,336.

Guerrilla, gė-rĭl'la, an irregular mode of carrying on war by means of small independent bands of armed men, self-constituted and un-connected with the regular army. The name originated in the Spanish war for independence (1808–14), when the term guerrillas was applied to the bands of Spanish peasants, organized to harass the French armies that then occupied Spain. Guerrilla warfare was carried on to some extent during the Revolution and also in the Civil War, particularly by the Confederates. Guerrilla methods were also effectively used by the Cuban patriots in Cuba's war for independence.

Guesclin, Bertrand du. See Du Guesclin.

Guest-bees, a large genus (*Nomada*) of little bees of both Europe and America, which lay their eggs in the nests of burrowing bees of the genera *Andrena* and *Halictus*, where the young share the food gathered for the young of their hosts, and the adults live harmoniously together,— apparently a case of partnership rather than of parasitism. Compare Cuckoo-Bee.

Gug'genheimer, Randolph, American lawyer and politician: b. Lynchburg, Va., 20 July 1848; d. Elberon, N. Y., 12 Sept. 1907. He studied at New York University and began his business career as clerk in a woolen goods house in New York. He later entered a law office, studied law, was admitted to the bar, and became the head of a law firm, which was particularly successful in important negotiations with English syndicates, investing capital in American industries. He also was active in the political life of the city as a Democrat; was a member of the board of education for three years; and was also president of the board of aldermen, in which capacity he served as acting mayor of Greater New York.

Guiana, ge-ä'nä, the name applied to all that tract of country in South America bounded by the Atlantic Ocean, the Amazon River and its branches, and the Orinoco River and its branches. It lies between lat. 8° 40' N. and lat. 3° 30' S., between lon. 50° and 60° W. Its greatest extent east and west is 1,090 miles; its greatest breadth, from Punta Barima, to the confluence of Rio Negro with the Amazon, is 710 miles. The total area is more than 800,000 square miles. The western districts belong to Venezuela; the southern and eastern districts to Brazil. The three European colonies, the British, Dutch, and French Guianas, extend from the seacoast to the frontiers of those republics.

Early voyages to this part of South America are mentioned in the article Discoveries, etc. The first settlements on the northern coast lay much farther toward the west, and exploration and colonization east of the Orinoco began when European adventurers continued in this new field their search for Eldorado. Spanish and Portuguese expeditions into Guiana during the 16th century were very numerous, but always disastrous. The English undertook its conquest, believing, in the words of Sir Walter Raleigh, "that whatever prince shall possess it, that prince shall be lord of more gold, and of a more beautiful empire, and of more cities and people, than either the king of Spain or the great Turk." Capt. Laurens Keymis, sent by Raleigh in 1596 to explore the region, reported that "the like occasion seldom happeneth in many ages." In the articles, Dabaiba and Eldorado, it is shown that the birthplace of the Eldorado myth was the region now known as Colombia, and that the time of its birth was near the beginning of the 16th century; but in the course of 100 years the site of Eldorado was transferred to central Guiana, and Schomburgk asserts that the possibility of its existence in that locality continued to occupy the imagination and attention of adventurers until the close of the 18th century. Humboldt was the first to prove that a lake "like unto Mare Caspium," as Raleigh described it, no longer existed, and it was erased from the maps; Schomburgk identified the locality where it was sought with the small lake Amucu near an Indian village named Pirara. Raleigh led several armaments from England with the hope of conquering the golden capital. When these undertakings ended in disappointment, Capt. Keymis committed suicide, and Raleigh "paid the forfeit of his illusions with his life upon the scaffold." Dutch traders, who arrived about 1580, settled on the Pomeroon and Essequibo rivers; and after the establishment of the Dutch West India Company land on the Berbice River was granted to van Peere. The Pomeroon colony was abandoned owing to attacks by the English in 1666 and by French privateers. In 1740 English planters from the West Indies established themselves on the Essequibo, as a result of the "open door" policy adopted by the Dutch with respect to that region alone. Next, the overflow of immigration settled in the Demerara district; and in 1781 all three colonies, Essequibo, Demerara, and Berbice, were taken by the British. Recaptured before the year was out by the French (who were then allies of the Netherlands), they were again taken by the British in 1796. The peace of Amiens restored the original status; but English troops interposed once more, and the colonies were ceded to Great Britain by the treaties of 1814–15. They were united in 1831, forming British Guiana.

In the region east of Berbice, a few English people attempted to form a colony at the village of Paramaribo (1626), but abandoned the project. Ten years afterward the French invested Paramaribo, but relinquished it, proceeded to Cayenne, and there founded what is now known as French Guiana. In 1652 a body of English settlers again arrived at the Coma River, and succeeded in establishing themselves. This colony was granted in 1662 by Charles II. to Lord Willoughby, who changed the name Coma River into Surryham, in honor of the Earl of Surrey. Hence we have "Surinam," the name often used instead of Dutch Guiana. The British crown bought the colony from the heirs of Lord Willoughby, but it passed into the hands of the Dutch about the time when Holland gave up the attempt to keep New Amsterdam, now New York. The statement often repeated, that Surinam was "exchanged" for New Amsterdam is incorrect.

1. British Guiana is situated approximately between lat. 1° and 8° 40' N. It is bounded on the north and northeast by the Atlantic Ocean, on the east by Dutch Guiana, on the south by Brazil, and on the west by Brazil and Venezuela. Its area is 104,000 square miles. The old settlements of Essequibo, Berbice, and Demerara form counties with the same names. Of these, Demerara contains the capital of the colony (see Georgetown); Essequibo, the town

of Bartica, the point of departure for miners going to the gold-fields; and the capital of Berbice County is New Amsterdam. One of the chief points on the new boundary line with Venezuela, Mount Roraima, is an immense sandstone mass rising with perpendicular sides 2,000 feet above the slopes (themselves 6,000 feet above sea-level) which form its base. Some of the neighboring mountains resemble it in form, but are less imposing. Midway between this group and the Atlantic coast is the Imataca range, extending east-southeast to the confluence of the Cuyuni and Essequibo. The latter with its tributaries drains nearly the whole interior of the colony; the Demerara, though much smaller, is more important, because it flows through the region which has become the centre of population; the Corentyne is the boundary between British and Dutch Guiana.

Geology and Mineral Resources.— The original sea beach is found far inland, where it now appears as long stretches of white sand reefs, the sand being derived from a barrier of primary, volcanic and metamorphic rocks, which impedes the navigation of the rivers. The strip between this barrier and the ocean front — composed of layers of soft mud, clay, sand, broken shells, and decomposed vegetable matter — is really an enormous mud-flat, about 100 feet in depth, and covered with a rich, heavy loam, and in places, with a kind of peat called pegass. The whole interior of the country, between the agricultural coast-strip and the range culminating in Roraima, is an auriferous region. The gold is commonly found in combination with silver. Quartz-mines have been worked in upper Demerara, but placer-mines in the beds of former streams or the channels of existing ones are more usual. Other mineral products are iron, sapphires, diamonds, mercury, garnets, antimony, and plumbago. A sandstone formation characterizes the southwest, from Mount Roraima to the Potaro and Essequibo rivers, thence extending eastward across the Demerara, Berbice, and Corentyne. The sandstone is interbedded with volcanic rocks. In many parts of the colony there are red, yellow, and blue clays; and fine white clay, suitable for the manufacture of porcelain, is also found.

Soil and Climate.— The surface of the coast alluvium is so fertile that alternation of crops is not required; it is, however, very heavy and hard to cultivate. The thermometer ranges generally from 70° to 80° F., with little difference in this respect between day and night. Rainfall in some years 130 inches, in others not more than 70 inches. The year is divided into two rainy seasons (November–February and May–July), and two dry seasons. Neither destructive earthquakes nor hurricanes occur. There has been only one serious outbreak of yellow fever during 50 years. Death rate of the colony about 35 per 1,000.

Flora and Fauna.— Characteristic forest products are exceedingly hard and heavy woods. The greenheart, mora, and wallaba are valuable for building; the simaruba, letter-wood, and cralwood, for making furniture, etc. Vegetation in Guiana is remarkable on account of the altitude of the trees and the great size of leaves and flowers. The gigantic water-lily, Victoria Regia, is very common. Some of the orchids form large masses, with flower-stems 12 feet high. Common mammals are sloths, deer, ant-eaters, tapirs, armadillos, peccaries, jaguars, cavies, and ring-tail monkeys. Monkeys belong to two families which are entirely confined to this region, and bats develop here their most extraordinary specializations. In some parts of the forest vampires are "ready to suck the foot or even the cheek of the unwary traveler." The manatee (*vulgo* "mermaid" or "water-mamma"), inhabiting some of the large rivers, and coming to the surface at intervals to breathe or to graze on the plants which line the banks, owes its popular designations to the circumstance that it suckles its young at the breast. The representative families of birds are, with few exceptions, peculiar to this region, the list of such birds including greenlets, tanagers, hang-nests, sugar-birds, tree-creepers, manakins, and cotingas. Alligators and boa constrictors both attain to great size in this region; iguanas and smaller kinds of lizards are numerous. Among the insects, the variety of genera and species can, it is thought, scarcely be equaled in any other part of the world. Uncommon brilliance of coloring is characteristic of both the birds and the insects.

Agriculture.— About 80,000 acres are under cultivation, or, say, one acre out of every 100 available for the purpose; and of this amount 71,700 acres are in sugar plantations. Only a very small portion is devoted to coffee and cocoa.

Commerce, Shipping, Railways, etc.— The chief imports in 1901–2 were tissues, flour, machinery, manures, rice, fish, hardware, coal, and tobacco, cigars, and cigarettes. The total value of imports (principally from Great Britain and British possessions) was $7,073,845. The chief exports in the same year, with their values: Sugar, $5,190,815; gold, $1,857,460; rum, $804,230; balatta, $118,205; timber and woods, $105,605; diamonds, $95,275; charcoal, $35,930; and molasses, $24,015. The total value of exports was $9,108,120. In 1901 the registered vessels belonging to British Guiana numbered 48, comprising 32 sailing vessels (1,497 tons), and 16 steamers (2,213 tons). Total tonnage entered and cleared, in 1901–2, was 725,867. (See also routes of vessels under GEORGETOWN.) There are 108 miles of railways, 264 miles of good roads, and 12 miles of the larger sort of canals, used for navigation. Smaller canals, to carry off superfluous water from the plantations, intersect each other in every direction. The heavy rainfall and the flatness of the coast region oblige the planters to maintain these canals to provide drainage, and by means of the larger draining trenches the sugarcanes are taken to the mills in punts. There are 73 post-offices, 46 telegraph offices, 9 traveling post-offices, about 559 miles of telegraphs and cables, and telephone services (677 miles) in Georgetown and New Amsterdam.

Money and Banking.— British gold and silver are used. There are 25 savings banks, with 21,200 depositors, and 2 banks with note circulation.

Government.— The governor is assisted in executive and administrative matters by an advisory council, composed of 3 colonists and 3 officials, all appointed by the king of England; in legislative matters by the Court of Policy (7 officials beside the governor, and 8 elective members, chosen from inhabitants by constituency of 2,070 voters qualified by income or property). The governor has a casting vote, and can decide

BRITISH, DUTCH, AND FRENCH GUIANA. BOLIVIA, PARAGUAY, URUGUAY, ARGENTINE REPUBLIC AND PART OF BRAZIL.
SCALE OF MILES ON EQUATOR
Population of places is indicated by different lettering, thus;
100,000 and over ---- BAHIA
50,000 to 100,000 ---- Para
10,000 to 50,000 ---- Ouro
5,000 to 10,000 ---- Paraty
Smaller Places ---- Regencia
Railroads
Copyright, 1903, by The American Company.
Longitude West from Greenwich
BAY OF RIO DE JANEIRO
RIO DE JANEIRO and Vicinity
BRITISH GUIANA
DUTCH GUIANA
FRENCH GUIANA
BRAZIL
BOLIVIA
PARAGUAY
ARGENTINA
URUGUAY
ATLANTIC OCEAN
EQUATOR
TROPIC OF CAPRICORN
Mouths of the Amazon River
PERNAMBUCO (Recife)
BAHIA (San Salvador)
RIO DE JANEIRO
Rio de S.Francisco

any question against the votes of the representative members. The colonists are in the majority, however, in the Combined Court, which votes the taxes and public expenditures.

Finances.— Total revenue for the year 1901–2 was $2,657,535, derived mainly from customs, licenses, duty on rum, and royalty on gold. Public expenditures in the same year amounted to $2,613,155. The public debt in 1901 was $4,960,600.

Population, Schools and Judiciary.— The census of 1891 showed: Negroes, 115,588; East Indians (Hindu coolies), 105,465; aboriginal Indians, about 17,463; Portuguese from Madeira, 12,166; whites of other nationalities, 4,558; Chinese, 3,433; mixed races, etc., 29,376. The total number of inhabitants was therefore 288,049. In 1901–2 the schools, numbering 213, had 26,684 pupils. There are three judges, and, in the several districts, a number of magistrates. The criminal law is based on that of England; in civil cases the Roman-Dutch law is applied, with certain modifications.

History (including the boundary dispute with Venezuela).— Prohibition of the slave trade checked the agricultural development of the colony, and emancipation of the slaves (1838) ruined many planters, the freed negroes demanding higher wages than the planters could afford to pay. This crisis led to the introduction of large numbers of laborers from Madeira, the East Indies, China, and Malta. Immigrants of a different class began to arrive about 1886 in consequence of the rediscovery of gold; but serious difficulties arose precisely on account of the enhancement in the value of the auriferous regions, some of the most promising of which were located in the territory west of the Essequibo claimed by both Venezuela and Great Britain. The inland limits of the Spanish (afterward Venezuelan), the British, the Dutch, the French, and the Portuguese (afterward Brazilian) Guianas were undetermined. In 1841 Schomburgk surveyed the boundary line of British Guiana for the British government, and made two maps; the second or revised map placing the boundary with Venezuela much farther toward the west than the first. Subsequently Venezuela and Great Britain agreed not to encroach upon the territory in dispute, pending a settlement of the boundary question, but both countries offended against the spirit of this compact. The proposal for arbitration in 1887 was met by England's prompt refusal to admit any doubt as to her title to the lands east of the revised Schomburgk line, and, a little later, by the establishment of British posts, and the declaration that the region drained by the Barima River was hers by right. It is necessary to bear in mind that if England had accepted the views of Venezuela and Brazil as to the boundaries of British Guiana, that colony would have disappeared from the map. Brazil claimed all but about 12,000 square miles; Venezuela nearly the whole of the old Essequibo colony, the Pomeroon and the unsettled interior districts. When President Cleveland, in 1895, called to the attention of the British government the bearing of the Monroe doctrine upon the question at issue, his suggestion was at first not accepted. His message to Congress went much farther. It advised Congress that a commission should be appointed for the determination of the true boundary, and declared in effect that any attempt to extend British territory beyond the true boundary should be resisted by the United States, by force, if necessary. It was a threat of war. Pursuant to the act of Congress 21 Dec. 1895, a commission was appointed 1 Jan. 1896. But before their report was submitted a treaty providing for the reference of the matter to a tribunal of arbitration had been signed at Washington (2 Feb. 1897). Arbitrators were: Chief Justice Fuller and Justice Brewer of United States Supreme Court; Lord Herschell (and, after his death, Lord Russell of Killowen), and Justice Sir R. H. Collins; and as president, Prof. Martens. The tribunal met at Paris in 1899. The award, given 3 October, determined the boundary nearly in correspondence with the second or revised Schomburgk line, assigning to Great Britain a region about 60,000 square miles in area which Venezuela had claimed. On the other hand, Point Barima, at the principal mouth of the Orinoco, and certain gold-fields near the headwaters of the Cuyuni, were awarded to Venezuela. The territory of British Guiana, thus defined, extends along the seacoast to Point Playa, and includes the whole valley of the Barima and that of the Cuyuni east of the Wenamu — the larger part, though not the best part, of the mining region.

2. Dutch Guiana or Surinam is bounded on the north by the Atlantic Ocean, on the east by French Guiana, on the south by Brazil, and on the west by British Guiana. It extends from lat. 2° to 6° N., and from lon. 53° 50′ to 58° 20′ E. Area 46,060 square miles. The political divisions are districts, 16 in number, and communes; the capital, Paramaribo, has about 31,817 inhabitants. Chief products are: Cacao (75 plantations), sugar (7 plantations), coffee, bananas, rice, maize, rum, molasses, and gold (output valued at about $480,000 in 1900). The mining experience of this colony resembles that of British Guiana: the metal has been sought hitherto in beds of streams, etc., but is now being taken also from mines which require crushing machinery. Imports regularly exceed in value the exports; thus in 1901 imports amounted to $2,831,112, and exports to $2,146,224. During the years 1897 to 1901 the value of exports remained almost stationary, while that of imports steadily increased. Executive authority is vested in a governor. The representative assembly, called the Colonial States, is composed of members chosen for 6 years by a limited number of electors. The council consists of 5 members, including the governor himself as president, and represents the sovereign. The revenues of the colony fall short of the expenditures. The military force is about as follows: Garrison, 20 officers and 351 men; militia, 27 officers and 411 men; and civic guard, 59 officers and 1,061 men. There are a few guard ships and vessels of the royal navy. The number of inhabitants in 1902 was somewhat more than 69,000. Educational institutions are: A normal school; schools maintained by the Moravian Brethren and the Roman Catholics; 33 private schools, with 4,822 pupils; and 20 public schools, with 2,342 pupils. The judicial system comprises a court of justice (all the officers appointed by the queen), two circuit, and three district courts. Slavery was abolished 1 July 1863, but the authorities imposed the con-

ditions that for 10 years the emancipated negroes should remain upon the plantations of the districts in which they had formerly lived, and should perform the same kind of work for wages that they had been accustomed to while in bondage. After 1 July 1873, the importation of laborers to replace the freedmen became a matter of life and death in Surinam as in the neighboring colonies, for agriculture was almost ruined.

3. French Guiana, lying between the Atlantic Ocean, Brazil, and Dutch Guiana, has an area of about 30,500 square miles. Besides Cayenne, capital of the colony, and its only port (population, according to the latest census, 12,612), there are 13 communes. Mineral productions are gold, silver, marble, phosphates, and iron. In 1901 the exports of gold amounted to 94,147 ounces. Agricultural productions are varied (including sugarcane, cocoa, coffee, rice, indigo, tobacco, maize, and manioc), but laborers are few, the area under cultivation is small, and the total value of the crops insignificant. Here, as in Dutch Guiana, the value of exports is much less than that of the imports, the difference in 1901 being about $689,750. Colonial interests are entrusted to a governor and privy council of 7 members, and one deputy represents the colony in the French Parliament. There is also an assembly called the Council-General, composed of 16 members. Revenue and expenditures for 1902 were each estimated at $657,261; but the cost of maintaining the penal establishment ($1,139,122, according to the budget of 1903), is borne by the French republic. Between 300 and 400 French soldiers are kept in the colony. The total population, including convicts and Indians, was given as 32,908 in 1901. Cayenne has a superior court, court of first instance, and two justices of the peace: a college, a library, and a museum; in the entire colony there are 27 primary schools

From the first, the French undertaking in Guiana has been unsuccessful. On 11 Dec. 1653, the survivors of the original colony abandoned the fort and sailed away, after suffering from hunger and disease. A new company formed for the colonization of Cayenne in 1663 was scarcely able to hold its own against hostile neighbors in Brazil. The deportation of political prisoners to Guiana at the end of the 18th century completed the ruin which Portuguese attacks had begun; for the exiles ascribed the death of their companions to the climate; and French Guiana was completely discredited in the eyes of the world. In January 1809, the colony surrendered to the Portuguese and English. It was restored to France by the treaties of 1814–15. Since 1855 it has been used as a penal settlement. In 1902 the number of convicts in residence there was 10,075, including 240 women. The boundaries with Brazil were determined 1 Dec. 1900, by the Swiss court of arbitration.

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Marrion Wilcox,
Authority on Spanish America.

Guicciardini, Francesco, frän-chĕs'kō gwē-chär-dē'nē, Italian historian: b. Florence 6 March 1483; d. there 23 May 1540. He studied at Padua, and became an advocate and professor of law at Florence. In 1512 he was appointed ambassador to the court of Ferdinand the Catholic of Spain. At a later period he was invited by Leo X. to his court, and entrusted with the government of Modena and Reggio. This office he discharged also under Adrian VI., to the general satisfaction; and afterward, when Clement VII. (de' Medici) ascended the papal chair, Guicciardini was sent as lieutenant of the pope to Romagna. He contributed here to the public good by restoring civil order, constructing roads, erecting public buildings, and founding useful institutions. Having been appointed lieutenant-general of the pope, he, in 1521, defended Parma when besieged by the French. In 1534 he began his great work 'Istoria d'Italia' (1561–4) extending from 1490 to 1534. In 1537 he contributed greatly to the elevation of Cosmo de Medici to the office of grand-duke, but when later he attempted to impose constitutional limitations upon the grand-ducal power, he lost his influence. The 'History' was translated into English by Goddard, and the translation published between 1753 and 1761. The reader of Guicciardini is sometimes offended by a want of method, and his statements cannot always be depended on as derived from the best sources.

Guide-birds, or Honey-guides, certain small, mainly black and yellow birds, allied to the barbets, and constituting a genus inhabiting the tropical regions of the Old World, which have the curious habit of attracting the attention of men, and of honey-loving quadrupeds, to bees' nests, profiting by the disturbance which follows. They are fond of bees, grubs, and honey, but cannot often get them without assistance; sometimes, also, they show equal zeal in leading a person to a snake, leopard, or something else which has attracted their notice. Although the genus is known in India and Malaya, it is in South Africa that its traits are most noticeable and the books of travelers and explorers there abound in accounts of its guiding habits. Sir John Kirk contributed the following exact description of the work of *Indicator minor* to the 'Ibis' (1864):

"The honey-guide is found in forests, and often far from water, even during the dry season. On observing a man it comes fluttering from branch to branch in the neighboring trees, calling attention. If this be responded to, as the natives do by whistling and starting to their feet, the bird will go in a certain direction and remain at a little distance, hopping from one tree to another. On being followed it goes further; and so it will guide the way to a nest of bees. When this is reached, it flies about, but no longer guides; and then some knowledge is needed to discover the nest, even when pointed out to within a few trees. I have known this bird, if the man after taking up the direction for a little then turns away, to come back and offer to point out another nest in a different part. But if it do not know of two nests, it will remain behind. The difficulty is, that it will point to tame bees in a bark-hive as readily as to those

1. Guide-bird (Indicator sparrmanni).
2. Garden Warblers (Sylvia curruca and S. rufa).
3. Guinea Hens (Numida cristata and N. meleagris).
4. European Golden Oriole (Oriolus galbula).
5. Grakle (Eulabes religiosa).

in the forest. This is natural, as the bee is the same; the bark-hive, ‹musinga› as it is named, being simply fastened up in a tree and left for the bees to come to. The object the bird has in view is clearly the young bees. It will guide to nests having no honey, and seems equally delighted if the comb containing the grub be torn out when it is seen pecking at it."

Guido Reni. See RENI, GUIDO.

Guidon, gī'don, a swallow-tailed flag, such as is carried by a regiment of cavalry or mounted artillery. In the United States cavalry the regimental guidon is half red and half white, dividing at the fork. The red above has "U. S." in white. The white is below and has the letter of the company in red. The fly is 3 feet 5 inches to the end of the tail; the head is 27 inches. The lance is 9 feet long, including spear and ferrule.

Guienne, gē-ĕn', or **Guyenne**, ancient Aquitania (q.v.), a former southwestern province of France, now divided into the departments of Gironde, Lot, Lot-et-Garonne, Dordogne, Aveyron, and part of Landes and of Tarn-et-Garonne. The capital was Bordeaux.

Guija, gwē'hä, a lake in the republics of Guatemala and San Salvador, in Central America. It is in a volcanic region, and contains two small volcanic islands.

Guikowar, gīk'wär, the native title of the Mahratta prince, ruler of the province of Baroda (q.v.) in British India. The ruling Guikowar in 1874 was tried for attempting to poison the British resident and was deposed. Since 1802, when the province lost its independence to the English, the authority of the Guikowar has been merely nominal.

Guild, Curtis, American journalist: b. Boston, Mass., 1827. After several years devoted to reporting for the Boston *Journal*, he became one of the owners of the Boston *Traveller* and in 1859 established the Boston *Daily Commercial Bulletin*, of which he became the editor. He has published ‹Over the Ocean› (1867); ‹Aboard Again› (1873); ‹Britons and Muscovites› (1888); ‹A Chat About Celebrities›; ‹From Sunrise to Sunset› (verse).

Guild, Curtis Jr., American journalist and politician: b. Boston, Mass., 2 Feb. 1860. He was graduated at Harvard in 1881 as class orator, and entered the employ of the *Commercial Bulletin* of Boston, conducted by his father, Curtis Guild (q.v.). He interested himself at once in local politics, was Republican delegate-at-large to the St. Louis convention in 1896; and active in securing the gold plank in the national platform. In the following campaign he made a political tour of 10 States. He was appointed brigadier-general of Massachusetts militia and inspector-general of rifle practice by Gov. Roger Wolcott. At the outbreak of the Spanish war he was appointed lieutenant-colonel and inspector-general, United States Army, serving in the Seventh Army corps under Gen. Fitzhugh Lee. In 1900 he accompanied Gov. (now President) Roosevelt on a tour of political speaking through the West. In 1902 he became sole owner of the *Commercial Bulletin*. He was elected, 4 Nov. 1902, lieutenant-governor of Massachusetts, with John L. Bates, governor-elect; and was inaugurated 10 Jan. 1903. In 1905 and 1906 he was elected governor.

Guild, Reuben Aldridge, American librarian and author: b. West Dedham, Mass., 4 May 1822; d. 1899. His published works include: ‹Biographical Introduction to the Writings of Roger Williams› (1866); ‹History of Brown University with Illustrative Documents› (1867); ‹Chaplain Smith and the Baptists› (1885).

Guild, a fraternity, society or company, formerly active in commerce and mechanics. Guilds played an important part in public affairs in the Middle Ages. The Romans had various mechanical fraternities, but these seem to have been merely religious and political societies; while the associations of workmen in the arsenals that existed under the empire were regular hereditary castes, enjoying certain privileges and bound to certain duties. In Italy, the cradle of the class of free citizens in the Middle Ages, and particularly in the Lombard cities, those connecting links between the ancient and modern civilization, some remains of these Roman institutions, or recollections of them, probably contributed to revive the guilds, which naturally presented themselves as an excellent means of supporting the citizens against the nobility by uniting them into powerful bodies. It is certain that small societies existed as early as the 12th century, which appear, in the following century, to have been in the possession of important political privileges. When the advantages of these associations became known and felt they rapidly increased; and in the struggles of the citizens and the nobility the principal resistance against the latter was made by the corporations. As soon as the citizens acquired an influence on the administration the guilds became the basis of the municipal constitutions, and every one who wished to participate in the municipal government was obliged to become the member of a guild. Guilds in Germany possessed no political importance before the 13th century. At this time they acquired the right of bearing arms for the defense of their own interests, and when a struggle arose between them and the citizens belonging to ancient families the guilds were victorious, and became so powerful that even persons of "free occupations" joined these associations as the allodial possessors of land sometimes placed themselves under feudal lords. The by-laws of the German guilds contained regulations as to the training of apprentices, the practice of one's trade in different towns as a journeyman, and the requirements of a master. At an early period these workmen's associations met with opposition, but the opposition was not at first directed against them on account of the obstacles they threw in the way of commercial intercourse, and the other evil consequences of their monopoly, but simply on account of their political influence. In the 18th century several edicts were made in Germany against the abuses of the guilds, and at different dates in the 19th century freedom was granted in most of the states of Germany to all to practise any trade without being admitted into a guild. In Austria this was done in 1860, and in 1868 it was done for all the states of the North German Confederation.

In Great Britain the societies of mechanics were important principally in a political respect, on account of their connection with the democratic element of the constitution. These societies originated at the time of the development of the importance of the cities. In the towns where they long existed they had an important influence in the election of representatives, and in the municipal administration. These guilds, in England, had no legal right to prevent any man from exercising what trade he pleased. The only restriction on the exercise of trades was the statute of Elizabeth, requiring seven years' apprenticeship. The guilds of the city of London (among the oldest of which are the weavers, founded in 1164; the parish clerks, in 1232; the saddlers, in 1280; the fishmongers, in 1284; the goldsmiths, in 1327; the skinners, in 1327; and the grocers, in 1345) are still very important corporations, still continuing to fulfil the chief object for which they were founded — that of giving relief to poor and decayed members, and also having in many cases the management of vast funds bequeathed for benevolent purposes by persons who selected one or other of the guilds as trustees. Sometimes these funds are bequeathed for specific purposes, which the guilds, as trustees, are of course bound to carry out; but in other cases, where they are available for general purposes, the guilds have usually shown great discretion in the manner in which they have employed them. Besides the secular guilds or mechanics' associations there were from a very early period, in Great Britain, religious guilds, resembling the religious societies of modern times. From the time of Henry II. all such guilds were required to have a charter from the crown. In 1388 a return to these guilds was ordered to be made, and it was then found that that of Corpus Christi, York, numbered 14,800 members. Some of the most objectionable features of the ancient guilds have again been developed by some of the trades unions, their modern representatives.

In France guild-privileges were sold by the state from the 10th century till the revolution of 1789, and the position of the artisan had come to be a most pitiable one; but at that date every restriction on the exercise of any trade was removed. This was done also at a later period in Belgium, Holland, Italy, Sweden (1846), and Denmark (1862). An account of guilds in America will be found under LABOR UNIONS. See also TRADE UNIONS for the modern European history of guilds.

Guildhall, the usual designation in England for the mediæval city halls, the most famous of which is the London Guildhall, King Street Cheapside, first built in 1411, all but destroyed in the fire of 1666, and rebuilt in 1669. The façade dates from 1789. The great hall used for the famous city feasts, the election of city officers and members of Parliament, and for the public meetings of the livery and freemen, is 153 feet long, 48 feet broad, and 55 feet high. It is decorated by statues of various celebrities, and in the common council room there is a collection of valuable paintings.

Guilford, Conn., a town and borough of New Haven County, on Long Island Sound, and on the New York, N. H. & H. R.R., 14 miles east of New Haven. It was settled as Menunkatuck by English colonists in 1639, and one of the ancient stone buildings of that date is now used as a State museum. Farming, canning, iron working, and some woolen manufactures are the chief industries. Halleck the poet was a native and resident of Guilford. Pop. of town and borough (1900) 2,785; of town, 1,512.

Guilford (gĭl'fŏrd) **College**, N. C., a town of Guilford County, on a branch of the Southern R.R., six miles west of Greensboro. It was incorporated in 1895 and derives its name from Guilford College, a coeducational establishment controlled by the Friends, and founded in 1837. The income of the college is $20,000, and it has a library of over 6,000 volumes.

Guilford Court House, Battle of, 15 March 1781; in results one of the decisive battles of the Revolution. Cornwallis at Hillsboro proclaimed that he had conquered North Carolina, and called on the well-disposed to rally around him; Greene, awaiting reinforcements near the Virginia border, perceived the necessity of showing the patriots they were not abandoned, and advanced across the Dan. After some days of fencing and recruiting, Greene halted for battle at Guilford Court House. He had about 4,400 men, but 3,000 were militia; and of his Continental regulars, only the Virginians and the First Maryland were veterans, the Second being new. Cornwallis had 2,213 trained troops. Greene posted his first militia line in an open field, to thin the British front before giving way; the second in a wood 300 yards back; the regulars on a rise 400 yards to the rear, near the court-house. Their front was convex; the Virginians on the right, then in succession Singleton's artillery, Gunby and Howard's First Maryland, and Ford's Second Maryland on the left. Lee's Legion and Campbell's riflemen guarded the left flank; William Washington's cavalry, Lynch's rifles, and the remnant of the Delaware regiment, the right flank. The British routed the first militia after it fired one or two volleys; but only drove the second from the wood after an obstinate and murderous combat. Advancing against the hill, their left was riddled by a withering fire, and then broken by a bayonet charge of the First Maryland; but their right crushed the Second and captured two cannon. The First faced about and checked it; Washington in turn pierced the British line and retook the pieces. The First steadily crowded back their opponents with the bayonet; and Cornwallis only stayed the tide of defeat by ordering his artillery to open on the Marylanders through his own ranks, checking the pursuit at heavy loss to himself. Reforming, the British moved forward; and with double the number of real troops, carried the hill and held it against every assault. Toward evening Greene, after five hours' conflict, withdrew, leaving his artillery on the field because the horses were killed. The American loss was 79 killed and 184 wounded; and about 1,000 militia dispersed to their homes. Cornwallis lost 93 killed, 413 wounded, and 26 missing — 532 in all, or a quarter of his entire force. He announced a victory to Parliament, but Fox declared that "another such victory would destroy the British army"; and, in fact, Cornwallis had to fall back on Wilmington, abandoning his hold on the

Carolinas, except two or three places on the coast, and shortly going to Virginia and capture.

Guillaume, gwĭ-yōm', **Eugene,** French sculptor: b. Montbard, France, 4 July 1822; d. Rome, Italy, 28 Feb. 1905. He opened his first studio at Dijon, and subsequently became a pupil of Pradier at Paris. In 1845 he carried off the Grand Prix de Rome. It was during studies at Rome that he manifested that mastery of the human form which appears in his 'Reaper,' which he modeled at Rome. It was subsequently cast in bronze, and is now in the Luxembourg. In 1852 he produced in marble the sitting figure of Anacreon with the dove of Venus. He was, however, less successful in ideal creations than in portrait busts. His statues of Napoleon I. as lieutenant of artillery and as emperor, his bust portraits of Archbishop Darboy, of F. Baloz, Ferry, and Thiers are characteristic and dignified, but he is perhaps best known for his sculptures on the façade of the New Opera House, Paris (1869); 'The Fount of Poetry' (1873); 'Aopheus' (1878); 'Two Hermes'; 'Anacreon with Eros'; and 'Sappho with Eros and Andromache.' He was the designer of the medals given at the expositions of 1867 and 1878.

Guillemet, Jean Baptiste Antoine, zhŏn băp-tēst an-twän gwĭ-yĭ-mā, French painter: b. Chantilly 1842. After studying under Corot and Oudinot he exhibited for the first time in 1865. He chooses for his subjects the scenery of Normandy, and the Seine valley, and is faithful in his transcripts from nature, but his work lacks the color and subtility as well as the imagination of the Barbizon school. His 'View of Bercy' and 'View of Paris' are in the Luxembourg.

Guillotine, gĭl'ō-tēn, a machine for beheading, so called from Dr. Joseph Ignace Guillotin, and introduced during the French revolution. It consists of two posts united at the top by a cross beam, and furnished with grooves, in which a broad steel blade heavily weighted with lead descends by the impetus of its own weight on the neck of the criminal, fastened to a plank beneath. The certainty and speed with which this instrument separates the head from the body gives it an advantage over the axe or sword wielded by the hand. Machines of a similar description have been in use among many nations. In Italy, from the 13th century, it was the privilege of the nobility to suffer capital punishment by an instrument called the *mannaia*, closely resembling the guillotine. In Germany, likewise, during the Middle Ages, an instrument resembling the guillotine was made use of, though the blade did not fall upon but was thrust through the neck of the criminal. There was formerly employed in Great Britain, also, and more especially in Scotland, an instrument of decapitation called the «maiden,» said to have been introduced by Regent Morton, who himself afterward suffered by it. It differed from the guillotine in this, that while the blade of the guillotine falls upon the neck of the criminal, in the maiden the blade is fixed with its edge upward, and the neck of the criminal is forced down upon it by the fall of a heavy weight. Such an apparatus was also known and used at an early period in France. The Dutch likewise formerly made use of a decapitating machine.

Dr. Guillotin was not the inventor of the instrument which bears his name, and had only a secondary share in its introduction into France. As a member of the constitutional assembly he proposed to that body to abolish all class distinctions in the method of inflicting capital punishments, and with that view to have some instrument invented which might do the work more quickly and certainly than the hand of the headsman. The establishment of a new penal code having now become the subject of deliberation, a vote for a uniform system of capital punishment was, on the motion of Dr. Guillotin, passed on 21 Dec. 1789, with a recommendation that the least painful method of inflicting it should be adopted. It was not till 1792, however, that this special machine was selected after a report from Dr. Ant. Louis, secretary to the College of Surgeons. The guillotine was first erected in the Place de Grève at Paris, and the first execution performed by it on 25 April 1792, on a highwayman. Shortly afterward, in remembrance of Guillotin's original proposition, it received the name of «guillotine,» both popularly and in official language, and it was introduced wherever the penal code of France has been adopted.

Guimaras, gē-mä-räs', Philippines, an island lying west of Negros and south of Panay, forming with Panay the strait of Iloilo. The east coast is mountainous, the west coast, open and fertile; an excellent road follows the entire coast, except for a distance of 10 miles, and the most important towns are on this road. The products include rice, corn, cotton, and tobacco, and there are important fishing interests. The island is a part of the province of Panay.

Guimbal, gēm-bäl', Philippines, a pueblo of the province of Iloilo, island of Panay, situated on the southeast coast, at the mouth of a river, 17 miles west of the town of Iloilo. Pop. 10,950.

Guinaan, gē nä'an, a Malay tribe of the Philippines, inhabiting the watershed of the Rio Abra and the Rio Grande de Cagayan, island of Luzon, and the neighboring region of Isabela and Abra. They are a heathen, head-hunting tribe, and have a distinct language.

Guinea, gĭn'ē, an English gold coin, first issued in 1663; by a proclamation issued 22 Dec. 1717, the guinea was declared current at 21*s.* sterling. Its true value, as derived from the market values of gold and silver at that time was 20*s.* 8*d.*, about $4.96. It has not been coined since 1817, when the sovereign supplanted it, but the fashion still prevails of quoting prices of some things in guineas, and subscriptions are frequently recorded in the same denomination.

Guinea-corn, a name given to durra, *Sorghum vulgare*, cultivated in the United States under the name of broom-corn. See DURRA; BROOM-CORN.

Guinea-fowls, a family of gallinaceous birds (*Numididæ*) allied to the pheasants and turkeys, natives of Africa and Madagascar. Twenty-three species are known, the most familiar being the common guinea-fowl of our poultry yard (*Numida meleagris*). This bird ranges in a wild state from Senegambia to the Niger

River, and is found also on the Cape Verde Islands. It is supposed to have been first brought to Europe by Portuguese explorers in the 16th century; but these fowls were domesticated in Rome during the classic period. Of the other species the vulturine guinea-fowl (*Acryllium vulturinum*) is one of the handsomest, being striped with brilliant blue; while the black guinea (*Phasidus niger*) and the turkey-like guinea (*Agelastes meleagrides*) are peculiar in possessing spurs.

Guinea-grass, a kind of grass (*Panicum maximum*), often 6 or 10 feet in height, a native of western Africa, which has been naturalized in South America and the West Indies, and is largely cultivated for fodder.

Guinea, Gulf of, that portion of the Atlantic on the coast of Africa, between Capes Lopez and Palmas. Two of its arms are the bights of Benin and Biafra. The Niger flows into this gulf south of the bight of Benin. A number of small streams enter from French Kongo and Kamerun. It contains a number of islands, chief of which are St. Thomas, Fernando Po, and Prince's Island. The gulf has two currents, one setting eastward into the bights of Biafra and Benin, and the other coming from the south; they meet in the bight of Biafra, and unite in one stream which gradually expands as it flows northwest, then west and southwest.

Guinea-pig, or Cavy, a small, variable domesticated race of the restless cavy (see CAVY), bred in all parts of the world as a children's pet. It is about six inches long, and exists in several races, some short-haired, others with long, curiously ruffled hair. The colors are greatly varied, white, black and a mixture in quaint pattern of white and tan being preferred. It is a restless, grunting little creature, showing a small amount of intelligence, but gentle and amusing. It feeds on vegetables, bread, parsley, lettuce, etc., and is exceedingly cleanly in its habits. It begins to breed when five or six months old, the period of gestation being from 6 to 10 weeks, and the litters averaging from 4 to 5; and this extreme fecundity seems to be its only means of defence against extinction. The name is probably a corruption of 'Guiana-pig,' referring to its native home and its pig-like form and grunting. English children call them "cavies." They are bred by fanciers for show purposes, and clubs exist for the improvement of standard breeds.

Guinea-worm, a nematode worm (*Filaria medinensis*), the female of which may be three feet long, and as thick as a knitting-needle. It is a parasite in the feet and toes of residents of the East Indies and African coast, forming abscesses beneath the skin in which the worm is coiled up. It produces the disease known to the Greeks as dracontiasis, and one of those now called filariasis (q.v.). To extract the worm it must be slowly wound upon a roll of paper, a little at a time, care being taken not to break the worm, as if a portion is left in the abscess, the young will develop and be scattered under the skin. Although formerly confined to the Old World, the guinea-worm has recently been found in the tropics of America, but is very rarely seen in northern parts.

Guinevere, gwin'ē-vēr, the wife of King Arthur in the Arthurian legends (q.v.). In the first accounts of the Arthurian court, she plays a very unimportant part, and her character is not clearly portrayed. It is in the 13th century that the personality of the queen and the story of her love for Lancelot are first developed. The most vivid and powerful picture of Guinevere is that given by Tennyson in the 'Idylls of the King,' in which her sinful love for Lancelot is made the real cause of the downfall of the Round Table and Arthur's kingdom.

Guiney, Louise Imogen, American poet: b. Boston 7 Jan. 1861. She began to write for publication in 1880 and was a frequent contributor to 'The Pilot,' Boston. Her published works include 'Songs at the Start' (1884); 'The White Sail and Other Poems' (1887); 'A Roadside Harp' (1893); 'Martyr's Idyl and Shorter Poems' (1899); and in prose she has also published: 'Goose-Quill Papers' (1885); 'Brownies and Bogies'; 'Monsieur Henri' (1892); 'A Little English Gallery'; 'Lovers' Saint Ruths'; 'Patrins' (1897); 'The Secret of Fougereuse'; etc. She has edited an edition of Mangan's poems.

Guinness, SIR Benjamin Lee, Irish philanthropist: b. 1 Nov. 1798; d. 19 May 1868. He was a member of the great Dublin brewing firm, the largest in the world. In 1865–8 he was M. P. for Dublin. He restored St. Patrick's Cathedral, Dublin, at a cost of $700,000. His business in 1886 was placed in the control of a limited liability company, employing 3,000 persons and having a capital of £6,000,000.

Guinness, SIR Edward Cecil, Irish philanthropist: b. 10 Nov. 1847. He was the son of Sir B. L. Guinness (q.v.). In 1891 he became Baron Iveagh. He gave $1,250,000 for the purpose of erecting sanitary dwellings for working people at a low rent. Of this sum $1,000,000 was to be given to London, and the remainder to Dublin. The income obtained on the capital is to be employed in the same fashion.

Guinobatan, gē-nō-bä'tän, Philippines, a town in the province of Ambos Camarines, island of Luzon, on the Quinali River. Pop. 10,000.

Guise (gü-ēz or gēz) **Family, The**, French ducal house, a branch of the family of Lorraine. The founder was Claude, a younger son of René II., duke of Lorraine, who in 1506 became naturalized in France, and in 1513 married Antoinette de Bourbon, the daughter of the Count of Vendôme. In his favor the county of Guise (one of his numerous possessions in France) was erected in 1528 by Francis I. into a duchy. He died in 1550, leaving behind him five daughters (the eldest of whom, Marie, married James V. of Scotland, and was the mother of Mary, queen of Scots) and six sons — François, who succeeded him in the duchy of Guise and his other dignities; Charles (usually known as Cardinal of Lorraine), Louis (Cardinal of Guise), Claude, François, and Rene, all persons of note. The family acquired great political importance on the accession of Francis II., who was married to Mary, queen of Scots. François, the second duke of Guise, was assassinated in 1563, and left three sons, Henri who inherited his father's titles; Louis, cardinal of Lorraine and archbishop of Rheims (both put to death in 1588 on the command of Henry III.); and Charles, duke of Mayenne. Henri, third duke of Guise, was succeeded by his son Charles, who died in Italy in 1640, and was succeeded by his second son Henri. Henri died without issue in 1664, when he left the title to his nephew, Louis Joseph, duke of Joyeuse and Angoulême. His son and succesor, François Joseph, died in 1671, leaving only one son, who died at the age of five in 1675, when the direct line of the house of Guise became extinct. In 1704 the title was revived for the house of Condé.

Guise, France, a town in the department of Aisne, on the Oise, 25 miles by rail northeast of St. Quentin. It is an ancient city, mentioned as early as 1050, and has interesting remains of the 16th century castle of the famous Dukes of Guise. The town is noted for the ironworks of Dequerème et Cie founded by Jean Baptiste André Godin, and conducted on a profit-sharing plan. The workmen are provided with dwellings on the associated plan; the first portion of the *familistère* was erected by Godin in 1859–60 at a cost of $400,000. In connection with the workman's colony is a *phalanstère*, or common dwelling-house accommodating 400 families, a theatre, library and reading-room, schools, nursery, covered playgrounds, and a co-operative store. Pop. (1901) 7,300.

Guitar', a stringed musical instrument, with an oval body, and a neck like that of the violin. The modern or Spanish guitar has six strings, the three highest of gut, the three lowest of silk covered with fine wire, and tuned to the E in the second space of the bass staff, A, its fourth, and the treble D, G, B, and E The intermediate intervals are produced by bringing the strings, by the pressure of the fingers of the left hand, into contact with the frets fixed on the key-board, while those of the right pluck or twitch the strings. The Spaniards are supposed to be the inventors of the guitar, and it is most widely used in Spain, though its use is quite general in other countries.

Guiteau, gē-tō', **Charles Julius,** American assassin: b. about 1840; d. Washington, D. C., 30 June 1882. He became a lawyer in Chicago, and in 1880, after the election of James A. Garfield to the presidency, went to Washington, presumably to secure the office of United States consul at Marseilles, but did not succeed. Owing to this and the fact that the new President was opposed to the Stalwarts, led by Roscoe Conkling, Guiteau became greatly incensed. On 2 July 1881, he shot the President in the waiting room of the Baltimore and Potomac Railroad station in Washington; and on 19 Sept. the President died from the effect of his wound. Letters taken from Guiteau after his arrest showed that he had planned to «remove» the President. He was indicted for murder on 7 October, was found guilty on 25 Jan. 1882 after a sensational trial in which insanity was the only plea offered for the defense, and was hanged in the District of Columbia jail, 30 June following. See GARFIELD, J. A.

Guiuan, gē'wän, Philippines, a pueblo of Sámar, on the extreme south coast, 78 miles southeast of Catbalogan, having a good harbor. On the edge of a reef near the town are several sulphur springs, which though covered by the sea at high tide, are never brackish. Pop. 11,300.

Guizot, François Pierre Guillaume, fran-swä pē-är gē-yōm gē-zō, French historian and statesman: b. Nimes 4 Oct. 1787; d. Valricher near Paris, 13 Sept. 1874. His father, a lawyer, having in 1794 perished by the guillotine, his mother and her three sons retired to Geneva, where François was gratuitously educated at the gymnasium. In 1805 he commenced the study of law at Paris, but gradually drifted into the literary profession. In 1812 he married Mlle. de Meulan, editor of the 'Publiciste,' and became professor of history at the Sorbonne On the fall of the empire he obtained several public offices, such as councillor of state, and director-general of the departmental and communal administration. In 1816 he published 'Du Gouvernement Représentatif et de l'Etat Actuel de la France,' and 'Essai sur l'Instruction Publique.' In 1820 the Duc de Berry was assassinated, and Guizot's party fell before an ultra-royalist reaction. In 1825 he lost his chair on account of the political character of his lectures, but regained it in 1828. In 1829 he again became councillor of state, and after the July revolution was appointed minister of the interior, but resigned in 1831. After the death of Périer, Guizot, along with Thiers and De Broglie, formed a coalition ministry, and rendered great service as minister of public instruction. He became ambassador at the British court in 1840, and next year was the real head of the government of which Soult was the nominal chief. He retained the office of minister of foreign affairs until 1848, and during that period opposed all measures of reform. After the fall of Louis Philippe, Guizot escaped, fled to England and though he returned the next year he henceforth practically retired from public life. Born of a Calvinist family, he always remained a stern Protestant of the orthodox type, although he zealously supported the temporal authority of the pope. Among his numerous works may be mentioned, 'Histoire de la Civilisation en France' (1830); 'Histoire générale de la Civilisation en Europe' (1828); 'Histoire de la Civilisation d'Angleterre' (1827); 'Washington'; 'Discours sur la Révolution d'Angleterre'; 'Méditations et Etudes Morales'; 'Guillaume le Conquérant'; 'Mémoires pour servir à l'Histoire de mon Temps' (1858–68); 'Méditations sur l'Etat Actuel de la Réligion Chrétienne' (1865); 'Mélanges Biographiques et Littéraires'; 'Histoire de France Racontée à mes Petits Enfants' (1870); etc.

Gujarat, gŭzh-rät', or **Guzerat, India,** a region bordering on the Arabian Sea, comprising part of the northern section of the presidency of Bombay and some native states. Area of the whole, about 70,000 square miles; pop. about 11,000,000.

Gulf of Saint Lawrence. See SAINT LAWRENCE, GULF OF.

Gulf-stream. See CURRENTS, MARINE.

Gulfport, Miss., city in Harrison County, on the Gulf of Mexico, and the Gulf & Ship Island and the Louisville and N. R.R.'s. Gulfport has grown in 5 years from a seacoast hamlet to a thriving city. The keynote of its success is the fact that it has one of the best harbors on the Gulf of Mexico. Prominent among its public buildings is the «Great Southern» hotel, with its 250 rooms, intended as a winter resort for Northerners and as a summer resort for the people of the South, especially those of New Orleans. It is situated directly on the shore and is undoubtedly the finest resort hotel between Tampa and New Orleans. Other prominent buildings are the county courthouse and those of the First National bank and of the Gulf & Ship Island railroad. The latter is used for the offices of the company. The First National bank is now the largest bank in the State of Mississippi, having a capital of $250,000. The most important manufacturing plants are oil and fertilizer factories, the Gulfport Packing Company and the shops of the Gulf & Ship Island railroad. There are, also, numerous smaller concerns, such as iron foundries and wood-working plants. Pop. (1900) 1,020; (1903) 3,500.

Gulfweed, a genus (*Sargassum*) of seaweeds of the sub-order *Fucaceæ*, which grow in deep water along all warm coasts, and becoming easily detached, are found floating in immense quantities in the middle of all oceans, where they accumulate in vast eddies, as it were, of the oceanic currents. The North Atlantic species (*S. bacciferum*) is the best known, and takes its popular name from its presence in long yellow lines in the Gulf Stream; and its specific name from the berry-like appearance of its air-vessels. The frond is very long, and is furnished with distinct, stalked, nerved leaves, and simple axillary stalked air-vessels; and its structure approaches that of the higher plants. Where the Gulf Stream is deflected from the banks of Newfoundland eastward, and sends off its more southern branch toward the Azores, is situated the Sargasso Sea, "that great bank of weeds, which so vividly occupied the imagination of Christopher Columbus, and which Oviedo calls the seaweed meadows" (Humboldt). The quantity of floating seaweed is often such as to impede the progress of ships. Multitudes of small marine animals accompany it, with fishes ready to prey on them, constituting a distinct and considerable fauna. The gulfweed is eaten in China, and in other parts of the East also it is used in salads and as a pickle.

Gulick, John Thomas, American clergyman: b. Kauai, Hawaii, 13 March 1832. He was graduated at Williams College in 1856, studied theology at the Union Theological Seminary, went to China as a missionary, and subsequently to Japan. He is a well-known writer on topics relating to evolution and natural history. He contributed to the 'Journal' of the Linnæan Society of London: 'The Diversity of Evolution under One Set of External Conditions' (1872); 'Divergent Evolution Through Cumulative Segregation' (1887); 'Intensive Segregation' (1889); and other monographs.

Gulliver's Travels, a famous satire by Jonathan Swift anonymously published in 1727. It is one of the most brilliant and profound of satires, became immediately popular, and has never lost its interest for both young and old. It begins with Gulliver's account of himself and his setting forth upon the travels. A violent storm off Van Diemen's Land drives him, the one survivor, to Lilliput, where he is examined with curiosity by the tiny folk. His next voyage is to Brobdingnag, where he is a Lilliputian in comparison to the size of the gigantic inhabitants of this strange land, in which he becomes a court toy. The next adventure is a voyage to Laputa, where the inhabitants are absorbed in intellectual and scientific pursuits, and "taken up with intense speculations," and their conduct is most eccentric; this is probably a satire upon pedantry. The last voyage takes the traveler into the country of the Houyhnhnms, where the horses under this name have an ideal government,— Swift's Utopia,— and are immensely superior to the Yahoos, the embodiment of bestial mankind.

Gulls, a large group of sea-birds found throughout the world and constituting, together with the terns (q.v.), skimmers (q.v.), and skuas or jaeger-gulls, the family *Laridæ* (q.v.). Some 53 species of gulls are known, ranging in size from that of a pigeon to that of a goose. The prevailing color is pure white below and pearl gray above, while some species have a gray or blackish head, and a few are dull gray all over. The young birds of all species are dusky during the first year. They walk with tolerable ease, and swim well, but are incapable of diving. They keep much on the wing, and their flight is rapid, strong, and long sustained, even in heavy gales. In sitting they contract their necks and rest on one foot. They nest along the shores in the grass, on rocky cliffs or rarely in small trees, forming the nest of dry grass, sedges, etc., and invariably in colonies, creating a great uproar when their nesting-grounds are visited. The wild characteristic note is, in the bigger species, harsh and querulous, in the smaller a "laughing" or screaming; the lesser skuas give vent to a curious mewing cry and the great skuas to a similar but deeper sound. At the breeding-quarters the utterances are naturally more agitated and shrill, and the parents hang excitedly above a visitor's head. "The food," says Evans, "consists mainly of fish, mollusks, crustaceans, and worms, but is varied in the stronger forms by small mammals, young birds, and eggs; the great black-backed gull undoubtedly attacks lambs and weakly ewes; carrion is not uncommonly devoured; and *Larus maculipennis* acts as a scavenger at Buenos Ayres, besides clearing the country of grasshoppers, and robbing the Cayenne lapwing of its insect booty. Skuas give chase to their smaller kin, and force them to disgorge the fishes they have just caught, while even solan geese are sometimes victimized; *Larus scopulinus*, moreover, which robs the oyster-catcher of New Zealand, is a further instance of parasitic habits. Insects and their larvæ, turnips, berries, and grain are also eaten by these omnivorous but useful creatures."

Most gulls are migratory and scatter far along the coasts during fall and winter in search of food. On the eastern coast of the United States are five species. The large herring-gull (*Larus argentatus*) breeds on the coast of Maine and winters to the southward, being abundant about all harbors and along tidal rivers from October to April. Associated with them are sometimes seen the larger black-backed gull (*L. marinus*). In summer are present the smaller black-headed or laughing gull (*L. atricilla*) which nests plentifully on the salt marshes of the Middle and Southern States. The Bonaparte's and ring-billed gulls (*L. philadelphia* and *L. delawarensis*) breed on our northern coasts. In the interior Franklin's gull (*L. franklini*) inhabits the lake shores and marshes of the upper Mississippi Valley; while on the Pacific coast occur several other species. In the arctic regions the most abundant gull is the great Burgomaster (*L. glaucus*), one of the largest species, which wanders some distance southward in winter. Two other species peculiar to the far north are the pure white ivory gull (*Pagophila alba*) and Ross's rosy gull (*Rhodostethia rosea*). The latter is one of the rarest of birds and one of the most beautiful, the whole under surface being suffused with pink and the neck surrounded by a dainty collar of gray. It has been seen in numbers only by the arctic explorers Murdoch and Nansen. The Kittiwake (*Rissa tridactyla*) is another species of circumpolar distribution, peculiar in lacking the hind toe. Several of these species are known on the coasts of Europe or Asia; and the gulls of other parts of the world present little that is peculiar. Large areas of coastal beaches and islands formerly inhabited by gulls in various parts of the world, but especially along the eastern coast of the United States, have been wholly depopulated of these beautiful and useful birds by the incessant robbery of their nests for the sake of the eggs — which are conical in form, and white or greenish, heavily blotched with purple and brown in color; — or for the sake of their plumage to be used in millinery trimmings. Protective laws now prevent this waste of life.

Consult Evans, 'Birds' (1900); Coues, 'Birds of the Northwest' (1874); Baird, Brewer and Ridgway, 'North American Water Birds' (1884).

Gum Arabic, a gum of the *Acacia arabica*, which grows in India and Arabia. Gum arabic can be obtained also from *Vachellia farnesiana* of India, a small tree closely allied to the true acacias. Gum arabic occurs in transparent white tears, which are often colored yellow or brown by impurities; it cracks on exposure to the air on the surface; it is brittle, and has a bland, mucilaginous taste. It dissolves in water, and the solution gives a precipitate of arabin on the addition of hydrochloric acid. Gum arabic contains about 70 per cent. of arabin, $2C_6H_{10}O_5+H_2O$, and 17 per cent of water; the rest consists of potash and lime, which are combined with the arabin.

Gum-boil, an abscess in the gum caused by inflammation, generally the result of toothache or of the presence of decayed teeth. The carious tooth or stump, if the inflammation proceeds from this cause, should be removed. When matter has formed it should be evacuated by a free incision, and the mouth should be frequently washed with tincture of myrrh and water. See DENTISTRY; TEETH.

Gum-resins are complex mixtures obtained from plants. They contain both a gum, which is soluble in water, and a resin, which dissolves in spirit. There are usually present in addition essential oil, coloring and extractive matter, and a variety of impurities. The gum-resins have frequently a strong and characteristic taste and smell. They are solid, opaque, and brittle. The common gum-resins are aloes, ammoniacum, asafœtida, euphorbium, galbanum, gamboge, myrrh, olibanum, opoponax, sagapenum, and scammony.

Gum-trees, a name for several different trees: (1) those of the Australasian genus Eucalyptus (q.v.); (2) in the United States, the pepperidge or tupelo, various species of which are called black, sour, cotton-gum, etc. (see TUPELO); (3) the liquid amber (q.v.).

Gumbinnen, goom-bĭn'nĕn, Prussia, the capital of a government with an area of 6,125 square miles. The town is on the Pissa, 22 miles by rail southwest of Edytkuhnen on the Russian frontier. It is comparatively modern, its municipal charter dating from 1722. There are manufactures of woolens and linens, and a trade in cattle and agricultural produce. Pop. (1903) 14,000.

Gumbo. See HIBISCUS; OKRA.

Gumma, gŭm'a, a tumorous deposit that occurs in the tertiary stage of syphilis (q.v.). It affects most frequently the bones, cartilages, skin, and periosteum. They are made up of a hard connective tissue which tends to undergo softening, causing destruction of the part and deep ulceration if near the surface. The periosteum of the cranial bones is particularly liable to be affected, causing dangerous pressure on the brain.

Gumming, or Gumosis. See DISEASES OF PLANTS.

Gums, various mucilaginous substances, generally obtainable from the sap of trees. They are soluble either in cold water or in alcohol. Many aromatic products such as are employed in making perfumes and incense are to be classed as gums. Gum Arabic is the best known among such products. It is obtained from the Senegal Acacia in Western Africa. There are no less than eight or nine varieties of this gum. Gum tragacanth comes from the *Astragalus gummifer*, in Western Asia. Cherry-tree gum, whose name tells its origin, is used for stiffening felt, as in hat making. There are some gums which might perhaps more properly be classed as resins, and are sometimes styled gum-resins; many of which are used in medicine.

Gun, a strongly-constructed metal tube, from which destructive projectiles are expelled by the gradually increasing pressure of gas evolved from fired gunpowder or other explosive. The term comprehends every description of firearm, from cannons, mortars, and other heavy pieces of ordnance, to the fowling-piece, rifle, and pocket-pistol. See ARMS; ARTILLERY; FIRE-ARMS; ORDNANCE.

Gunboat, a term originally applied to small craft mounting usually a single gun, and employed exclusively in the defense of coasts and rivers. Experiences in the Crimean war suggested the extension of the use of gunboats to offensive warfare. One of the main objects of a ship of war being to carry guns, it was thought that a vessel large enough to carry only a single gun of the largest size would, from the rapidity with which it could be manœuvred, and its comparative immunity from shot, have great advantages in attack against large vessels carrying a heavy armament, and requiring much room and time to manœuvre. About 1860 the British government constructed about 200 gunboats upon this principle. They were about 100 feet long, with 22 feet beam, and a draught at load-line of 6½ feet. Each was armed with one deck-gun a 68-pounder, which, by turning on a pivot, could be used either ahead, astern, or in any other direction; while the facility of manœuvring was further enhanced by the rapidity with which the vessel itself could be turned almost in her own length. Experience soon proved that there were serious defects in this species of armament. One of these was, that from being obliged to carry their guns constantly on deck the gunboats were liable to be top-heavy and untrustworthy in a heavy sea.

A new gunboat was designed in England in 1868 by G. Rendel, the chief peculiarity of which was the placing of the gun on a platform, which could be raised to the deck or lowered to the hold by a donkey-engine. The gun did not turn on a pivot, the manœuvring being effected entirely by the turning of the vessel, to effect which it was fitted with twin-screws worked by independent engines. Other types of gunboat have since been constructed for the British navy. One of a recent and powerful type is 165 feet in length, with a breadth of 31 feet, and a displacement of 805 tons. It draws 11 feet 7½ inches of water, and has triple-expansion engines, working up to 1,200 horse-power, with a speed of 13 knots an hour. It carries six 4-inch steel breech-loading guns, besides two quick-firing guns and machine-guns, and is bark-rigged. A number of what are known as torpedo gunboats have been constructed for the British navy. One boat of this class is 200 feet in length, with a beam of 23 feet, and a depth of 13 feet. It is built entirely of steel, has a torpedo-tube through the bow and another through the stern in a fore-and-aft line, and one on each broadside forward, a 4-inch 25-cwt. central-pivot breech-loading gun, and six 3-pounder, quick-firing guns. It has two sets of triple-expansion engines, working up to 2,700 horse-power, and enabling the vessel of 450 tons to steam over 18 knots an hour. Several first-class gunboats of a more recent type are twin-screw vessels, 180 feet long, of 700 tons displacement, armed with two 4-inch guns and four 12-pounder quick-firing guns.

In the United States the gunboat figured to a very considerable extent in coast and lake warfare in our first two wars. They were first used on the Delaware River, in 1775–6, and drove the British frigate Reliance out of the roads. In December 1807 there were 69 of them in United States service, and the Congress ordered 188 more built, as an auxiliary to the embargo declared a few days later, making 257 in all. Improved ordnance has made them valueless, and they had a bad effect on the service, but there was strong opinion in their favor at the time, and they did good service in the War of 1812. The theory was that these movable batteries could act in water where large vessels could not, could be concentrated against the latter so as to afford as large an armament, yet present only a number of small targets, while their antagonist presented only one large one; that shots aimed too high would do no harm to gunboats, but would injure masts and rigging of frigates; that loss of rudder and sailing gear, the most crippling of accidents to a ship, could not happen to the gunboats, propelled and steered by sweeps; that nearness to the water level gave the guns more accurate aim; and that 75 gunboats could be built for the cost of one 36-gun frigate.

In 1903 the United States navy had 20 of the ordinary gunboats in commission and about 60 torpedo-boats and destroyers of the gunboat type. Great Britain in 1902 had 33 torpedo gunboats, Germany 3, and France 15. In most countries the gunboat has been superseded by modern torpedo-boats and destroyers.

Gun-carriage, or **Gun-mounting**. See Artillery; Fortification; Ordnance.

Guncotton is the name originally assigned to the material produced by Schoenbein, of Basle, Switzerland, in 1845 by treating cotton with a mixture of strong nitric and sulphuric acids. The discovery that starch, woody fibre, and similar substances give rise to the formation of highly combustible bodies when acted upon by concentrated nitric acid is attributed to Braconnot in 1832, and he styled the bodies so produced generically *xyloidine*. Six years later Pelouze took up this subject and extended his investigations to the behavior of cotton, paper and vegetable substances generally, and later Dumas prepared from paper by this means the substance which he called *nitramidine*. No practical result followed these observations until the discovery by Schoenbein of the advantages which followed the use of the acid mixture; a discovery which was also independently made by Boettger, of Frankfort, in 1847 and by Knop, of Hanover, and Taylor, of England, in 1847. The discovery aroused the liveliest expectations which were stimulated by the facts that the explosive was much more powerful than gunpowder and that when used as a propellant, it gave little or no smoke. Experiments and tests were begun shortly after with the new explosive in Germany, France, Austria, England, Russia, and the United States with a view of utilizing it as a substitute for gunpowder in guns. Unfortunately the material, as manufactured, was found to be not only so irregular in action that it was likely at any time to burst the piece, but also so unstable as to give rise to numerous accidents so that, especially after the serious and, at the time, inexplicable explosions at Vincennes and Bouchet in France, and Faversham in England, the experiments were discontinued except in Austria, where Baron von Lenk gave the matter close and long-continued study and came to the conclusion that the grave defects noted were not inherent in the material, but were due to the imperfect and irregular methods of manufacture, the failure to purify the cotton before treatment with the acid, and the failure to purify the guncotton and free it completely from acids after treatment. Following these convictions he improved the method of manufacture to such an extent that in 1862 the Austrian army had 30 batteries provided with guncotton cartridges made up by twisting the fibre into yarns which were braided together, but the spontaneous explosions at the magazine at Simmering in 1862 and at Steinfeld in 1865, together with the fact that the guncotton cartridges still gave at unexpected times abnormal pressures led to its further use in Austria being interdicted.

Von Lenk's process of manufacture was patented in England in 1862 and the Prentice Brothers began manufacturing under this process in 1864. In 1865 Abel patented an improvement of the process which was so successful in use that it gave guncotton a prominent and permanent place among explosive substances, and this process is followed to-day. The cotton when treated with the acid is in the fibrous condition which so well characterizes it, and under the microscope these fibres are seen to be hollow so that each is really a capillary or hair-like tube. Von Lenk had shown that cotton contains not only cellulose as the main component of its structure but that there were smaller and variable quantities of other substances naturally present besides foreign bodies accidentally present, and that it was necessary to get the cellulose in a pure and dry condition before treating it with acid. He, too, with others, had proved that the purity, strength and proportions of the acids used and the time and temperature of immersion of the cotton in the acid mixture affected very materially the character of the substance produced, while it was essential that every trace of free acid should be removed from the product, since a most minute quantity of sulphuric acid acts continuously and cumulatively on the guncotton and causes a progressively increasing rate of decomposition. Yet von Lenk and all others up to this time produced the guncotton in the same long staple form as the cotton from which it was made. It was evident to Abel's mind that as the dry cotton was immersed in the acid mixture the capillary tubes, of which it was composed, would suck up the liquid acid and retain it with such force and in such a manner as to make its removal by wringing, or washing with or in water or by neutralization with alkalies, extremely difficult and uncertain, and to remedy this Abel proposed to pulp the guncotton through which the fibres would be cut into such short lengths that the acids could be completely and readily removed from the interiors of the tubes while furthermore this pulped material could by molding and pressure be shaped into any desired forms and dimensions.

Abel's process for the manufacture of military guncotton as carried out at the United States naval torpedo stations was as follows: The cotton used was what is known as "cop" or weaver's waste, which is the tangled clippings from the spinning room of a cotton mill; the thready form of this material being preferred to the fluffy form of the unworked cotton. This was first hand-picked to remove the larger foreign bodies present and to open out after baling. It was then boiled in 200-pound lots in caustic soda solution to remove grease, oils and the incrusting substances on the fibres, then wrung out in a centrifugal wringer and dried in a heated closet. It was then put through a cotton picker to open up the fibre and remove foreign bodies which had been overlooked in the hand-picking, and was then dried in a second closet at 225° F. until it contained not over one half per cent of moisture, when it was stored in small lots in hermetically sealed metal vessels to cool. It was then dipped in lots of one pound each in 150 pounds of acids, consisting of 1 part by weight of nitric acid, 1.5 specific gravity, to 3 parts by weight of sulphuric acid, 1.845 specific gravity, contained in a large iron trough about which cold water circulated so as to maintain a temperature of 70° F. throughout the dipping. The cotton was plunged rapidly under the acid, allowed to remain immersed for 10 minutes, removed to a shelf above the acid dipping trough, where it was squeezed to remove the excess of acid, and then at once transferred to a two-gallon crock made of acid-proof earthenware. As transferred to this digestion crock the cotton carried with it from 10 to 12 pounds of the acid mixture, and by pressing the mass down in the crock with an iron tool, the cotton was forced to the bottom and covered with a layer of the acid mixture which was squeezed from it. The crock was then covered and placed in a wooden trough where it was partly surrounded with cool water, which was kept in constant circulation, and where it was allowed to remain, so that the cotton could "digest" the acid, for 24 hours. Then the contents were thrown into a steel centrifugal wringer by which the greater part of the acid was removed. The guncotton was then thrown into a tub holding 800 gallons of water through which a large stream of water was continually flowing and in which a large paddle-wheel was in revolution so as to very quickly bring the acid guncotton into contact with so large a volume of cold water as to prevent its becoming heated. The guncotton was then boiled twice for eight hours each in a dilute solution of soda, wrung out and washed with fresh water and put in the pulper. This was an ordinary "beater," "rag-engine," or "Hollander," such as is used in the paper-making industry, and the guncotton, suspended in water, was subjected to the action of the machine for two days in charges of from 300 to 350 pounds, where, by the shearing action of the knives, the fibres were cut into short lengths and the guncotton was reduced to the fineness of cornmeal, and mixed into a pulp with the water present. This was drawn into a large tank, known as the poacher, where the powdered guncotton was allowed to settle and the supernatant water drawn off. Fresh water was added and, by means of a revolving paddle in the poacher, the guncotton was mixed with it and washed by it, and this washing was repeated six or seven times until the chemical test of a sample showed that the acid had been completely removed. Then it was treated with a solution of lime containing a small quantity of caustic soda and also of precipitated chalk, and the mass was ready for molding.

As shown above the first use to which guncotton was put was as a propellent in guns, and Abel devised means for making powder grains from the pulped guncotton, but he soon pointed out the advantages which it possessed, when compressed, for use in military and naval mines and torpedoes and for engineering operations in times of war, and these are the chief uses to which it has been put. To compress it the alkaline solution from the poacher, containing the finely divided guncotton in suspension, was pumped up to a stuff-chest, which is a cylindrical tank containing a vertical shaft armed with paddle-blades which, by revolving, keeps the guncotton in suspension. From here, by means of a wagon, the pulp was run into a hydraulic press where it was subjected to a pressure of 100 pounds to the square inch and thereby molded into blocks. These blocks were then transferred to another press where they were subjected to a pressure of from 6,000 to 6,800 pounds to the square inch. As made at the United States naval torpedo stations the blocks from the molding press were prismatic, with the vertical edges chamfered, 2.8 inches in diameter by 5¼ to 5½ inches high, with a circular hole ½ inch in diameter, produced by a mandrel in the press, running vertically through the centre of the prism. After final pressing the blocks were 2.9 inches in diameter by 2 inches high, the hole remaining practically unchanged, and they still contained from 12 to 16 per cent of water, though as sent out into the service as "wet guncotton" they were soaked in water until they contained 35 per cent. In the final press by means of steel dies, inscriptions in letters and figures, such as the place and date of manufacture and factory lot, were placed upon each block.

In the fibrous condition guncotton appears like the cotton from which it is made, but it has a harsher feel and it becomes electrified by friction when dry. When dry if rubbed in the dark it becomes phosphorescent. Under the microscope by polarized light it exhibits colors, while cotton is colorless. Pure guncotton is without odor or taste and is insoluble in water. The gravimetric density before pulping is 0.1, after pulping 0.3, and after compression from 1.0 to 1.3, but by excessive pressure it has been raised to 1.4. The real specific gravity of guncotton is 1.5. When dry, compressed guncotton is detonated by inserting a detonator in the hole in the block and firing it. Wet guncotton is detonated by the detonation of a block of dry guncotton fired in contact with it. The violence of the explosion of guncotton when thus detonated is comparable with, if not superior to, that of nitroglycerin. Dry guncotton may be set on fire and, when compressed, it burns so slowly in the open that the fire may be extinguished by pouring water upon it. Wet guncotton, thoroughly saturated with water, can be shaped by a tool without taking fire or exploding. In forming the cylindrical and conical charges for the torpedoes thrown from the pneumatic guns of the United States steamship Vesuvius at Santiago, the prismatic blocks above described were sawn with a band saw, turned in a lathe and cut with chisels as wood is treated, but care was used to keep the blocks and dust wet throughout the process.

Pure cotton is composed of cellulose having a formula which chemists believe to be some multiple of $C_6H_{10}O_5$. When it is acted upon by nitric acid or mixtures of nitric with sulphuric acid, under the proper conditions, cellulose nitrates are produced, through, it is believed, the replacement of hydrogen atoms in the molecule by NO_2 groups, thus forming esters or organic salts. Views differ as to the number of cellulose nitrates existing but, following Vieille, who is the most widely accepted authority on this point, taking the formula of cellulose as $C_{24}H_{40}O_{20}$, we may have the following:

Cellulose Nitrates	Percent of Nitrogen	Weight obtained from 100 parts of Cellulose
Cellulose endecanitrate ..	13.47	176.4
Cellulose decanitrate....	12.75	169.4
Cellulose enneanitrate...	11.96	162.5
Cellulose octonitrate....	11.11	155.7
Cellulose heptanitrate...	10.18	148.6
Cellulose hexanitrate....	9.15	141.7
Cellulose pentanitrate...	8.02	134.7
Cellulose tetranitrate....	6.76	127.8

There are probably existing also isomers of many of the nitrates given in the table. Following their differences in composition these different cellulose nitrates have different properties especially as regards their solubility in organic solvents. Thus all except the endecanitrate, if properly made, are soluble at ordinary temperatures in a mixture of one volume of alcohol and two volumes of ether. Such cellulose nitrates are called *pyroxyline, nitrocotton, soluble guncotton*, and *collodion, cotton* or *guncotton*. The decanitrate is also called *pyrocellulose*. All the cellulose nitrates are by some called *nitrocellulose*. The material produced by the Abel process described above is partly soluble, but mostly insoluble in the ether-alcohol mixture, and to this material the name *guncotton* or better *military guncotton* is applied. In addition to guncotton, the cellulose nitrates are used in the manufacture of smokeless powder, explosive gelatine, pyroxylin plastics, pyroxylin varnishes, photographic films and collodion. For smokeless powders and explosive gelatine the deca- and enneanitrates are most largely used. For varnishes, collodion and photographic films the octonitrate is generally employed. And the heptanitrate, which is of low nitration, is preferred for the pyroxylin plastics. This last nitrate may be made by dipping one pound of pure dry cotton or tissue paper in 100 pounds of a mixture of 66 parts of sulphuric acid, 17 parts of nitric acid and 17 parts of water, and continuing the immersion at 30° C. for 20 to 30 minutes. The acid is then wrung out and the nitrate washed and neutralized. The higher nitrates are made by using stronger acids, longer exposures and higher temperatures. In making pyroxyline varnishes, which are largely used in coating metals, artificial leather and in waterproofing, the pyroxylin is dissolved in ethyl acetate, amyl acetate and similar organic solvents.

Collodion, which is used in surgery, is made by placing 30 grams of pyroxylin in a suitable bottle, pouring upon it 750 cubic centimetres of ether, corking the bottle and allowing the whole to stand 15 minutes. Two hundred and fifty cubic centimetres of alcohol are then added and the bottle shaken until the pyroxylin is dissolved. On allowing to stand the solution becomes clear, and if poured upon a flesh wound the solvents evaporate and a continuous film of pyroxylin is formed which protects the wound from the air and which also, by contracting as it dries, brings the edges of the wound together. Substances such as cantharides, tannic acid and the like, by which to produce blistering, styptic and other effects, may be added to the collodion. See EXPLOSIVES.

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Gunnery is the science and art of using guns. As a science it treats primarily of the motion of projectiles, and has three branches, "interior ballistics," "exterior ballistics," and "effects of projectiles."

"Interior ballistics" considers motion within the gun, and seeks to determine the fluid pressure caused by the combustion of a given charge of powder and the velocities thereby imparted to the projectile and to the gun itself.

From the middle of the 14th century until some 20 years ago, a practically unchanged mixture of nitre, sulphur, and charcoal, called gunpowder, was universally used as the propelling agent in firearms. At first, as the name implies, it was used in the form of dust; later the superior effects produced by granulation were discovered, and a powder in the form of small irregular grains was used in all kinds of guns; early in the 19th century powders were divided into two classes, the finer-grained "musket powder" being used in all shoulder pieces, and the coarser "cannon powder" in all artillery; about 1860 Gen. Rodman, U. S. A., proposed and developed the manufacture of powders of regular granulation and very large grains for use in the 15- and 20-inch smooth-bore guns; with the advent of large rifled cannon, the practice became general of molding powder into separate grains of a size and density suited to the particular gun in which it was to be fired; a slower burning gunpowder, called brown, or cocoa, powder from its color, and made from underburned charcoal, next came into use for large guns; and, finally, the discovery that the high explosives can, by suitable treatment, be made to burn progressively in guns made smokeless powders practicable, and these have now entirely superseded gunpowder.

The explosion of the powder charge of a gun begins with "ignition," which is the setting on fire of a portion of it; "inflammation," or the spreading of the fire from grain to grain, throughout the charge, follows; and "combustion," or the burning of each grain from surface to centre, completes the phenomenon. Meanwhile the gaseous products of the combustion, filling the powder chamber, develop a fluid pressure which starts the projectile from its seat and gives it an accelerated motion along the bore. Evidently the gas pressure at any instant depends upon the quantity of powder consumed at that instant and the space which the products of its combustion occupy, and the latter depends not alone upon the volume of the powder chamber, but also upon the displacement of the projectile. It might well be thought that the periods of time required for the inflammation and combustion of a charge of gunpowder are so small as to be negligible, yet much of the superiority of modern over ancient ordnance comes from proper regulation of those time intervals. The ballistic power of granulated was much greater than that of dust powders because the interstitial spaces between the grains greatly increased the rapidity of inflammation, and the use of large charges of grained powders without inadmissible strains upon guns was made possible only by so diminishing the rapidity of combustion that the burning of the powder was not complete till the projectile had traversed a considerable portion of the bore of the gun. Robins, Hutton, and Count Rumford were the pioneers in the experimental determination of the force of fired gunpowder and in measuring, by means of the former's "ballistic pendulum," the velocities which it imparted to projectiles, but Rodman was the first to directly measure the pressures developed in guns by the explosion of their charges. In 1861 he published the results of experiments made for the United States government, and described his pressure gauge, a modification of which is still universally used for measuring powder pressures. The Rodman gauge consists of a piston contained in a small cylinder inserted in the gun wall so that the inner end of the piston is exposed to the bore of the gun, while its outer end, which carries a knife edge, presses against a disk of soft copper; on firing the gun the gas pressure forces the piston outward and the knife edge makes a cut in the copper which, by comparison with cuts made by known forces, measures the gas pressure which produced it. Rodman measured the pressures in guns not only at the bottom of the bore, but at intervals to the muzzle, thereby determining the necessary thickness of metal to withstand them, and he showed that by making the size of the powder grains vary with the size of guns, their ballistic power could be increased without increase of strain upon their walls.

The first exhaustive investigations of the phenomena attending the explosion of gunpowder were those of Noble and Abel, communicated to the Royal Society in 1874 and 1879. They measured velocities with the electric chronograph, and powder pressures with the Noble "crusher" gauge, which differs from the Rodman gauge in using the extent to which a copper disk is shortened by crushing, instead of the dimensions of a cut, to measure the force. They found that the products of explosion consisted of 57 per cent by weight of solid or liquid matter and of 43 per cent by weight of permanent gases; that the gases, reduced to 32° F. and atmospheric pressure, would occupy about 280 times the volume of the original powder; that the pressure produced if the powder filled the space in which it was exploded was about 43 tons per square inch; and that the temperature of combustion was about 4000° F. They also deduced formulæ for the pressure at any point in the bore of a gun and for the work per pound of powder which its charge would do, both based on the assumption that the solid and liquid residue gave up its heat to the gases during their expansion; and these formulæ were very generally used until gunpowder was replaced by smokeless powders, it being only necessary to apply to the calculated work of any powder charge a "factor of effect" based upon experience in order to predict with reasonable accuracy the muzzle energy of the projectile and thence to deduce its velocity. By far the most important and complete study of the questions of interior ballistics has been made by the engineers of the French "Service des Poudres et Salpêtres" during the past 20 years, and it is to their experimental investigations that we owe almost all of the latest knowledge upon this subject. Sarau was the first to take into account the progressive combustion of the powder charge under the varying pressure in a gun, and by assuming that the velocity of combustion is proportional to the square root of the pressure he deduced his now classic formulæ for the muzzle velocity and maximum pressure resulting from firing a given gun with any given charge of a powder of previously established characteristics. He, like all previous investigators, assumed that the powder grains burned progressively from the surface in parallel layers, but Vieille, by registering the movement of the piston of a crusher gauge while it was compressing a copper disk under the action of powder pressure, measured the rate at which the pressure was developed and, having thus determined the law of combustion of various explosives, proved that progressive burning from the surface was a characteristic only of the modern smokeless powders and did not occur in the case of the older black and brown gunpowders in the forms in which they were actually used in guns. Vieille found that the velocity of combustion of pure guncotton smokeless powders was proportional to the two thirds power of the pressure, varying from about 1.4 inches per second under a pressure of two tons per square inch to about six inches per second under 20 tons per square inch; while in the case of smokeless powders containing from 40 per cent to 50 per cent of nitroglycerine, such as cordite and ballistite, the velocity of combustion was about three times greater and varied about as the five ninths power of the pressure. He also established the fact that the pressure caused by the combustion of any explosive in a closed chamber is accurately given by the expression $p = \frac{f\Delta}{1 - \alpha\Delta}$ in which Δ is the "density of loading" or the ratio of the weight of the explosive to the weight of water which would fill the chamber; f is the "force" of the explosive, varying from about 22 tons per square inch for gunpowder, to as much as 67 tons per square inch for some smokeless powders; and α is the "covolume" of the explosive, having a value from 0.5 to 0.6 for gunpowders and not differing greatly from unity in the case of high explosives and smokeless powders.

Notwithstanding his somewhat erroneous assumptions, Sarau's formulæ gave very accurate results for gunpowder, and when put in the slightly modified form which follows they are still the most reliable for use with smokeless powders. As originally used, Sarau's formulæ contained factors depending upon the form of the powder grain and its time of combustion in free air; but with smokeless powders these may be displaced by a single factor, namely, the "least dimension" of the grain, since with true progressive burning it is this, which, for any given powder, fixes its time of combustion.

These formulæ, as modified, are

$$V = A\frac{w^{3/8}\,u^{3/8}}{e^{1/8}\,p^{1/4}\,c^{1/4}\,s^{1/4}}\left(1 - B\frac{p^{1/2}\,u^{1/2}}{e\,c}\right) \text{ and } P = K\frac{w\,p^{1/4}}{e\,c^{2}\,s},$$

in which V is muzzle velocity of projectile in feet per second.

u is travel of projectile in the bore, and c is the calibre, in inches.

p is weight of projectile, and w that of powder charge, in pounds.

s is volume of powder chamber, in cubic inches.

e is the least dimension of the powder grain, in inches.

P is maximum pressure in gun, in pounds per square inch.

A, B, and K are constants, having the following values as determined by experiment for the guncotton smokeless powder used in the United States:

$A = 373.08$; $B = .00035133$; $K = 98555$.

The following practical formulæ give approximately the changes in muzzle velocity and maximum pressure (dV and dP) due to small changes in the weight of projectile or of powder charge (dp and dw).

$$\frac{dV}{V} = -0.43\frac{dp}{p};\ \frac{dP}{P} = 0.3\frac{dp}{p};\ \frac{dV}{V} = \frac{5dw}{8w};\ \frac{dP}{P} = \frac{7dw}{4w}.$$

Similarly, the change in muzzle velocity, due to a change in the length of bore, is $\frac{dV}{V} = k\frac{du}{u}$ where k has a mean value of about five sixteenths, varying from three eighths for slow to one fourth for quick powders.

Among modern practical ballistic instruments are Sébert's "projectile register" and "velocimeter." The former directly measures the acceleration of a projectile during the first part of its motion in the gun, and thus determines the pressure on its base; but the difficulty of stopping the projectile in a butt without injuring the recording apparatus contained in it has prevented the extensive use of this device. The velocimeter is an apparatus for the simultaneous registering of the time and the distance moved by a gun in free recoil, whence the pressure on the bottom of the bore is calculated.

DIAGRAM 1.

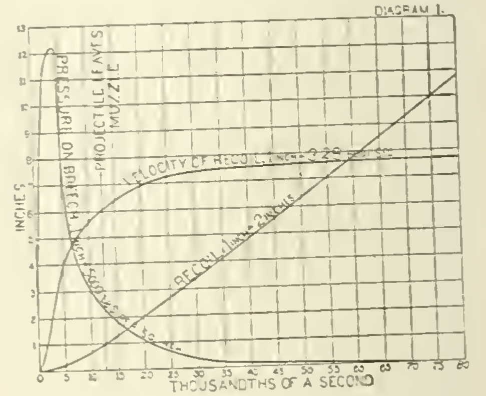
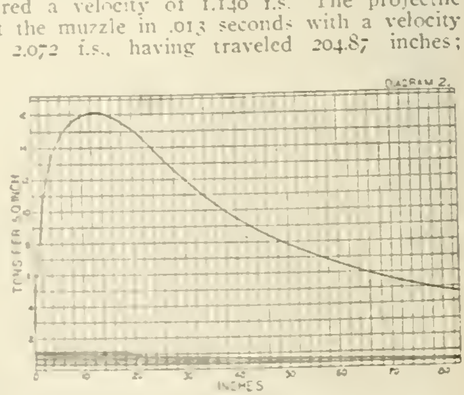


Diagram 1 gives the information obtained by means of the velocimeter from the firing of a United States army 8″ rifle. The projectile weighed 300 pounds; the charge was 52 pounds of a guncotton nitroglycerine smokeless powder; and the total recoiling weight was 34,573 pounds. The maximum pressure of 61,500 pounds per square inch was attained in .0045 seconds from the beginning of motion, and at that time the gun had moved 0.20 inches to the rear, and acquired a velocity of 10.76 f.s.; while the projectile had moved 27.54 inches and acquired a velocity of 1,140 f.s. The projectile left the muzzle in .013 seconds with a velocity of 2,072 f.s., having traveled 204.87 inches;

DIAGRAM 2.



while at the same instant the gun had moved 1.9 inches and had a velocity of 10.78 f.s., and the pressure had fallen to about 11,000 pounds per square inch. Spring gauges, capable of giving a continuous record of the varying pressures in a gun and registering them as the gun recoils, have also been successfully used in recent years, and diagram 2 gives the information obtained by such means from the firing of a French 10 c.m. (3.97 inches) gun. The projectile weighed 31 pounds, and the charge was 4.4 pounds of French guncotton smokeless powder. The maximum pressure of 18.6 tons per square inch was developed when the gun had moved 0.14 inches in free recoil, and the projectile 12.0 inches; when the projectile left the muzzle the gun had recoiled 0.95 inches and the pressure had fallen to about 5.3 tons per square inch.

It will be seen from diagram 1 that the velocity of recoil increases from about 20 f.s. to 25 f.s. after the projectile has left the muzzle. This is due to the reaction of the escaping powder gases. If u and W are the maximum velocity of free recoil and the total recoiling weight, p and w being the projectile and powder-charge weights, and v the muzzle velocity, then $Wu = vp + nvw$, where nv is the mean velocity of exit of the powder gases. With gunpowders n has a value of about three halves, but with smokeless powders it is probably somewhat larger.

The energy of rotation of the projectiles of modern guns is about 2 per cent of their energy of translation, and is allowed for in ballistic calculations by a suitable increase of the assumed value of the weight of the projectile. About 1 per cent of the available energy developed by the discharge is absorbed in the recoil of the gun: from 10 per cent to 12 per cent is taken up in giving energy of translation to the powder charge itself; and about 5 per cent goes to heat the gun walls.

Exterior Ballistics treats of the motion of projectiles after they have left the gun, and investigates the laws which govern their flight in air. The ancient artillerists supposed that the trajectory was composed of three distinct parts, of which the first, or "violent" part, was a straight line, the middle a circle, and the last, or "natural" part, again straight. Nicholas Tartaglia, who may well be called the father of ballistics, invented the quadrant for measuring a gun's angle of elevation, and in 1537 published a treatise on the flight of projectiles, in which he showed that no part of a trajectory is straight, and that the range increases with the angle of elevation up to 45°, where it is greatest. Galileo, who also neglected the resistance of the air, showed that the path of a projectile is a parabola with vertical axis. Newton, assuming that the resistance of the air is proportional to the square of a projectile's velocity, demonstrated that the trajectory consisted of two dissimilar branches, one ascending and the other descending, and that the latter would become vertical if sufficiently prolonged. Robins was the first to measure experimentally with any degree of accuracy the velocity of projectiles. In 1742 he published his famous 'New Principles of Gunnery,' and described his invention, the "ballistic pendulum," which consisted of a heavy bob suspended from a tripod and arranged to receive the impact of a projectile and to register the resulting swing: the velocity imparted to the bob by the impact could then be calculated, and thence, by the principle of the equality of the quantities of motion before and after the impact, the striking velocity of the projectile could be determined. Robins measured velocities as high as 1,700 f.s., and determined approximately the loss of velocity due to air resistance for distances up to 250 feet from the gun: he also suggested using the gun itself as a pendulum and calculating the velocity of the projectile by observing the swing of the gun when it was fired, and Count Rumford soon afterward experimented with this device. Dr. Hutton made extended experiments in England from 1775 to 1791 with both the ballistic pendulum and the gun pendulum, but there was no further great advance in knowledge of ballistics until the French government experiments were made at Metz in 1839 and 1840, from the results of which it became possible to roughly construct trajectories and to calculate, by empirical formulæ, approximate ranges and times of flight for any given elevation of a gun. In 1840 Wheatstone suggested measuring the velocity of a projectile by causing it to cut successive wire screens, each of which formed part of an electric circuit, and in following years many instruments for measuring projectile velocities by electricity were perfected, of which the Boulengé chronograph is to-day the most widely used. This instrument consists of two electro-magnets, the magnetizing currents of which pass through wire screens at a carefully measured distance apart in the path of the projectile, and from one of which is suspended a long cylindrical rod, called the chronometer, while from the other is suspended a shorter rod, called the registrar. A spring trigger carrying a knife edge is so arranged that when the registrar drops it strikes and releases it, causing it to fly forward and make a cut on the side of the chronometer. When released by hand the trigger makes a mark on the suspended chronometer called the origin: when the circuits are simultaneously broken by a device called the disjunctor the chronometer and registrar fall freely side by side until the released trigger makes a second mark on the chronometer at a distance above the origin called the disjunctor reading: when a projectile is fired it cuts the first screen, releasing the chronometer, then it cuts the second screen, releasing the registrar, and thus a mark is made whose distance above the origin is the velocity reading: then the time of falling freely the velocity reading less the time of falling freely the disjunctor reading is the time it took the projectile to travel from the first to the second screen, and the distance between the screens divided by this time is taken to be the velocity of the projectile when midway.

The perfection of a means of accurately measuring the velocity of a projectile at any desired point in its path made it practicable to experimentally investigate the laws governing the resistance of the air. Bashforth, in extensive experiments (1865-70 and 1878-80), showed that the resistance was proportional to the square of the projectile's diameter, and for flat, hemispherical, and ogival-shaped heads, varied in ratios about as 1.5, 1.0, and .80; his earlier experiments, however, were vitiated by his use of studded projectiles having insufficient rotation for smooth flight. Mayevski's deductions, published in 1883, and founded upon Krupp's experiments, are probably the most reliable. Expressing the retardation $\left(\frac{dv}{dt}\right)$ in the form $A\frac{d^2}{w}v^n$, in which d is diameter in inches, and w is weight in pounds of the projectile, v is its velocity, and $\frac{dv}{dt}$ its retardation in f.s.s., he found the following values for A and n:

v between 2800 f. s. and 1375 f. s.;	$n=2$;	log A =	6.119244(−10)
v " 1375 " " 1230 " ;	$n=3$;	"	2.980883(−10)
v " 1230 " " 970 " ;	$n=5$;	"	6.801844(−20)
v " 970 " " 790 " ;	$n=3$;	"	2.773423(−10)
v " 790 " " 0 " ;	$n=2$;	"	5.669876(−10)

These values of the consonants n and A are for projectiles having ogival heads of two calibres radius, and for a standard condition of the atmosphere. For other conditions the retardation found as above must be multiplied by a coefficient of form (i), and by the ratio of the actual density of the air to its assumed standard density $\left(\delta=\frac{\Delta 1}{\Delta 0}\right)$. Thus we have for a general formula $\frac{dv}{dt}=i\,\delta\,A\frac{d^2}{w}v^n$, in which i depends upon the form of the projectile, and is unity for most modern projectiles, and δ depends upon the temperature, barometric height and humidity, and is unity for ordinary atmospheric conditions.

Since the retardation is inversely proportional to $\frac{w}{i\,d^2}$, that factor, which is called the "ballistic coefficient" and denoted by C, measures the "ranging power" of a projectile. With spherical projectiles C could only be increased by increasing the calibre, but with rifled guns it became possible to greatly increase its value for any calibre of gun by lengthening the projectile and sharpening its point, and it is this fact which largely accounts for the immense superiority in ballistic power of rifled over smooth-bore guns.

Assuming that the axis of a projectile coincides with the tangent to its path, as is practically the case with modern rifled guns, the resultant action of the resistance of the air will likewise coincide with the axis, and the trajectory will be the same as if the mass of the projectile were concentrated at its centre of gravity and moved under the action of two forces, one the constant vertical force of gravity w, and the other the variable resistance $\frac{w}{g}\frac{dv}{dt}=A\frac{i\,\delta\,d^2}{g}v^n$ acting in the tangent. Under these circumstances the differential equation to the trajectory is readily obtained, and, though its form prevents direct integration, its approximate solution has been effected by several different methods, of which Siacci's is the simplest and the one almost universally used. By Siacci's method the two co-ordinates, the inclination, the time, and the velocity at any point of the trajectory are given as functions of a new variable, called the pseudo-velocity, and, by means of tabulated values of those functions all the problems of exterior ballistics may be accurately solved.

As shown by Mayevski's formulæ, we may consider the air resistance to be proportional to the square of the velocity, so long as the velocity exceeds 1,375 f.s., which is the case throughout the trajectories of modern naval and coast defense guns (excepting mortars), when they are fired at the moderate elevations with which alone they are practically used. Within these limits the equation to the trajectory in air, the gun being the origin, is $y=x\tan a-\frac{g\,x^2}{2V^2\cos^2 a}\left(1+\frac{2kx}{3}\right)$, the first two terms of which represent the trajectory in vacuo, and in which a is the angle of departure of the projectile, V is its initial velocity, and k is the constant in the expression for the retardation $\frac{dv}{dt}=kv^2$. Thus, for example, taking the case of a 12″ projectile of standard form, 880 pounds weight, and 2,800 f.s. initial velocity, we have, under standard atmospheric conditions, $k=A\frac{d^2}{w}=\frac{d^2}{w}(6.119244-10)=.000021534$, and, supposing we wish to determine the proper angle of elevation for a range of 3,000 feet, putting $y=0$, we get $\sin 2a=\frac{g\,X}{V^2}\left(1+\frac{2kX}{3}\right)=0.0128$; whence $a=22'$. By the same formula the elevation for a range of 15,000 feet will be found to be $2°-09'$, which agrees with the published range table for the latest pattern United States naval 12-inch gun.

Representing the ratio of the range of any projectile in vacuo (P) to its range in air (X) by n, so that n is the $1+\frac{2k}{3}X$ of the preceding formula, it can be shown that n, while always greater than unity, cannot exceed 3, and that for flat trajectories the following relations are quite approximately true: the angle of fall (ω), which in vacuo equals the angle of projection (a), in air is given by $\tan\omega=\left(2-\frac{1}{n}\right)\tan a$; the abscissa of the highest point (X_1), which in vacuo is half the range (X), in air is given by $X_1=X\frac{\sqrt{3n^2-3n-1}-1}{3(n-1)}$ and cannot exceed $0.57X$; the time of flight (T), which in vacuo would be $T_1=\frac{X}{V\cos a}$ or very closely $\frac{X}{V}$, in air is given by $T=\frac{2.(3n-2)^{\frac{3}{2}}-1}{9\quad n-1}.\frac{X}{V}$, or still more roughly by $T=n\frac{X}{V}$, and cannot exceed $1.05T_1$; the striking velocity (U), which in vacuo would be the same as the initial velocity V, in air is given by $U=\frac{V}{\sqrt{3n-2}}$ and cannot be less than $0.38V$.

Experience shows that the projectiles of rifled guns, when fired in a still atmosphere, deviate from the plane of fire (a vertical plane through the axis of the gun) to an extent approximately proportional to the square of the time of flight and in the direction toward which the upper surface of the projectile moves in its rotation. This deviation is called "drift," and for all United States guns is to the right, since they are so rifled that their projectiles, viewed from the rear, turn with the hands of a watch. With modern high-velocity guns drift is only important at very long ranges, being, for example, in the case of the 12-inch rifle already cited about 1½ yards at 2,000 yards range, and about 100 yards at 12,000 yards range. The cause of drift is that soon after the projectile leaves the gun the line of action of the air resistance ceases to coincide with the axis (on account of the curvature of the trajectory), and, meeting that axis obliquely between the point of the projectile and its centre of gravity, tends to raise the point, which action, combined with that of rotation, causes the point to move first to one side (the right for right-handed rotation), and then downward: this movement, by virtue of which the axis of the projectile tends to describe a cone about the tangent to the trajectory, is called precession, and its result, in combination with the angular motion of the tangent caused by the curvature of the trajectory, is to keep the point of the projectile always on that side of the plane of fire toward which it was first deflected. Thus with right-handed rifling the projectile, during its flight, always points very slightly to the right of the plane of fire, and consequently the resistance of the air has a component normal to that plane which carries the projectile bodily to the right with increasing velocity.

For many reasons, among others the fact that the drift caused by rotation is affected by lateral wind pressure, it is difficult to determine accurately the deviation of a projectile which will result from a side wind. Hélie's formula, $D = WT - \frac{X}{V \cos \alpha}$ in which W is the velocity component of the wind at right angles to the line of fire, T is the actual time of flight, and $\frac{X}{V \cos \alpha}$ is the time the projectile would take to traverse the range (X) if its original horizontal velocity ($V \cos \alpha$) remained unchanged, is usually relied upon; but, while reasonably accurate for light projectiles, it gives much too great results for modern projectiles of large calibre, especially at moderate ranges. Assuming that in the short time of flight the projectile can acquire but little lateral velocity, the wind effect is a practically constant lateral pressure, and the deviation caused by it will be $D = k \frac{W^2 T^2}{d}$ in which, d being the diameter of the projectile, W the wind velocity at right angles to the plane of fire, T the time of flight, and D the deviation, k will be a consonant whose value must be found by experiment. The increase or decrease in the range caused by the wind is approximately $\Delta X = 2WT\left(\frac{VT}{X} - 1\right)$, in which W is the velocity component of the wind in the plane of fire.

The Effects of Projectiles depend not only upon their own characteristics, but also upon the nature of the objects attacked. «Cannister,» the balls of which spread on leaving the gun and rapidly lose their velocity, are only effective at ranges within 300 or 400 yards and against exposed men or very light vessels, such as torpedo boats. The «shrapnel,» burst by the action of a time fuse, produces a cone of balls and fragments whose axis is the trajectory and whose angle of dispersion depends upon the violence of the explosion, and can be used effectively against exposed men at any range, provided the point of burst can be properly adjusted: with field artillery, which uses shrapnel almost exclusively, it is usual to adjust the fuses with a view to causing the burst to occur when the height of the shrapnel above the point of attack is about one two hundredth of its distance from the gun. «Common shell» are sometimes used like shrapnel, but as a rule they are fitted with percussion fuses to cause them to explode on impact, in which case they are effective against unarmored ships and fortifications, and against any structures not protected by armor sufficiently thick to cause them to break up without penetration. If made of steel, and with thick walls, a common shell may be capable of penetrating steel plating of a thickness equal to half its own calibre, but as a rule the shell walls are thin and the power of penetration much less than this. It requires a resistance at least equal to that of a quarter-inch steel plate to actuate the fuse of a 6″ shell, and after penetrating such a plate it will range 10 or 15 feet before bursting. The larger the shell the more the resistance required to burst it, and the farther it travels after impact before bursting. From the point of burst the fragments spread in a cone, the angle of dispersion depending upon the relation between the velocity of the shell as a whole at the instant of bursting and the velocity imparted to the fragments by the explosion. The greater destructive effect of shell loaded with high explosives than of those loaded with gunpowder is primarily due to the much wider angle of dispersion of the former. «Armor-piercing shell» have been so perfected as to be capable of penetrating, unbroken and undistorted, a thickness of wrought iron or steel only limited by their striking energies. Against hard-faced armor, however, these projectiles require the aid of soft steel caps in order to penetrate even a moderate thickness without being shattered. The formulæ of Jacob de Marre, based upon French experiments, are considered the most reliable for calculating the velocity necessary for the perforation of oak, wrought iron, or homogeneous steel by projectiles of the usual form and of such quality as not to be broken or seriously distorted by the impact. When a projectile is distorted, or is broken, by impact, the velocity necessary for perforation increases very rapidly with the amount of distortion, or the number of fragments.

These formulæ are as follows:

For oak $\quad v = \frac{e^{.6} a^{.9}}{p^{.5}}$ (log 2.20987)

For wrought iron $\quad v = \frac{e^{.65} a^{.75}}{p^{.5}}$ (log 2.96162)

For steel $\quad v = \frac{e^{.7} a^{.75}}{p^{.5}}$ (log 3.00941)

In which e is the thickness to be perforated and a the diameter of the projectile, both in inches; p is weight of the projectile, in pounds; and v is its striking velocity in feet per second.

For capped projectiles and Harveyized armor, the Davis formula, based upon experiments at the United States naval proving ground, is $v = \frac{e^{.8} a^{.5}}{p^{.5}}$ (log 3.25312), and the same formula will serve as well as any yet proposed for Krupp armor, if to the calculated velocity be added from 50 to 100 f.s., the amount added increasing with the thickness of the plate.

The above formulæ are all for normal impact. When the angle which the axis of the projectile makes with a normal to the plate is less than 30°, provided the projectile remains whole, and if its velocity component normal to the plate exceeds the velocity required for perforation with normal impact, it will perforate the plate: with greater angles of incidence than 30° the projectile is deflected unless it very greatly overmatches the plate.

Experiments show that a projectile which will penetrate a distance unity into oak will penetrate slightly less than one half into concrete, about one half into good masonry, about three halves into sand, about four into common earth, and about seven into clay.

The Art of Gunnery is concerned with the actual use of guns, and primarily with pointing them so that when fired their projectiles shall hit the target. If a great number of rounds be fired from a gun under as nearly as practicable the same conditions, and the impacts are received upon a vertical screen, the average of their distances above or below the mean point of impact is called the mean vertical error of the gun: their average distance to right or left of the mean point of impact is called the mean horizontal error: and the trajectory from gun to mean point of impact is called the mean trajectory. Theory, as well as practical experience, indicates that only about 2 per cent of the projectiles fired will deviate from the centre of impact more than three times the mean error, and with modern guns the mean errors are so small that we may reasonably expect practically all the shots fired on any occasion, from a stationary platform, and at a fixed angle of elevation, to strike within a vertical rectangle 9 feet high by 6 feet wide at a distance of 2,000 yards. It is only necessary, therefore, to point a gun so that its mean trajectory intersects the target at the latter's centre in order to obtain a large percentage of hits: the accomplishment of this, however, is not easy and constitutes the principal part of the gunner's art. Guns are pointed by directing what is called the "line of sight" at the target. Originally the upper surface of the gun itself was used as the line of sight: this was called "sighting by the line of metal," and resulted in the gun having an elevation corresponding to the difference in thickness of the metal at breech and at muzzle, which elevation determined the range. Later a piece of wood or metal, called a dispart, was secured to the muzzle so as to give a line from breech to muzzle parallel to the gun's axis: such a line of sight had to be directed more or less above the target according to the range. Early in the last century the present method of having one fixed and one movable sight, so that the line between them, which is the line of sight, can be adjusted at any desired angle with the axis of the gun, came into use. It is customary to make the rear sight the movable one, and to put range marks on it so that if, for example, it is set at the mark 2,000 yards, the angle between the line of sight and the axis of the gun is the angle of elevation necessary to give the projectile a range of 2,000 yards. Besides the movement of the rear sight up or down, to insure the gun's having proper elevation, it is also usual to have means of moving it sidewise, so that the line of sight can be adjusted to make any desired small angle, in the horizontal plane, with the axis of the gun, and thus the drift of the projectile may be allowed for by causing the gun to point the proper amount to one side of the target at which the line of sight is directed.

If now gun and target are stationary, if there is no wind, if the air is of standard density, if the sight is set for the correct distance of the target, and so as to compensate for the drift at that distance, and if the line of sight is accurately pointed at the centre of the target, then the mean trajectory will pass through that centre and the chance of hitting will be a maximum. The first difficulty is that the line of sight cannot be accurately directed, since to do so requires the eye to determine when three objects at different distances (rear sight, front sight and target) are exactly in line: with the telescope sights now coming into general use this source of error is practically eliminated. In the next place the distance is never exactly known: there is always some movement of the atmosphere; the density of the air may readily be as much as 9 per cent greater or less than on the average: the target is usually in motion: and in the case of naval guns the gun is always in motion. The skill of the gunner, then, consists, first, in estimating the total lateral deviation which will result from wind and motion of gun and target at right angles to the plane of fire, and pointing sufficiently to one side of the target to compensate therefor: and second, in so adjusting the elevation of his gun as to compensate for the vertical deviation due to wind and motion of target in the line of fire, to angular motion of the gun if such exists, and to abnormal air resistance. With modern guns, mounted on shore, where the platform is stationary and the distance of the target can be measured with comparative accuracy, the percentage of hits upon a target of ordinary size should be very large, even at long range, if the gunners are well practised. Under the conditions of naval actions it is not surprising that in the past the percentages of hits have been extremely small, and it is not to be expected that they will ever be large, at least during such parts of actions as are fought at long range.

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Gun'nison, a river of Colorado formed at Almont by the junction of the Taylor and East Rivers, flows southwesterly to Gunnison, near Cimarron enters the Grand Cañon of the Gunnison 15 miles long, and continuing in a northwesterly direction past Delta unites with the Grand River at Grand Junction after a course of nearly 200 miles. See Uncompahgre Valley Project.

Gunny, a jute (see Jute) cloth, also a bag or sack. Gunny-bags are very largely exported from India to various parts of the world. American cotton is largely packed in these. They can be manufactured at a low price, hence the great demand for them. The name gunny is applied to the cloth as well as to the made-up bags. About 1850 the peasant hand-looms of Lower Bengal met both the home and the foreign demand for Indian-made gunny-bags — indeed the making of these was then the great domestic industry of that portion of India. At the present time the number made at the great steam-factories, of which there are now 23 in India, far exceeds what is produced by hand-looms. For example, in one year 82,-779,207 gunny-bags were exported from India, of which only 5,000,000 were woven by hand.

Gunpowder, an explosive substance formed by mixing saltpeter, charcoal and sulphur together. The mixture may vary in composition between quite wide limits, and yet possess explosive properties; but the proportions adopted by the United States governmental authorities are saltpeter, 75 per cent; charcoal, 15 per cent; and sulphur, 10 per cent. The saltpeter used is the India saltpeter or niter, which is known to chemists as potassium nitrate, and although found native as an incrustation on the soil in India it is to-day largely made from Chile saltpeter, or sodium nitrate, by reacting on the latter with potassium nitrate. It is carefully purified, finely ground and thoroughly dried for use, in the manufacture of gunpowder. The charcoal most suitable for gunpowder is that variety which is mostly readily ignited, most quickly burned and gives the least quantity of ash. Such charcoal is produced from dogwood, willow or alder, by heating the air-dried woods in closed iron cylinders or retorts out of contact with air so that they undergo destructive distillation and leave the charcoal as a residue, this method of manufacture having been invented in England by Bishop Landloff and adopted in that country in 1797. The dogwood, which is really the alder-buckthorn, *Rhamnus Frangula,* is cut when one inch in diameter; the willow and alder when four inches; though these dimensions vary in practice. The wood is cut in the spring when in full sap, stripped of its bark and seasoned by an exposure of two to three years; the dogwood being stacked under shelter, but the other woods in the open so that the rain may wash the sap from the wood and the sun's rays and the air may destroy the spiral cells. The charring is effected by fires outside the retorts or by passing superheated steam or hot carbon dioxide gas through the retorts. The character and yield of the charcoal produced varies with the temperature to which the wood is exposed and the time of exposure. When the wood is heated to 290° C. red charcoal is formed; when heated to 350° C. or above, black charcoal is produced. When the heating is done quickly the yield of charcoal is much larger than when the heating is slow. Red charcoal is much more easily ignited and burns faster than black charcoal. Charcoal for the manufacture of gunpowder is ground to a fine powder by rotation in a drum with a quantity of brass or bronze balls. Sulphur of commerce is purified for use in this manufacture by fusion and distillation; being eventually obtained in the form of roll brimstone, which is then crushed to a fine powder by heavy rollers. It must be free from sulphuric and sulphurous acids, as well as solid impurities, and should consist entirely of that modification of sulphur which is completely soluble in carbon disulphide.

The dry, finely ground and sifted saltpeter, charcoal and sulphur are weighed into the mixing machine, which consists of a gun-metal drum arranged to make 40 revolutions a minute and provided with hollow bearings through which a shaft is passed which carries 44 arms or fliers of such length as to just clear the interior surface of the drum. This shaft revolves in an opposite direction to and with twice the speed of the drum. After the ingredients are put in the drum the mixing is carried on for five minutes and then the mixture goes to the incorporating or wheel mill. The process of incorporation is of the greatest importance i. this manufacture. It consists in the long continued grinding together of the ingredients in order to mix them so intimately that the product appears to the naked eye as a homogeneous mass, for, unless this be done, complete reaction between the components of the powder by combustion cannot be expected. The finished gunpowder depends for its excellence largely upon the completeness and thoroughness of the incorporation. The incorporating mill consists of a circular bed of iron or stone on which the mixture is placed. A vertical shaft rising through the centre of this bed carries a horizontal one, on the two ends of which heavy stone or iron wheels, called edge runners, are hung. These wheels rotate about the horizontal shaft and, as the vertical shaft revolves, they travel at the same time in a circle around the bed so that, at the points on the bed where the edge runners touch, the motions of rotation and translation are converted into a twisting motion, like that of a muller, and the material beneath is thus overturned and very intimately mixed. The edge runners weigh from three to seven tons, are from four to seven feet in diameter, and are so movable on the spindle that they can accommodate themselves to varying thicknesses of powder on the bed. One of the edge runners is a little nearer the vertical shaft than the other, so that they travel in different paths and they are followed by a scraper which throws toward the centre of the bed the material that has been forced to the exterior by the edge runners. To incorporate, 50 pounds of the mixture are spread out on the mill-bed and slightly moistened and the wheels are set in motion. If the wheels are of stone weighing 3½ tons and making 7½ revolutions per minute, the incorporation is completed in 3½ hours. If the wheels are of iron weighing 4 tons and making 8 revolutions per minute, 2½ hours are required for cannon powder. The operator does not remain constantly in the mill but goes in occasionally to wet the charge, from 2 to 10 pints of water being used in accordance with the weather. The chief danger from accidental explosions during the manufacture of gunpowder is found in the incorporating mills; fortunately there is less explosive material here at any time than there is at any other part of the works. To render the damage done by an explosion as slight as possible, the buildings in which these operations are conducted are built with a strong framework covered with light boards, or else with three sides of stone and the fourth and roof of light wood, so that when an explosion occurs the framework or the stone walls remain. These mills are usually built in groups, and to prevent an explosion in one being communicated to the others, each is provided with a drenching apparatus which automatically wets and protects the charges in the mills adjacent to the one which is blown up. The communication of fire or explosion is also arrested by means of barricades built about the mills which consist of masonry filled with earth, or simple earth mounds or sometimes wooden structures built in the shape of a letter A.

When the incorporation is completed the mill cake, as the mixture is now called, is removed from the bed and runners by means of a copper chisel and wooden mallet. It is partly in the form of a compact cake and partly fine meal and in this condition it is put into the press. This is a powerful hydraulic press with a rectangular box which is divided into compartments of the desired width by means of copper or gun-metal plates. When the spaces between the plates have been filled with mill cake, pressure is applied which causes the particles to cohere, and the gunpowder is taken from the press in sheets having an area equal to that of the plates and a thickness dependent on the width of the filling space, the amount of the pressure applied and the duration of its application. Sometimes the press plates are corrugated like waffle irons, as for instance, in the manufacture of waffle and of hexagonal powders, and sometimes they are replaced by a press block filled with molds in each of which a separate grain is pressed, as in the manufacture of cocoa or prismatic powder. The operation of pressing is a most important one, since the density of the finished powder depends upon it and, as it is markedly affected by even slight changes in atmospheric conditions, it is a very nice one.

The press cake passes to the corning or granulating machine, where it is cut into grains. This machine consists of a hopper into which the charge is fed, an elevating band, an endless revolving table, four pairs of rollers and several sets of screens for sorting the grains according to size into boxes placed to receive each different size. The rollers, which are of gun-metal, are corrugated or provided with teeth, the upper two being coarser than the lower, and they are adjusted to the size of grain required. When the hopper has been emptied a clutch is relieved which stops the machine and at the same time rings a bell which notifies the operator of the fact for, as the machine is self-feeding, the workmen are not obliged to be present while it is at work. The grains are now freed from dust by passing through horizontal cylindrical sieves such as are used in flour-mills and they are then glazed by rotation in wooden barrels where, by the friction of the grains against each other, their angles are rounded off and a hard polished surface is imparted to them whereby they become better able to bear transportation and are less likely to absorb moisture. Sometimes the grains are coated with graphite which is put in the glazing barrel with them. Though but 4 ounces of graphite are used to 1,200 pounds of gunpowder it is considered objectionable for use with fine grain regulation powder as it delays ignition and fouls the piece, yet it improves powder to be used in fixed ammunition, in that it enables the grains to readily pack close together. As more dust is formed during the glazing process the grains are again put through the dusting reels and are then exposed for a day in the drying house to a temperature of from 125° to 130° F. The finished powder is packed in 1-pound tins or 25-pound kegs, though other sized packages are produced to some extent. According to the size or form or structure of the grains gunpowder is known as *mealed powder, superfine*, designated by the mark *F.F.G.; fine grain, F.G.; large or coarse grain, L.G.; large grain for rifles, R.L.G.; mammoth, pebble, pellet, cubical, hexagonal, sphero-hexagonal, waffle, Fassano* or *progressive*, and *cocoa* or *brown prismatic powder*. Mealed powder is in the form of dust and is used for driving fuses for ammunition and in pyrotechny. Fassano or progressive powder is formed by pressing mill cake to a density of 1.79, then breaking this press cake into 1/8 to 1/4 inch grains, mixing these grains with a prescribed quantity of fine grain powder, pressing this mixture to a mean density of 1.76 and breaking this press cake into grains about 2½ inches square by 1¾ inches thick. By this means a grain of varying density was obtained which burned progressively. This feature was introduced into powder-making by Prof. R. Ogden Doremus of New York, but was developed in Europe. Cocoa or brown prismatic powder is the final stage of development of the compressed perforated grain invented by Gen. Rodman of the United States army. In experimenting with the 15-inch and 20-inch smooth-bore guns invented by him, Gen. Rodman found that he could reduce the initial pressures, while securing the desired velocities, by using perforated disks of compressed powder which were of a diameter equal to the calibre of the gun and between 1 and 2 inches in thickness. He styled this charge a "perforated cake cartridge" and in his 'Properties of Metals for Cannon and Qualities of Cannon Powder,' published in Boston, Mass., in 1861, he mathematically demonstrated that at the beginning such disks presented the minimum of free surface to combustion but as the powder burned there was a constant enlargement of the perforations, whereby the area of surface exposed to combustion was constantly increased and that therefore the volume of evolved gases increased as the volume of the chamber, due to the travel of the projectile, increased, in consequence of which the pressure was more uniformly distributed along the bore than it had been with the granulated powders hitherto employed. Owing to difficulties in manufacture and use, Rodman later found it convenient to build up his charges with perforated hexagonal prisms of comparatively small size. The Civil War prevented the further development of this novel idea in powder-making in this country at that time, but a Russian military commission, which visited the United States during the Civil War, was so impressed by what Rodman had accomplished, that on its recommendation the manufacture was taken up and carried on in Russia on an extensive scale, and it soon spread to other countries. About 1880 Germany adopted cocoa powder, which was a brown prismatic powder with a single canal, the grains having the form of an hexagonal prism, 1 inch in height by 1.36 inches in diameter, and a density of 1.86. This powder, however, differed from ordinary gunpowder both in the kind of charcoal used and in the proportions of the components. The charcoal was underburned or red charcoal made from rye straw, and the composition was saltpeter 80.50 per cent, charcoal 16.00 per cent, sulphur 2.50 per cent, and moisture 1 per cent. Cocoa powder was so successful for use in modern high-powered rifle guns that it was sought for by all military nations and the want was met in this country by substituting for the rye straw charcoal red charcoal from wood and carbohydrates, such as sugar, and this brown prismatic powder

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was used in our modern large calibre guns until displaced by smokeless powder.

Although very great care is exercised in the manufacture of gunpowder, yet there are so many opportunities for variations to occur in each of the many steps of the process that even the best powder-makers cannot regularly produce powder that will always give the same pressure and velocity in the same gun. Since, in order to ensure accuracy of fire, the successive powder charges used must possess the same ballistic properties this result is secured by proving a number of factory runs by firing trials and then mixing these together in the proportions required to produce the desired result. This process is called blending. It was practised by Benvenuto Cellini and has been in vogue ever since.

Good black gunpowder should have a perfectly uniform slate color and it should show no difference in color when crushed. If it is bluish or quite black it contains too much charcoal or is too damp, while the presence of bright points or bluish-white spots indicates that the saltpeter has effloresced. If the powder soils the hand or a sheet of paper when run over them it contains too much moisture or else meal powder. On pressing the powder in the hand it should not crackle or be easily crushed and when crushed the grains should not fall at once to dust, but should first split into angular fragments. Three different densities are determined for gunpowder, each of which furnishes valuable information. These are the gravimetric density which is the weight of a unit volume of powder grains including the air between and enclosed in them; the relative density, which is the weight of a unit volume of powder grains excluding the air between them but including that contained in the pores of the grains; and the absolute specific gravity, which is the weight of the powder exclusive of all air.

Since smokeless gunpowder has been perfected and adopted for use in guns of all calibres it has been declared that it would supersede black gunpowder altogether; yet the census of the United States for 1900 shows that there were over 25,000,000 pounds of black gunpowder made in this country in that year and the production bids fair to be large for many years to come, because in ordnance it is necessary to use a priming charge of black gunpowder with which to fire the smokeless gunpowder; because smokeless powder cannot be efficiently substituted for black gunpowder in the older forms of small arms that are widely scattered over the country; because black powder is most suitable for use in fuses and in pyrotechny; and because smokeless powder is too expensive and inferior for use in saluting.

Gunpowder was formerly used in blasting as well as for a propellent, but usually a special mixture containing as little as 60 per cent of saltpeter was prepared for this purpose. In 1857 Lamotte Dupont of Wilmington, Del., invented *blasting powder* which differs from gunpowder chiefly in that Chile saltpeter is used in place of India saltpeter. Though cruder materials are used and less care is taken the methods pursued for its manufacture are in general similar to those used for gunpowder.

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Gunpowder Plot, a famous conspiracy formed in England in 1604 by Robert Catesby, and a small band of other Roman Catholics, who, goaded into excitement by the penal laws directed against their faith and its professors, aimed to blow up the Houses of Parliament by gunpowder 5 Nov. 1605. An anonymous letter of warning, sent to Lord Monteagle, led to the discovery of the plot, and the various conspirators were arrested and executed. Among those put to death was Guy Fawkes, who had been caught in the vault below the House of Lords with matches ready to fire the train. Since 1605 all places connected with the Houses of Lords and Commons where explosives could be stowed away are annually searched at the opening of Parliament.

Gunsaulus, gŭn-sâ'lŭs, **Frank Wakeley**, American clergyman and educator: b. Chesterville, Ohio, 1 Jan. 1856. He was graduated at the Ohio Wesleyan University in 1875, was ordained to the Methodist ministry, but became a Congregationalist. He was pastor of Congregational Churches at Columbus, Ohio (1879–81), Newtonville, Mass. (1881–5), and Baltimore, Md. (1885–7). In 1887 he became pastor of Plymouth Church, Chicago, and from 1899 of the Central Church of that city. For some years he was also president of the Armour Institute of Technology, Chicago, resigning in 1901. He is well known as a platform lecturer, and has published: 'Monk and Knight' (1891); 'Phidias' (1893); 'Gladstone' (1898); 'The Man of Galilee' (1899), and other works.

Gunshot Wounds are wounds caused by missiles projected from firearms by the explosion of gunpowder, etc. Such wounds present great diversity of form, depending on the kind of missile. All show more or less contusion and laceration of the tissue, particularly beneath the surface. Of the two wounds usually caused, that of entrance and that of exit of the missile, the latter is usually the larger. Deflection of the missile from the straight line by hard tissue is common. Thus a ball striking the front of the chest may pass around the ribs, emerging at the back. Infection of the bullet itself, particularly when driven at high speed, is not common; and as the presence of a bullet in the body is not of itself dangerous, the error of much probing along the track is evident. A bullet readily located (the X-rays are now largely used for this purpose) is ordinarily extracted, and where signs of infection become evident the conversion of the punctured wound into a free large open wound is necessary.

Gun'ter, Archibald Clavering, American author: b. Liverpool, England, 25 Oct. 1847; d. New York, 23 Feb. 1907. He was a mining and civil engineer in the West from 1867 until 1875, when he became a stock broker at San Francisco. From 1878 he devoted himself to writing plays and novels. The best known of the former are: 'Courage'; 'Prince Karl'; and 'The Deacon's Daughter.' His works of fiction, sensational volumes, largely without literary merit, include: 'Mr. Barnes of New York' (1887); and 'Mr. Potter of Texas' (1888); both successfully dramatized; 'That Frenchman' (1889); 'Miss Nobody of Nowhere' (1890); 'Baron Montez of Panama and Paris' (1893); and 'Adrienne de Portalis' (1900).

Günther, gün'tĕr, **Siegmund**, German geographer and mathematician: b. Nuremberg 6 Feb. 1848. Educated at several German universities he became professor of geography in the School of Technology at Munich, in 1886. Among his many valuable professional works may be named 'Lehrbuch der Determinatentheorie' (1875); 'Parabolische Logarithmen und parabolische Trigonometrie' (1882); 'Die Meteorologie ihrem neuesten Standpunkt gemass dargestellt' (1889); 'Lehrbuch der physikalischen Geographie' (1891).

Gun'ton, George, American economist: b. Cambridgeshire, Eng., 8 Sept. 1845. He came to the United States in 1874, and until 1880 was a writer on economic subjects. He then turned his attention to sociological and economic work, and in 1890 became president of the Institute of Social Economics and editor of the 'Social Economist,' which in 1896 became 'Gunton's Magazine.' His publications include 'Wealth and Progress' (1887); 'Principles of Social Economics' (1891); 'Trusts and the Public' (1899).

Guntown, Battle of. After Gen. Forrest's capture of Fort Pillow, 12 April 1864, Gen. Sturgis was ordered to march from Memphis to intercept him, but before the expedition got fairly under way it was ascertained that Forrest had fallen back to northern Mississippi. On 1 June Sturgis started from White's Station, near Memphis, with about 5,500 infantry and artillery, under Col. McMillan, and 3,400 cavalry, under Gen. Grierson, to defeat Forrest and prevent his interference with Sherman's advance on Atlanta. Moving southward, Sturgis reached Ripley, 80 miles from Memphis, on the 8th, and on the 10th struck the Mobile & Ohio Railroad near Guntown, Miss., where Grierson, in advance with the cavalry, met Forrest's cavalry near Brice's Cross-roads, and became immediately engaged. Sturgis, who was six miles in rear with the infantry, moved on the double-quick, followed by a train of 250 wagons and, coming to where Grierson was engaged, without giving his exhausted men a moment's rest, and badly handling them, threw them into the fight. In three hours' time Forrest routed him, drove him from the field in confusion, captured prisoners, guns, and wagons, and closely pursued him to near Ripley. There, early in the morning of the 11th, his rear-guard, taking advantage of a small stream, after a sharp fight checked Forrest, and Sturgis continued his retreat to Memphis, having lost 23 officers and 594 men killed and wounded, 1,623 prisoners, 14 guns, and his entire train of 250 wagons, with 10 days' rations and a large supply of ammunition. Forrest's engaging force did not exceed 4,000 men; his loss was 492 killed and wounded. Consult: 'Official Records' Vol. XXXIX.

E. A. Carman.

Gur'don, Lady Eveline Camilla Wallop, English writer d. 1894. She was the second daughter of the fifth Earl of Portsmouth, and was married to Sir William Gurdon in 1888. Her contributions to periodicals were collected after her death in a volume entitled 'Suffolk Tales' (1896), in certain respects one of the most noteworthy English collections of short stories, both as regards style and sympathetic treatment.

Gurhwal, gŭr-wăl', India. See Garhwal.

Gurjun (gĕr'jŭn) **Balsam, or Wood Oil,** the juice or liquid of the *Dipteraceæ* which grow in the Andaman Islands. It resembles copaiba balsam, and has at various times been sold as such. Its chief use in the East is as a varnish for boats and for preventing the attacks of ants on timber. It was used for the checking and alleviating of leprosy by the late Father Damien among the lepers of Molokai, in Hawaii.

Gurkhas, goor'kaz. See Ghurkas.

Gurko, goor'kō, **Ossip Vladimirovitch,** Russian soldier: b. 15 Nov. 1828; d. 28 Jan. 1901. He took part as captain in the Crimean war and as lieutenant-general commanded the Russian advance-corps which at the beginning of the war with Turkey crossed the Danube and seized Tirnova (July 1877). In the same year he captured Gorny Dubnik and Telish, and on 15–17 Jan. 1878 defeated Suleiman Pasha at Philippopolis. He was governor-general of St. Petersburg in 1879–80, of Poland in 1883–94, and in 1894 was retired with field-marshal's rank. He was among the foremost Russian generals of recent times.

Gurnards, gĕr'nardz, a family of teleost fishes (*Triglidæ*) occurring in all warmer seas, resembling somewhat the sculpins in the rough spiny bones of the skull, but differing in having the body regularly scaled or covered with bony plates. The fantastic sea-robins (*Prionotus*) are common representatives on our coasts. Closely allied are the flying-gurnards (family *Cephalacanthidæ*) of the warmer seas, in which the pectoral fins are very long, enabling the fish to flutter a short distance in the air.

Gurney, gĕr'nĭ, Sir **Goldsworthy**, English inventor: b. Cornwall, England, 1793; d. 1875. He built a steam carriage in 1827, and was the first to devise and use the high-pressure steam-jet in locomotion. He invented the oxyhydrogen blow-pipe, and the Drummond light.

Gurney, Joseph John, English Quaker philanthropist: b. Earlham Hall, near Norwich, England, 2 Aug. 1788; d. there 4 Jan. 1847. He was a banker in Norwich and in 1818 became a preacher in the Society of Friends, and the same year accompanied his sister, Mrs. Elizabeth Fry (q.v.), on her tour to Scotland, having warmly taken up the benevolent cause to which she had devoted herself — the amelioration of the condition of prisoners. In 1827 the two made a journey to Ireland with the same object, and in 1837 Gurney visited the United States and Canada, where he was absent for nearly three years. He went with Mrs. Fry in 1841 to Holland, Belgium, and Germany, and in 1842–4 visited France and Switzerland. The object of these journeys was to reform prison management, and effect the abolition of slavery in the French colonies, for which purpose he had interviews with Louis Philippe and M. Guizot. He was the author of 'Notes on Prisons and Prison Discipline' (1819); 'Observations on the Religious Peculiarities of the Society of Friends' (1824); 'Essays on the Evidences, Doctrines, and Practical Operation of Christianity' (1827); 'Winter in the West Indies Described in Familiar Letters to Henry Clay of Kentucky' (1840).

Gurowski, goo-rŏf'skē, **Adam de,** Count, a Polish scholar and author: b. Kalisz 10 Sept.

1805; d. Washington, D. C., 4 May 1866. In early life he was a leading Polish patriot, and an instigator of the revolution of 1830. Later he became an advocate of Panslavism, and was employed in Russia. In 1841 he left the latter country and in 1849 came to the United States, and from 1861 to 1863 was a translator in the State Department at Washington. Among his works, several of which were written in French and German, are: 'Civilization and Russia' (1840); 'Panslavism' (1848); 'Russia as It Is' (1854); 'The Turkish Question' (1854); 'America and Europe' (1857); 'My Diary: Notes on the Civil War' (1862–6).

Gur'teen, Stephen Henry Villiers, American Protestant Episcopal clergyman and sociologist: b. near Canterbury, England, 9 June 1840; d. 1898. He was educated at Jesus College, Cambridge, and was ordained in 1875. He was professor of Latin at Hobart College, Geneva, N. Y., was successively rector of Trinity Church, Buffalo, and Trinity Church, Toledo, Ohio, and dean of St. Paul's Cathedral in Springfield, Ill. He interested himself in charity organization, and was instrumental in forming the Order of Associated Charities. He wrote: 'Phases of Charity' (1877): 'Provident Schemes' (1879); 'What is Charity Organization?' (1879); 'Handbook of Charity Organization' (1882); 'How Paupers are Made' (1883); 'Beginnings of Charity Organization in the United States' (1894).

Güssfeldt, Paul, powl güs'fĕlt, German explorer: b. Berlin 14 Oct. 1840. He studied science and mathematics between 1859 and 1865 in Heidelberg, Giessen, and Bonn. The German African Company sent him out on an expedition in 1872 to explore the Loango coast. He was shipwrecked near Freetown (14 Jan. 1873), and landed at the mouth of the Kongo. He has given an account of this expedition in the work 'The Loango Expedition' (1879), which he wrote in collaboration with his fellow travelers Falkenstein and Pechuel-Loesche. In 1876 he explored the Arabian Desert, and in September 1882 he visited South America. Among the Andes he discovered a vast area of glaciers, in lon. 34° 30' S. He climbed the highest peak of the volcanic range of the Andes (21 Feb. 1882) and reached the edge of the crater of Maipó, and during April and May of the same year explored the lofty plateaus of Bolivia. He has published 'In den Hochalpen' (1893); 'Reise in den Anden von Chile und Argentinien' (1887); 'Der Mont Blanc' (1894).

Gustavus (gŭs-tā'vŭs) **I.** (commonly called Gustavus Vasa), king of Sweden: b. Lindholmen 12 May 1496; d. Stockholm 29 Sept. 1560. He studied at the University of Upsala, and entered the service of Sten Sture the younger, administrator of the kingdom, in 1514. Sweden had, by the union of Calmar, become subject with Norway to the crown of Denmark. The country was at this time divided into two parties. There was a Danish party headed by the Archbishop of Upsala, and a Swedish party, which upheld the independence of the country, headed by the administrator whom it had raised to power. Gustavus fought with distinction under Sture against the Danes in 1517 and 1518. He was one of six hostages sent by Sture as guarantee of the safety of King Christian II., but effected his escape, and reached Lübeck in 1519. After wandering about for some time as a proscribed fugitive he took refuge in the mines of Dalecarlia, where he worked as a common laborer. After various adventures he attempted open resistance. Christian II. was crowned at Stockholm on 4 Nov. 1520. On the 8th the leaders of the Swedish party, among whom was Gustavus' father, were executed. By the beginning of 1521 Gustavus had raised a considerable force, driven the Danes from several positions, and excited a general insurrection in Dalecarlia. In April he defeated the Danes at Westeraas; in July he seized Upsala, and in August was named administrator of the kingdom by the states which had assembled at Wadstena. On 6 June 1523 he was elected king by the Diet of Strengnäs. In 1527 he obtained the exclusion of the bishops from the senate, and their subjection to the civil power. He now openly professed Lutheranism, and was crowned by a Protestant archbishop of Upsala on 12 Jan. 1528. The Lutheran religion was formally established at a diet held at Orebro in 1529. In 1544 the states assembled at Westeraas declared the kingdom hereditary in his house. A war broke out with Russia in 1555, which was concluded by the Peace of Moscow, 2 April 1557.

Gustavus II. (Gustavus Adolphus), king of Sweden, grandson of Gustavus Vasa: b. Stockholm 9 Dec. 1594; d. Lützen, Saxony, 16 Nov. 1632. He was trained to war under experienced generals, and at 16 took his place in the state council. Charles IX., the father of Gustavus, had been declared king to the exclusion of his nephew Sigismund, who, on accepting the crown of Poland during his father's lifetime, had abjured the Protestant religion. On the death of Charles, Gustavus succeeded him, with the consent of the states, as king-elect. Sweden was at this time at war with Denmark, and Gustavus was in command of the army. He chose for his chancellor and first councillor Axel Oxenstiern, a man 10 years his senior, and already eminent for his ability, who eventually proved himself to be one of the greatest of European statesmen. The war with Denmark was concluded through the mediation of England in 1613. A new enterprise at this time presented itself to the ambition of Gustavus — the throne of Russia was vacant and contested. A party favored the election of Charles Philip, the brother of Gustavus, and was supported by a Swedish invasion under Gen. de la Gardie, who had penetrated to Novgorod; while the Poles, who had also invaded Russia, had reached Moscow. Michael Romanoff was, however, elected czar. Gustavus took a personal share in the Russian war, which continued for about four years after this election, and had made considerable conquests in Livonia and the neighboring provinces when peace was concluded at Stolbova in 1617. In 1620 he married Eleanora, sister of the elector of Brandenburg. The war with Russia was followed by war with Poland, which lasted nine years, and was concluded on advantageous terms for Gustavus by a six years' truce in September 1629. He had made important conquests, which he was allowed to retain, in East Prussia.

His attention was now diverted from northern wars by the affairs of Germany. The oppression of the Protestants by Ferdinand II.

excited his sympathy. He was alarmed by the progress of Wallenstein, which threatened to extend the empire to the Baltic, and by leaguing himself with the Protestants of Germany he might hope for easier and more extensive conquests than by struggling single-handed against the northern powers. He named his daughter Christina heiress to the throne, embarked for Germany in May 1630, and landed with an army of 13,000 men in the island of Usedom on the coast of Pomerania. (See THIRTY YEARS' WAR.) After repeatedly defeating the imperial generals, and conquering a great part of Germany, he was killed in the battle of Lützen. Gustavus differed from some other great commanders in preferring a small well-ordered army to a large one, asserting that all over 40,000 men were an encumbrance. His character made him beloved by his soldiers, and he was served with a devotion which enabled him to effect great things with small means. The discipline he imparted to the Swedish army, and the prestige of success derived from his victories, lasted long after his death. His body was taken to Sweden. See Droysen, 'Gustav Adolf' (1879); Stevens, 'History of Gustavus Adolphus' (1885); Fletcher, 'Gustavus Adolphus' (1891); Dodge, 'Gustavus Adolphus' (1890).

Gustavus III., king of Sweden: b. Stockholm 24 Jan. 1746; d. there 29 March 1792. He was the eldest son of Adolphus Frederick, duke of Holstein, who had been called to the Swedish crown in 1743, and succeeded his father on 12 Feb. 1771. He found the country divided between two aristocratic factions, the adherents of France and Russia, known respectively as the Hats and Caps. He resolved to give the country a new constitution, and to increase the power of the crown. He instituted a new military order of Vasa, in order to gain the goodwill of the officers; and effected his purpose by means of a sham revolt, which enabled him to assemble troops, wherewith he surrounded the assembly of the states-general, and forced them to accept his constitution, which, as it only circumscribed the privileges of the nobility, was generally popular. In 1788, when war had broken out with Russia, the nobles revenged themselves by inducing the states-general to refuse himself supplies. The fidelity of the Dalecarlians enabled him to repulse the enemy. To free himself from the hostility of the nobles he determined on another coup d'état, which he executed on 3 April 1789, by causing the leaders of the opposition to be arrested, and then passing a law extending the royal prerogative. He concluded peace with Russia by the Treaty of Varela in August 1790. The Swedes were opposed to an alliance with Russia, and a diet which Gustavus assembled at Gefle for the purpose of procuring supplies, though surrounded with troops, proved so refractory that he was obliged to dismiss it. The nobles long before this had formed a conspiracy against him, and resolved on his death. Three of them took an oath to murder him, and drew lots which should carry out their intention. The lot fell on Captain Ankarström, who shot the king in the back at a masquerade given at the opera house at Stockholm, 16 March 1792. See Bain, 'Gustavus III. and his Contemporaries' (1895).

Gustavus IV., Adolphus, king of Sweden: b. 1 Nov. 1778; d. Saint Gall, Switzerland, 7 Feb. 1837. He succeeded on the death of his father, Gustavus III., and, on assuming power, showed that he had inherited his father's hatred of the principles of the French revolution, which he carried to the extent of fanaticism. In 1803 he made a journey to Germany to promote a union of the German princes against Napoleon. He was at Karlsruhe when the Duke D'Enghien was seized, and sent his aide-de-camp to Paris to protest against that act of violence. After the Peace of Tilsit he exposed himself to a war with Russia while he was at war with France, by refusing to join the continental blockade and opening his ports to England; and in 1808 he quarreled with England, his only ally. His internal policy was as bad as his external. His subjects were oppressed with taxes to support his wars, and had in return the humiliation of finding Pomerania in the possession of France, and Finland in that of Russia. A conspiracy was formed against him; he was deposed, and the diet by a decree of 10 May 1809 declared his family forever incapable of succeeding to the crown of Sweden. His uncle, the duke of Sudermania, was proclaimed king, under the title of Charles XIII., and in the following year adopted as his successor, Bernadotte, prince of Ponte Corvo. Gustavus died in poverty. He took the title of Colonel Gustafson, and has left, among other writings, 'Memoirs of Colonel Gustafson' (1823). See Kleinschmidt, 'Die Irrfahrten Gustavus IV. Adolf von Schweden' (1888).

Gutenberg, goo'tĕn-bĕrg, **Johannes or Henne**, German inventor of printing with movable types: b. Mainz about 1400; d. there 23 Feb. 1468. Little or nothing is known of his early life. In 1434 he was living in Strasburg, and in 1439 entered into a contract with one Andreas Dryzehn or Dritzehn and others, binding himself to teach them all his secret and wonderful arts, and to employ them for their common advantage. The death of Dryzehn, which happened about the end of 1438, broke off the undertaking of the company. About 1448 he returned to Mainz, and soon formed a copartnership with Johann Fust or Faust, a rich goldsmith who furnished money to establish a press, in which the Latin Bible was first printed. This, the Mazarin Bible, begun about 1450 and finished about 1455, is the first book known to have been printed with movable types. After some years this connection was dissolved. Fust had made large advances, which Gutenberg was now called upon to repay; and as he either could not or would not do it, the subject was carried before the tribunals. The result was that Fust retained the press, which he improved, and continued to use in company with Peter Schöffer of Gernsheim. By the patronage of a counsellor of Mainz, Conrad Hummer, Gutenberg was again enabled to establish a press the following year, from which there issued the fine 'Catholicon' of 1460, and also the 'Letters of Indulgence' of 1454 and 1455. Gutenberg's name does not appear in any production of his press, nor do any of his friends and patrons mention him in connection with the invention of printing. See Van der Linde, 'Gutenberg' (1878), and 'Geschichte der Erfindung der Buchdruckerkunst' (1886); Hessels, 'Gutenberg: Was He the Inventor of Printing?' (1882); 'Haarlem the Birthplace of

Printing, not Mentz' (1887); Gordon Duff, 'Early Printed Books' (1893).

Guthrie, Thomas, Scottish clergyman and philanthropist: b. Brechin, Forfarshire, 12 July 1803; d. Saint Leonard's, Sussex, 24 Feb. 1873. He was educated at the University of Edinburgh, and was licensed as a preacher in connection with the Church of Scotland in 1825. He accepted a call to Greyfriars, Edinburgh, in 1837, where he soon became very popular with all classes. In 1843 the Disruption took place, and Guthrie was active with Chalmers and Candlish in organizing the Free Church, becoming minister of Free St. John's, Edinburgh. The work with which his name is chiefly identified out of Scotland, was the establishment of ragged schools, of which he was the earliest advocate. He was widely known for his gifts as an orator, and on retiring from the ministry in 1864 was editor of 'The Sunday Magazine' till his death. Among his published works are: 'The Gospel in Ezekiel' (1855); 'A Plea for Ragged Schools' (1847); 'The City: its Sins and Sorrows' (1857); 'Autobiography' (1874-5). See Smeaton 'Thomas Guthrie' (1900).

Guthrie, Thomas Anstey ("F. Anstey"), English humorist: b. Kensington, London, 8 Aug. 1856. He was graduated from Cambridge in 1875, and called to the bar in 1880, but never practised and has devoted himself to authorship, his books having been extremely popular both at home and in the United States. He is the author of 'Vice Versa' (1882); 'The Giant's Robe' (1883); 'The Black Poodle' (1884); 'The Tinted Venus' (1885); 'A Fallen Idol' (1886); 'The Pariah' (1889); 'Tourmalin's Time Cheques' (1890); 'Voces Populi' (1890); 'Mr. Punch's Pocket Ibsen' (1893); 'Puppets at Large' (1897); 'Love Among the Lions' (1898); 'The Brass Bottle' (1900); 'A Bayard From Bengal' (1902); etc.

Guthrie, William Norman, American Episcopal clergyman and author: b. Dundee, Scotland, 4 March 1868. He was graduated from the University of the South in 1889 and was professor of modern languages there 1889-90, and at Kenyon College, Ohio, 1892-3. He entered the Episcopal ministry in 1893, and has since been rector of several Cincinnati churches. He has published: 'Love Conquereth' (1890); 'Modern Poet Prophets: Essays Critical and Interpretative' (1897); 'Songs of American Destiny' (1900).

Guthrie, Okla., the capital of the Territory of Oklahoma and the county-seat of Logan County, on the Cottonwood River and on the Atchison, Topeka & Santa Fe, the Chicago, Rock Island & Pacific, the Oklahoma Eastern, the Missouri, Kansas and Texas, the Fort Smith & Western, Denver, Enid & Gulf, and the St. Louis, El Reno & Southern Rys.

Industries, Etc.— Guthrie has a very large trade, and is especially noted as a wholesale distributing centre. It has planing, flour and cotton-seed oil mills, furniture and carriage factories, a foundry and machine shops, a broom works, a plow factory, creamery, railroad repair shops, novelty works, book bindery, etc.

Buildings, Educational Institutions, Etc.— Guthrie's chief buildings are the capital, Federal court and post-office building, the city hall, the Scottish Rite temple, Carnegie Library, and the Federal prison. The Carnegie Library (costing $25,000) is a noteworthy institution. The city possesses an excellent public school system, including a high school, Saint Joseph's Academy, and many private schools add to the city's educational facilities. A $50,000 county high school has just been built, and the Capitol University is located on a height overlooking the city on the west.

Government.— The city is governed by a mayor and a council of ten members elected biennially. The chief of police and all other city officers are chosen by the people. The city has electric lighting and owns and operates its own water-works, has several miles of paved streets, large gas plant and work has begun on a street railway.

History.— Guthrie dates its existence from the opening of the territory in 1889, and it was made the capital city one year later, in 1890. The city has had a rapid development and has had a rival in Oklahoma City, about 30 miles south. Pop. (Federal census of 1900) 10,006; (territorial census of 1904) 23,000.

Gut'ta Per'cha, a substance which has been known generally and used in Western countries only since about 1845, though travelers and residents in the East were acquainted with it long before, and had seen various articles made of it, but without knowing the nature of the material. It is the inspissated milky juice of several large trees belonging to the order *Sapotaceæ*, the principal being *Isonandra gutta*, and is obtained by felling the large and old trees, cutting off rings of bark at intervals along the stem, collecting the juice which issues, and concentrating by evaporation, if necessary. The result of this terribly wasteful process is, that the gutta percha tree has been exterminated from various districts in which it was formerly abundant. The tree is found in the Malayan peninsula, and in some of the neighboring islands, in great numbers and of very large size; but if these trees be also cut down, instead of the juice being tapped by incisions (a method which has now come into use), gutta percha will become one of the rarest of substances.

The crude substance is gray or reddish, and is mixed with fragments of bark, leaves, and other impurities, from which it is separated by washing with cold and then with warm water. This softens the gutta percha, and the impurities can be easily picked out. When pure it has a brown color; at the ordinary temperature it is hard and tough, and in not too thick pieces is flexible like leather. It is elastic only to a very slight extent, and cannot be beaten out. It has little or no adhesion for other bodies, but its own cohesiveness is remarkable, a thin strip of it bearing a very considerable weight. When warmed it gradually softens, and then can be drawn into fine fibres, rolled into sheets, or molded. For the latter purpose it is admirably adapted, as when warm and soft it takes the finest impressions, which it retains after it has become cold and hard. When heated to a sufficiently high temperature in the air it catches fire, and burns with a bright flame; heated in close vessels it gives off oily hydrocarbons and an acid liquor, so that gutta percha seems to consist mainly of carbon and hydrogen, with some oxygen, while nitrogen is absent, or present only in very minute quantities. Attempts have been made to resolve gutta percha into proximate constituents, and accordingly three substances extracted from it have been described. These are named respectively gutta, which is the chief constituent, and when pure is white and opaque; alban, a white oxygenated crystalline substance; and fluavil, also oxygenated, and of a yellow color. These two are said to be formed from the first by oxidation, but there is a considerable diversity of opinion on the nature of these bodies. Ordinary gutta percha is insoluble in water, partially in alcohol and ether, readily and completely in chloroform, turpentine, benzol, bisulphide of carbon, and naphtha. It is also dissolved to a slight extent by oils. It is not attacked by solutions of alkalies, nor by hydrofluoric acid; but it is acted on by sulphuric, nitric, and hydrochloric acids — being darkened in color, oxidized, rendered brittle, or altogether disintegrated — and by chlorine, which transforms it into a white substance like ivory. It is also affected by the oxygen of the air, especially in light, becoming brittle, resinous, and acid; it combines with sulphur and, like caoutchouc, can be vulcanized. Gutta percha is employed for a great variety of purposes, especially for insulating electric wires, being invaluable for submarine telegraph cables because, as a natural insulator of electricity, it is not affected by water, is very pliant, and forms a uniform and close-fitting coating to the wires. It is much prized for making certain kinds of surgical instruments, and in sheets for surgical dressing, and is used for making water-pipes and tubes of various kinds, hose, machine-belting, soles for shoes, golf-balls, overshoes, buckets, picture-frames, and many other articles in general use.

Guy, Thomas, English philanthropist: founder of Guy's Hospital, London: b. about 1645; d. December 1724. His principal income arose from the disreputable purchase of seamen's prize tickets in Queen Anne's war, and from his dealings in South Sea stock in 1720. By these speculations, aided by most penurious habits, he amassed a fortune of nearly half a million pounds sterling, of which he spent upward of $1,000,000 in building and endowing his hospital in Southwark. He also erected almshouses at Tamworth, furnished three wards of St. Thomas' Hospital, and benefited Christ's Hospital and various other charities. He was member of Parliament for Tamworth 1694–1707.

Guy Mannering, a novel by Sir Walter Scott. It was the second of his novels, appearing anonymously in 1815, seven months after 'Waverley.' It is said to have been the result of six weeks' work, and by some critics is thought to show the marks of haste. Its time is the middle of the 18th century, its scene chiefly Scotland. There are fewer than two-score characters in 'Guy Mannering,' and the plot is not very complicated. Meg Merrilies, and Dominie Sampson, the uncouth, honest pedant, are the only great creations it contains.

Guy of Warwick, a metrical romance belonging to that Anglo-Danish cycle from which the Norman trouvères drew so much material. The earliest existing manuscripts of this romance are in French; though it is supposed to have been written by Walter of Exeter, a Cornish Franciscan. It consists of about 12,000 verses, iambic measure, arranged in rhymed couplets.

Guyon, Jeanne-Marie Bouvier de la Motte, zhän mä-rē boo-vē-ā dē la mōt gē-ōn, Madame, French mystic: the introducer in France of the system of Quietism, b. Montargis 13 April 1648; d. Blois 9 June 1717. At the age of 16 she was married to Jacques Guyon, after whose death in 1676 the tendency to mystic enthusiasm which had characterized her younger years again acquired ascendency. She published numerous works, such as 'Le Cantique des Cantiques interprété selon le Sens Mystique' (1685); 'Poésies Spirituelles' (1685); 'Discours Chrétiens et Spirituels' (1716); etc. At last the archbishop of Paris thought it necessary to take steps against the spread of Madame Guyon's mystical doctrines, and through his influence she was shut up in the convent of the Visitation, but afterward released at the instigation of Madame Maintenon, who herself became for a time a convert to the new doctrines, and allowed Madame Guyon to preach in the seminary of St. Cyr, where she made a convert and disciple of Fenelon. A commission of ecclesiastics, chief among whom was Bossuet, now sat in judgment, and the doctrines of Madame Guyon were condemned (1695). This led to her being imprisoned for some years, latterly in the Bastille, whence she was liberated in 1702. The rest of her life was spent in retirement and in works of charity. See Upham, 'Life, Religious Opinions, and Experiences of Madame Guyon' (1870); Guerrier, 'Madame Guyon, sa vie, sa doctrine, son influence' (1881).

Guyot, gē-ō, **Arnold**, American geographer: b. near Neuchâtel, Switzerland, 28 Sept. 1807; d. Princeton, N. J., 8 Feb. 1884. He studied theology at Neuchâtel and Berlin; but later turned his attention to natural science, and in 1835 took the degree of doctor in the University of Berlin. He then went to Paris, where he resided five years, passing the summers in scientific excursions through France, Belgium, Holland, and Italy, examining the characteristic physical features of those countries. In a tour of Switzerland, in 1838, he ascertained and announced in a communication to the Geological Society of France several of the most important laws concerning glaciers. He first discovered the laminated structure of the ice, and showed that the motion of the glacier is due to the displacement of its molecules. These discoveries were fully confirmed and illustrated by the investigations of Agassiz, Forbes, and others. He next investigated the distribution of erratic boulders, in order to solve the question of the mode of their transportation. During seven summers he traced them on both sides of the central Alps, in Switzerland and Italy. Their vertical limits and the laws of their descent were determined by means of more than 3,000 barometrical observations; and the characteristic species of rock of each basin were tracked step by step to their source, often in the midst of the highest regions of ice and snow. A collection of more than 6,000 specimens of rocks was made as vouchers for the results. The full details of these investigations were announced to form the second volume of the 'Système glaciaire' by Agassiz, Guyot, and Desor, the first volume of which was printed in

Paris in 1848; but the political disturbances of that epoch and the removal of Guyot to the United States prevented its publication. The main results, however, are to be found in the 'Bulletin de la Société des Sciences Naturelles de Neuchâtel,' and in D'Archiac's 'Histoire de la Géologie'; and have since passed into various scientific manuals. In the College of Neuchâtel, which numbered Agassiz among its professors, Guyot occupied, from 1839 to 1848, the chair of history and physical geography. In the latter year a political revolution in Neuchâtel broke up the institution, and he was induced by Agassiz to remove to the United States. He resided for several years at Cambridge, Mass., occupying himself with the study of the physical geography of the American continent, and first became extensively known in this country by a course of lectures delivered in Boston in the winter of 1848–9 in the French language, on the relations between physical geography and history. These were translated and afterward collected into a volume entitled 'Earth and Man' (1849). The work had a large circulation in the United States, where it was extensively used as a text-book. For several years Guyot was employed by the Massachusetts board of education to deliver lectures in the normal schools of the State and before teachers' institutes, and in this way, addressing annually 1,200 or 1,500 teachers, he exercised an important influence in reforming the method of teaching geography. From 1855 until his death he was professor of geology and physical geography at Princeton. His meteorological observations, undertaken for the government, were the basis of the present United States weather bureau. Among his further works are 'Treatise on Physical Geography' (1873); 'A Memoir of Agassiz' (1883); and 'Creation, or the Bible Cosmogony in the Light of Modern Science' (1884).

Guyot, Yves, ēv, French publicist: b. Dinan, France, 6 Sept. 1848. He began his studies at Rennes, and early interested himself in social and economic problems of international importance. He took part in the revolution of 4 Sept. 1870, which, after the surrender of Sedan, established the third Republic. He is an ardent reformer, but not a socialist, a free-trader and member of the Cobden Club. In 1885 he was elected to the French Parliament, and in 1889 made minister of public works. He has for years been editor of the *Siècle*, a Liberal paper of a staid, old-fashioned style. He took a prominent part in the defense of Dreyfus, and waged a successful war for the abolition of the continental sugar bounties. Among his writings may be noted 'La Tyrannie Socialiste' (1893); 'Les Principes de '89 et le Socialisme' (1894); 'L'Economie de l'Effort' (1896); 'Le Bilan de l'Eglise' (1901); and 'La Question des Sucres' (1901).

Guzerat, gŭz-ĕ-rät'. See GUJARAT.

Guzman Blanco, Antonio. See BLANCO, ANTONIO GUZMAN.

Gwin'nett, Button, American patriot, one of the signers of the Declaration of Independence: b. England about 1732; d. Georgia 27 May 1777. He emigrated from Bristol to America in 1770, purchased a tract of land on St. Catharine's island, Georgia, and devoted himself to agriculture. He became conspicuous in 1775 by his maintenance of the colonial rights, was elected a representative to Congress in Feb. 1776, and re-elected for the following year, and in 1777 became president of the provincial council, the highest station in Georgia. He planned a military expedition against East Florida, which he refused to entrust to his rival Gen. McIntosh, whose official rank entitled him to command it, and which resulted disastrously. This event, aggravated by other disturbances, led to a duel between him and McIntosh, in which he was mortally wounded. See Dwight, 'Lives of the Signers' (1895).

Gwynn, Eleanor, commonly Nell Gwynn, English actress: b. Hereford, England, 1650; d. London 1687. She was at first an orange girl, and also gained her bread by singing from tavern to tavern. She became the mistress of Hart and Lacy, the actors, before going in her 16th year upon the stage, where she distinguished herself in light comedy. About 1667 she became the mistress of Lord Buckhurst, who surrendered her to the king. She caused much embarrassment to the Duchess of Portsmouth, who deemed herself too refined for such a rival. It is said that in her elevation she showed her gratitude to Dryden, who had patronized her in her poverty; and, unlike the other mistresses, was faithful to her royal lover. From her are sprung the dukes of St. Albans.

Gymkhana, jĭm-kä'na, a term of Hindu origin, presumably derived from *gend-khana*, that is, ball-house, and associated by Anglo-Indian soldiers and civilians with "gym" or gymnasium, whence its introduction into the English language. It is applied to a building or grounds arranged for athletic recreation, and signifies also the open air meetings for athletic and other mixed sporting events, including horse racing, which are the annual features of almost every military cantonment throughout India.

Gymnastics, History of. The development of gymnastics began in an early period of Grecian and Roman history. Systematic exercise received the stamp of approbation from the most eminent educators of ancient times, and has the endorsement of all teachers to-day. Such exercise has had its periods of decline in popularity, due to the development of professionalism, stimulated by the conferring of extravagant honors and rewards which caused the ranks of the athletes to be filled by a professional class of low extraction, who made their art a trade. But through these periods of decline there have been those who have kept in mind the true value and aim of regularly and systematically conducted exercise; and these advocates have outlived and lived down these evils. So that we find that the scientifically conducted gymnastics have never entirely lost their hold upon educators and those interested in the betterment of mankind.

Modern gymnastics differ considerably from the exercises of the ancients, which at first consisted of athletic feats performed by each individual according to his own notion, and were encouraged among the youth as combining amusement with exercise. They were at length reduced to a system which, in Greece, formed a prominent feature in the state regulations for education. In fact the period for gymnastics was equal to the time spent on art and music combined. Public games were consecrated to the gods, and were conducted with the greatest ceremony. The earliest mention we can find of gymnastic sports is in Homer's 'Iliad,' Book II., and again in Book XXIII., when Achilles instituted games in honor of Patroclus, and distributed prizes to the victors for boxing and wrestling. Plato tells us that just before the time of Hippocrates gymnastics were made a part of medical study, because they were suited to counteract the effects of indolence and luxurious feeding, and that at length they became a state matter reduced to a system and superintended by state officers. The first public gymnasia were built by the Lacedæmonians. These were imitated at Athens, where, in one called the Academy, Plato instructed his pupils, and in another, the Lyceum, Aristotle taught. These buildings were superintended by a chief officer. The athletics were in charge of a director, and medical officers were in attendance to prescribe the kind and extent of exercise. Baths were attached to the gymnasia, and a hot bath, followed by a cold plunge, was recommended. Plato and Aristotle considered that no republic could be deemed perfect in which gymnasia, as part of the national establishment, were neglected.

The Spartans were the most rigid in exacting for their youth a gymnastic training; even the girls were expected to be good gymnasts. The exercises for pupils in the gymnasia consisted of a sort of tumbling, war-dances, running — for both sexes — leaping, climbing ropes; of jumping or springing from the knees, with weights attached to the body, maintaining the equilibrium while jumping on slippery skins filled with wine; and of wrestling for the throw. Riding, driving, swimming, rowing, and swinging supplemented the indoor work.

During the Middle Ages the knightly amusement of the tournament absorbed nearly every other sport except foot-racing and wrestling, so that gymnastics fell into disuse till Basedow (q.v.) in 1776, at his institution in Dessau, united bodily exercises with other instruction. This example was followed by Salzmann at his institute and, from this small commencement, the practice gradually extended. In the latter part of the 17th century gymnastics were extensively introduced into Prussian schools by Guts Muths, who wrote several works on the subject. In 1810 the system was still more widely spread by Jahn, who is regarded as the founder of the present Turnverein (q.v.). Prussia at that time was impatient under Napoleonic rule, and Jahn conceived the idea of bringing together the young men for the practice of gymnastic exercises, and, at the same time, indoctrinating them with patriotic sentiments which might be made available to expel the French from Germany. The Prussian government favored the plan, and, in 1811, a public gymnastic school, or Turnplatz, was opened at Berlin, and was quickly imitated all over the country. In 1813 the citizens were called to arms against the French, and Jahn himself commanded a battalion of Lutzow's volunteers. When, however, there was no longer any reason to dread the French, the government of Prussia, regarding the meeting of patriotic young men as a means of spreading liberal ideas, closed the gymnastic schools and Jahn was imprisoned. In other countries, however, the system introduced by Jahn was eminently successful, especially in England, Switzerland, Portugal, and Denmark. It was first introduced into female education under the name of calisthenics when systematic exercises were added to hoop-trundling, skipping-ropes, etc., and to riding, archery, and other healthy outdoor exercises practised among the women.

The masculine sports of cricket, football, quoits, boxing, wrestling, leaping, foot-racing, etc., have been for centuries enjoyed by the boys of England in the playgrounds attached to the schools. In 1848 the political condition of Europe enabled the Turnvereine to be reorganized and the German emigration to the United States has brought these institutions with it. The first society was formed in New York. The organization, as first established, was confined to the practice of bodily exercises; but soon assumed a higher scope. Libraries were collected, schools established, a newspaper ('Turnzeitung') founded; and various arrangements were made for the diffusion of useful knowledge, and for mental culture as well as physical training. Much credit must be given to Ling for his efforts to develop educational gymnastics. He has many followers, and his publication on 'Educational and Curative Gymnastics' has much merit. Ling has been severely criticised by English writers for his claims to originality. They go so far as to say that he simply used the works of authors of his time and of an earlier period, and took his *holus-bolus* from Dr. Francis Fuller in the 'Medicina Gymnastica.' The first edition was published in 1728, and it ran through eight others. It is also claimed that he borrowed in its entirety without acknowledgment, the work of one John Pough, 'A Physiological, Theoretic, and Practical Treatise on the Utility of the Science of Muscular Exercise for Restoring the Power of the Limbs,' with such materials and German gymnastics as had previously found their way through Denmark and Sweden. Through the exertions of such men as Salzmann, Jahn, and others, together with certain English authorities as, Fuller, Pough, Croft, Chas. Thomas and John Graham it was not difficult to establish a system. In fact Salzmann's gymnastics for youth needs only what Pough supplies to give all that Ling calls his system which is only adapted to beginners. The quality of the Ling exercises is stilted, and there is little scope for variety. The fact is, the system sticks too closely to automatic movements, which undoubtedly produce precise and studied monotony in drill.

Turning now to the Dio Lewis period, we see that it marks an epoch in the introduction of an American system of physical training formed in a small measure upon the Swedish and largely upon the German system. This system incorporated free-arm exercises, the use of dumbbells, clubs, rings, wands, together with what was then called the Pangymnastikon, but which was nothing more or less than a pair of flying rings equipped with a pair of detachable stirrups from which swinging, jumping, and stretching exercises were performed. Dio Lewis' work took up the matter of the school-desk, criticised the faulty position of the ordi-

SWISS GYMNASTS, AT BERN,

nary desk, and the poor school-room ventilation. In 1861 the Normal Institute for Physical Education was incorporated and located in Boston. Its directors included many of the most distinguished educators of New England, and its departments of anatomy, physiology, and hygiene were in charge of able teachers. Dr. Dio Lewis gave the work in gymnastics. The aim of the institute was and is to furnish competent advocates and teachers of physical training.

Next follows the work of Dr. Sargent, with his American system of gymnastics. Dr. Sargent was born in Maine. He was fond of all kinds of outdoor sports and physical exercise, and joined a gymnasium club while attending high school; but as he had to work out of school hours to support his family, he could only attend to his exercising at odd moments as time permitted. On one occasion he broke a piece of apparatus and was expelled from the club. Piqued and aroused, he improvised an apparatus of his own in a barn. Shortly afterward the club gave a display and, after the members had finished, Sargent and a friend came forward and easily surpassed the athletic feats performed by the others. This event is said to have been the direct cause that led Dudley Sargent to become an ardent physical educator. He was graduated from high school in 1867, was invited to become teacher of gymnastics in Bowdoin College in 1869, and entered the college as a freshman in the regular course and conducted the physical work. In an endeavor to arouse the faculty and the public to the necessity for physical training, he was successful to the exent that, in 1871, gymnastics became a part of the regular curriculum, and Mr. Sargent, though a student only 22 years of age, was placed at the head of the department, and filled the position with credit. About this time he brought out his system of chest-weights. In 1872 he accepted a position as director of the Yale College gymnasium, and for three years had charge of both Yale and Bowdoin, spending part time in each place. It was while at Yale that he fully developed the "individual apparatus" for which he is so well known. At the solicitation of friends he went to New York and started a gymnasium on Fifth Avenue, which at once sprang into popularity. In 1879 he accepted the appointment of director of the Hemenway Gymnasium and assistant professor of physical training at Harvard University. This promotion of the department of physical training to a rank equal to the scholastic departments of the university was a great stride forward, and stamped the new system with the mark of public approval. To Dr. Sargent is the credit due for the invention of the chest-weight, the intercostal machine, quarter-circles, leg and finger machine, and other appliances to the number of 30 or more. He also elaborated a system of anthropometric measurements which enable an examiner to ascertain at once the physical condition of a student, and which guided a director in prescribing proper exercises for the development of deficient parts. Dr. Sargent believes in special work for individuals, and will not allow a man or woman to go into the gymnasium and take the drills and work with the apparatus indiscriminately. Health, harmony, and symmetry are the results aimed at.

About the same time, physical training was taken up by and introduced into the Young Men's Christian Association, whose local gymnasia have done much to give the work a moral tone. We owe a great deal to such men as R. J. Roberts of Boston, whose name has been associated with the advancement of physical education since 1875, and whose dumb-bell drill and book of exercises has long been a standard in the association's work. The organization of the physical work under the auspices of the Y. M. C. A.'s has been practically responsible for the systematization of the American system of gymnastics, and for the establishment of a universal nomenclature of gymnastics. Among those who have done most for physical training along educational lines, I would mention Dr. Hartwell of Boston, Dr. Gulick of New York, and Dr. Seaver of Yale.

To-day, practically, all private schools have a well-equipped gymnasium under the direction of a man who has had special training in the application of exercise, the theory and practice of gymnastics, and who is, in many cases, a medical graduate. Systematic progressive courses of work are conducted, which aim to develop and strengthen, to give co-ordination and grace, and to make the individual self-reliant and resourceful. The equipment required to obtain this result is necessarily extensive, consisting of a gymnasium, say 50 x 100 feet, with clear floor space, high-vaulted roof, a fine system of ventilation, and with every variety of apparatus which the ingenuity of the specialists, and the energy and resourcefulness of the manufacturers, can provide. The equipment consists of light apparatus — dumb-bells, Indian clubs, bar-bells, wands; heavy apparatus — German horse, parallel bars (suspended and floor), horizontal bars (high and low), buck, flying rings, traveling rings, horizontal and vertical ladder, climbing ropes, rope ladders, spring-boards beat-boards, floor-mats, wrestling and tumbling mats, Swedish stahl bars, booms, serpentine ladder, and balance-beams; as well as special apparatus — chest-weights, intercostals, quarter-circle, chest-expander, traveling parallels, wrist-machine, long inclined plane, sculling-machine, paddling-machine, leg-machine, neck-machine, bicycle-trainer, and so on through an almost endless variety. No plant is complete without its swimming-tank, varying in size from 15 x 45 up; its shower-baths, needle-baths, tub-baths; and some have steam-rooms and massage-tables. An indoor running track is an almost indispensable adjunct to all well-equipped gymnasia; and there should also be the equipment for indoor athletics during the winter months. Provision for indoor games is also essential — basket-ball, baseball, and ring-hockey. Each school has adjacent athletic grounds with tennis-courts, quarter-mile track, football and baseball fields, and golf course. See Physical Culture.

The college physical departments surpass those of the preparatory schools only in size and extent of equipment. Harvard University probably excels all others in point of variety of equipment for special work. The summer work in the public parks and school playgrounds must also be noted. These out-of-door gymnasia are equipped with extensive apparatus for all outdoor work. Preparatory school work in gymnastics is, by general consent, made to consist of a system of corrective, body-building exercises, made up of free-arm work and light calisthenics in the lower grades, followed by heavier calisthenics, dumb-bells, clubs and wands, light apparatus, intermediate and advanced apparatus, boxing, wrestling, and fencing, interspersed with periods for recreative games, competitions, and contests of skill and strength.

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Gymnophiona, jĭm-nō-fī'ō-na. See CÆCILIANS.

Gymnosperm, jĭm'nō-spėrm, a plant with a naked seed. Among the gymnosperms are the cycads, gingkos, conifers, and *Gnetaceæ*. The last group is represented by a single extraordinary tree or plant of West Africa (*Welwitschia mirabilis*), the stem of which, looking like a huge wood-fungus, may, when mature, be a little over a foot high but several feet across. It bears but two leaves, the cotyledons, which sometimes grow to be 5 or 6 feet long and 2 or 3 feet wide, ultimately splitting into strips. The plant is said to live over 100 years.

Gymnotus, jĭm-nō'tŭs. See ELECTRIC FISHES.

Gynæcology, in medicine and surgery, the science which treats of the physical organization of women and of the diseases peculiar to them.

Gyp, pseudonym of SIBYLLE GABRIELLE MARIE ANTOINETTE DE RIQUETTI DE MIRABEAU, COMTESSE DE MARTEL DE JANVILLE. See MARTEL DE JANVILLE.

Gypsophila, jĭp-sŏf'ĭ-la (BABY'S BREATH). A genus of European and Asiatic annual and perennial herbs of the natural order *Caryophyllaceæ*. They are highly valued and widely planted for their small flowers which, being upon branchy stems, give a pleasing effect to bouquets and a mist-like grace to flower-borders. They are of simplest culture upon somewhat dry soils, especially among rocks and in sunny situations. The perennial species are hardy. Six or more species and a few varieties are cultivated in American gardens and greenhouses.

Gyp'sum, a native hydrated sulphate of calcium, having the formula $CaSO_4 + 2H_2O$; the water of crystallization being the only thing that differentiates it, chemically, from the orthorhombic mineral anhydrite. Gypsum is usually colorless or white. It crystallizes in the monoclinic system, contact twins and penetration twins being very common; and it also occurs in massive forms. The pure crystals have a hardness of from 1.5 to 2.0, and a specific gravity of about 2.32. Gypsum is an exceedingly abundant substance, and is met with in many parts of the earth, and in a variety of forms. When found in the form of clear, transparent crystals, it is known as selenite; when the mineral is finely fibrous, and the fibres are parallel to one another so as to form a mass with a pearly opalescence, the mineral is called satin spar; when it occurs in uniform, fine-grained, translucent masses, it is known as alabaster; and when it occurs in large beds of massive rock, often mixed with clay, calcium carbonate, and other impurities, it constitutes the earthy gypsum, or rock gypsum, of commerce. Gypsum is soluble in from 400 to 500 parts of water at ordinary temperatures, but it dissolves more freely in hydrochloric acid. When heated, it loses part of its water of crystallization, though it retains the power of recombining with water to form a hard, non-crystalline mass, if the temperature to which it is exposed does not exceed 500° F. It is this property of recombining with water, which gives to dehydrated gypsum much of its industrial value. (See PLASTER OF PARIS.) When heated with charcoal, gypsum is converted into calcium sulphide, which dissolves readily in dilute acids, with evolution of sulphuretted hydrogen gas. In this way the sparingly soluble sulphate of calcium may be converted into the soluble chloride or nitrate of calcium. Gypsum, when pulverized, is used as a fertilizer, its efficiency in this respect being apparently due in large measure to the fact that it facilitates the decomposition of rocks containing alkaline silicates.

The production of gypsum in the United States, in 1901, was 1,246,649 short tons, valued at $1,577,493. Texas, Michigan, New York, and Iowa were the principal producing States. The United States ranks second in the world's production of gypsum, France being first, and Canada third.

Gypsy. See GIPSIES.

Gyra'tion, Radius of. The energy required to set a body in rotation in any given manner depends on the arrangement of the mass of matter to be rotated. Thus, a mass made into a ring like a wheel with very light spokes requires the expenditure of more energy in order to set it to rotate once per second on its axis than would be required if the same amount of matter were made into a uniform circular plate of the same radius. The energy required to set any given body in rotation about any given axis depends, in fact, on the "moment of inertia" of the given body about that axis; and the mass of the body being given, the moment of inertia depends on the way in which the mass is disposed about the axis of rotation. The radius of gyration about a given axis is the distance from that axis at which the whole of the matter of the given body might be concentrated without altering the moment of inertia. The moment of inertia and radius of gyration for any given body about any given axis may be calculated mathematically. The two magnitudes are evidently of great importance in the theory of rotating bodies.

Gyroscope, jī'rō-skōp, from the Greek *guros,* a circuit, *skōpéo,* I see. An instrument used in experimental physics for exemplifying the various properties of rotation and the composition of rotations. Its invention is ascribed to Jean Bernard Léon Foucault (1819-1868), whose famous experiments with pendulum and gyroscope proved and measured the diurnal motion of the earth. The application of the gyroscopic principle, however, was made many years previously to Foucault's experiments, and the instrument in some of its forms originated probably in Germany or France, towards the end of the 18th century. A form of the instrument is popular as a toy, in the familiar gyroscopic top. Since 1907 the gyroscopic principle has been adapted to the practical purposes of railroad transportation.

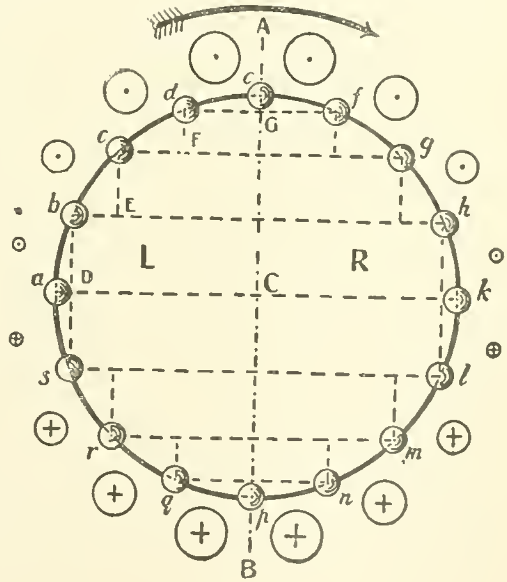
Freely supported on gimbals in a frame or in a box, the gyroscope consists of two interjointed wheels which revolve in opposite directions. As a rotating body will not alter the direction in which its permanent axis points, unless gravity intervenes, the action of gravity is eliminated by the opposing rotation within a rotation, of the central metallic disk, the middle point of whose axis constantly remains the centre of gravity of the machine. Upon this principle is explained the rotation of the earth on its axis, and the gyroscope thus affords a notable illustration of the harmony among physical laws. The gyroscope is so constructed that the axis of rotation can be made to point to some star in the sky. Then, as the heavy disk whirls round, it is found that the axis continues to point to the moving star, though, in consequence of this, apparently altering its direction relatively to bodies on the earth. If, again, the axis be pointed to the celestial pole, which is fixed, no alteration in its position relative to bodies on the earth takes place.

The following lucid and elementary exposition of the principles governing the action of the gyroscope is given by Dr. S. Tolver Preston in an article on 'The Mechanics of the Gyroscope' reproduced from *Technics* in the *Scientific American Supplement* of 8 Oct. 1904:

«According to the Newtonian system of dynamics (a system which is now universally recognized and accepted), the velocity of a particle can only be increased in any given direction by the application of a force acting in that direction; conversely, its velocity in a given direction can only be diminished by the application of a force acting in an opposite direction. The magnitude of the applied force is proportional to the rate of increase or decrease of the velocity of the particle.

Let us suppose that a series of equal heavy particles are arranged around the circumference of the circle in Fig. 1. These particles may be supposed to be rigidly connected one with another, the whole being connected by massless spokes, with an axle passing through *C*, the center of the circle; this axle being at right angles to the plane of the paper. This arrangement constitutes an ideal flywheel, and may be considered typical of an ordinary gyroscope disk.

Let the flywheel be set in rotation in the direction indicated by the arrow. The problem before us is to determine the nature of the forces which must be applied to the rotating flywheel in order to deviate the axis of rotation. Let us suppose that the flywheel, while still rotating about its axle, is constrained in addition to turn about the line *A B*, at right angles to the axle. Looking in the direction *A B*, let the flywheel turn about that line in a clockwise direction, so that the side *L* moves downward through the plane of the paper, while the side *R* moves upward through the same plane. The particles at *e* and *p* being, at the given instant, on the axis of rotation *A B*, will possess no velocity of rotation about that axis. So far as concerns other particles, their velocities of rotation about *A B* will be proportional to their perpendicular distances from that line. Sixteen equidistant particles on the circumference of the circle have been indicated. The rotational velocities of these particles, about



the line *A B*, will be proportional to the respective perpendiculars let fall on *A B*.

In a certain interval of time the disk will complete a revolution about its axle. In one-sixteenth of this interval of time, the particle *a* will move round the circle so as to attain the position previously occupied by the particle *b*. In doing so, the particle *a* will acquire the velocity previously possessed by the particle *b*, i. e., its velocity will be diminished, since *b* is nearer than *a* to the axis *A B*. The diminution of velocity will of course be proportional to *a D*, where *b D* is a line drawn from *b* perpendicular to *C a*. But since the velocity of the particle *a*, in a direction passing vertically downward through the plane of the paper, is diminished as the particle moves from *a* to *b*, this particle must have been acted upon by a force directed vertically upward through the plane of the paper, and proportional to *a D*. This force is indicated by a small circle containing a dot at its center. The dot indicates the pointed end of an arrow supposed to be directed vertically upward through the paper; while the diameter of the small circle is drawn proportional to *a D*, or to the magnitude of the force.

While the particle *a* moved to *b*, the particle *b* moved to *c*. In this time the velocity of the particle *b*, perpendicular to the plane of the paper, must have been diminished by an amount proportional to *b E*. A small circle containing a dot at its center, and of a diameter proportional to *b E*, indicates the magnitude and direction of the force which must have been applied to the particle as it moved from *b* to *c*.

The force which acted on the particle *c* as it moved to *d*, and that which acted on the particle *d* as it moved to *e*, are represented in a similar manner.

Owing to the rotation about the line *A B*, all particles on the right-hand side of the disk are moving upward through the plane of the paper; thus it follows that the particle *e*, in moving to the position *f*, must have acquired a velocity, directed vertically upward through the paper, proportional to *G f*. It must, therefore, have been acted upon by a force, proportional to *G f*, directed vertically upward through the paper. The forces acting on the particles *f*, *g*, *h*, can be determined in a similar manner.

It is obvious that the velocity of the particle *k*, directed upward through the plane of the paper, is diminished as that particle moves to the position previously occupied by the particle *l*. Consequently, it must have been acted upon by a force, of which the magnitude is determined in the manner previously explained, acting downward through the plane of the paper. A circle, of which the diameter is proportional to this force, while the cross at its center represents the feathered end of an arrow directed downward through the paper, indicates the magnitude and direction of the force acting on the particle *k* as it moved to *l*. The forces acting on the particles, *l*, *m*, *n*, *p*, *q*, *r*, *s*, are determined similarly, and represented by circles containing crosses, to indicate that the forces act downward through the plane of the paper.

A glance at Fig. 1 shows that all forces acting on the part of the flywheel above the line *a k*, are directed upward through the plane of the paper; while all forces acting on the part of the flywheel below the line *a k*, are directed downward through the plane of the paper. All the forces acting above the line *a k* might be replaced by a single resultant force, acting upward through the paper at some point on the line *C e*; while all the forces acting below the line *a k* might be replaced by a single resultant acting downward through the paper at some point in the line *C p*. These two resultant forces, acting parallel to each other, but in opposite directions, constitute a couple, and produce a torque or turning moment about the line *a k*. Thus, in order to turn the revolving flywheel about the diameter *e p*, we must apply a torque which, if it acted on the stationary flywheel, would turn it about the perpendicular diameter *a k*. Conversely, if we apply a torque tending to turn the flywheel about a diameter *a k*, it will turn, not about *a k* (as might have been expected), but about the perpendicular diameter *e p*.

The torque necessary to deflect the flywheel might be produced by forces acting directly upon it, as for instance, by blowing air on the upper half of the flywheel from the back, and on the lower half from the front. Generally, however, it is more convenient to act on the axle, the end above the plane of the paper being urged in the direction *C B*, while the end below the plane of the paper is urged, by an equal force, in the direction *C A*.

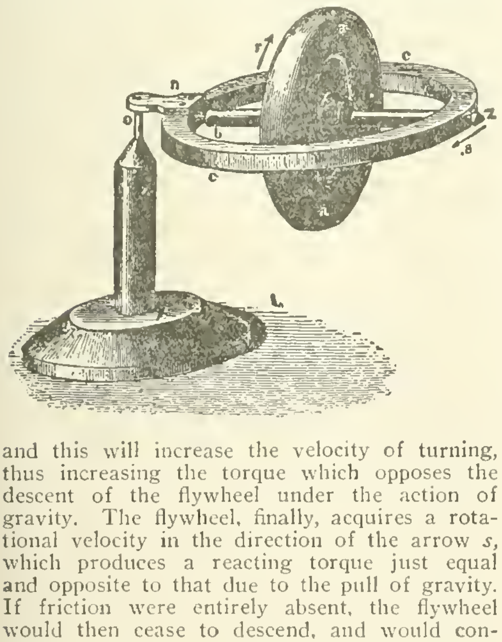
Some further points should be noted. Any force acting to the right of the line *A B*, is equal, both in magnitude and direction, to a corresponding force acting to the left of the same line. Consequently as the flywheel turns about the axis *A B*, no work will be performed by the forces producing this rotation. This follows from the circumstance that whereas one force acts in the direction of motion (so far as relates to rotation about the axis *A B*) the other equal force is opposed to that motion.

The actual behavior of a gyroscope can now be easily understood. The flywheel *a a* (Fig. 2) having been set in rapid rotation in the direction indicated by the arrow *r*, the frame carrying it is supported from a projection *n* at one end, on a pivot *o*. Instead of falling to the ground, as it would do if it were not rotating, the gyroscope remains with its axis *b z* horizontal; but the axis turns in a horizontal plane about the point of support *o*, in the direction indicated by the arrow *s*. The torque produced by the pull of gravity is easily seen to be that required to turn the flywheel *a a* about a vertical diameter in the direction mentioned. The fact that the flywheel, besides rotating about a vertical axis, also revolves in a circle about the point *o* as center, is merely due to the circumstance that, under the conditions of the experiment, the rotation cannot occur without the revolution.

It is instructive to consider the same problem from a somewhat different standpoint. We have already determined the nature of the applied forces required to turn the ideal rotating flywheel (Fig. 1) about the axis *A B*, in a clockwise direction when viewed from *A*. We found that a torque must be applied which tends to urge the end of the axle above the plane of the paper in the direction *C B*, and the opposite end of the axle in the direction *C A*. It will now be proved that the reaction of the rotating flywheel, when it turns as above, about the axis *A B*, produces a torque which tends to urge the end of the axle above the plane of the paper in the direction *C A*, and the other end of the axle in the direction *C B*.

Under the given conditions, the component velocities, downward through the plane of the paper, of the particles *a*, *b*, *c*, *d*, are all being diminished; and the consequent reactions tend to turn the axle in a clockwise direction, about the line *k a*, when viewed from the side *k*. The component velocities, upward through the plane of the paper, of the particles *e*, *f*, *g*, *h*, are all being increased, and the consequent reactions tend to turn the axle in the same direction. It is easily seen that the reactions due to the alterations in the velocities of the particles *k*, *l*, *m, n, p, q, r, s,* all tend to turn the axle of the flywheel in the same direction. Thus the torque due to the reaction of the rotating flywheel when turning about the axis *A B,* is of the character specified above.

«The precise way in which the gyroscope (Fig. 2) acts can now be readily followed. When the frame carrying the rotating flywheel *a a* is first supported on the pivot *o,* the initial tendency is for the whole to descend toward the earth, under the action of gravity. But the pivot *o* prevents the end *b* of the axle from descending, so that an incipient rotation about a horizontal diameter commences. The reaction due to this rotation produces a torque which tends to turn the flywheel about a vertical diameter in the direction of the arrow *s.* As the flywheel is free to turn in this direction, it at once commences to do so, and in so doing generates a reacting torque opposing the incipient rotation produced by gravity. The action of gravity being opposed, the rate of (incipient) descent of the flywheel is diminished; but so long as descent continues, a torque acting in the direction of the arrow *s* will be produced,



and this will increase the velocity of turning, thus increasing the torque which opposes the descent of the flywheel under the action of gravity. The flywheel, finally, acquires a rotational velocity in the direction of the arrow *s,* which produces a reacting torque just equal and opposite to that due to the pull of gravity. If friction were entirely absent, the flywheel would then cease to descend, and would continue to turn at a uniform rate in the direction of the arrow *s.* In this process, the work performed is that due to the incipient descent of the flywheel; this work is just sufficient to supply the kinetic energy due to the rotation of the flywheel and its supporting framework about the axis *o.* When the permanent condition outlined above has been attained, no further work is done in the absence of friction. If there is friction between the supporting lug *n,* and the pivot *o,* the gyroscope will slowly descend, at such a rate that the work performed by gravity is just equal to that needed to overcome the frictional drag.

«In the absence of friction, it is obvious that the gyroscope turns about *o* as center merely by virtue of its own inertia, after the final state has been reached; in this respect the motion resembles that of a planet around the sun. The torque due to gravity, though necessary, only serves the purpose of neutralizing the reacting torque which the turning of the flywheel about a vertical diameter produces.»

Mr. C. M. Brownall also, in a treatise on 'The Gyroscope, an Explanation without Mathematics,' published in the *Scientific American Supplement* of 10 Aug. 1907, summarizes the action of the gyroscope force as follows:

«I. The gyroscopic force always acts at right angles to the plane of motion of the axis, neither accelerating nor retarding it and only tending to change its direction. The gyroscopic force is of the nature of a couple, and can only be balanced by an equal couple.

II. The gyroscopic force is greater, other things being equal, as the velocity of motion of the axis is greater, as the velocity of rotation of the wheel is greater, as the mass of the wheel is greater and as this mass is more distantly situated as regards the center of the wheel.»

In May 1907, with a gyroscopic monorail car Mr. Louis Brennan, C. B., the inventor of the Brennan torpedo used by the British government, demonstrated before the Royal Society of Great Britain that he had discovered a practical application of the gyroscope which will probably revolutionize railway transportation.

The invention is, briefly, a system by which a vehicle or a train of vehicles supported by a single row of wheels may travel on a single rail and at all times maintain perfect equilibrium, whether in motion or stationary, and regardless of the distribution of the load, wind pressure and other conditions. Automatic stability mechanism carried by the vehicle itself endows it with this power. The mechanism consists essentially of two flywheels rotated directly by electric motors in opposite directions at a very high velocity, and mounted so that their gyrostatic action and stored up energy can be utilized. These flywheels are mounted on high-class bearings and are placed in exhausted cases, so that both air and journal friction is reduced to a minimum, and consequently the power required to keep them in rapid motion is very small. The stored up energy in the flywheels when revolving at full speed, is so great and the friction so small that if the driving current is cut off altogether they will run at sufficient velocity to impart stability to the vehicle for several hours, while it will take from two to three days before they come to rest. The model car, while running on a curved monorail, leans forward and so automatically balances the effect of centrifugal force, while a single wire hawser stretched across a river or ravine is all that is necessary in the shape of a bridge. The adoption of the gyroscopic principle to the practical purposes of steamship transportation is also in an advanced experimental stage, while it is considered probable that the crucial problem of the aeronaut, how to keep an automatic balance, may be solved by a simple application of the gyroscope.

H

H the eighth letter of the English and other alphabets derived from the alphabet of the Latins. It was borrowed by the Latins from the alphabet of the Greeks, and in early Greek represented an aspirate consonant sound, but in the Greek of classical times it stands for the prolonged vowel sound of *e*, as omega (ω) stands for the prolonged sound of omicron (o). The H is evidently a character borrowed from the Phœnician alphabet, where its form was 𐤇 and its sound guttural aspirate, like that of the corresponding Hebrew letter *cheth* or like *ch* in German and in Scotch. In Greek, after H was adopted as a vowel sign, the aspirate was represented by ‘ or ‘ either prefixed to a letter (ʽo) or written above it (ὁ): it was previous to this change that H was introduced into the Latin alphabet. It is probable that in early Latin this letter, occurring between two vowels, as in *nihil, mihi, traho, veho*, represented a guttural sound, as the *h* in *nihil* and *mihi* does still in the Italian pronunciation of Latin. But evidence exists that in the classical usage of ancient Latin speech initial *h* was of little account and was "silent" as in modern Italian and French: this is certain as regards the pronunciation of the vulgar; and that even the educated often "dropped the h's" we know from the fact that in ancient monuments we find Hannibal and Annibal, Hadria and Adria, herus and erus, haruspex and aruspex.

In Anglo-Saxon and earliest English speech *h* represents a guttural aspirate like German and Scotch *ch* in *ach, loch*: for example, in *niht* (night), *thoht* (thought) the *h* stood for the same sound as *ch* in the German words *nacht, gedacht*. In earliest English speech *h* was prefixed to *l, n*, and *r*, to represent a gutteral aspirate which is now entirely lost: examples, *hlaf* (loaf), *hnecca* (neck), *hring* (ring): the initial guttural in such words has been dropped, as in the names of the early Frankish kings Hlodowig became Ludovicus and Louis, and Hlothar became Lothair. The original guttural *h* in old High German *hros* is completely eliminated in the modern German *ross*, but is represented by the aspirate *h* in Old English *hors* (horse). The *h* after *w* in many words as wharf, what, when, etc., represents an initial aspirate in Old English hwarf, hwaet, hwaenne, etc.

H is added to various consonants to form digraphs for representation of various sounds, for example, *ch* as in chin, *sh* as in shy, *gh* as in gherkin, *th* as in thin, then; or even to represent sounds for which there is already a proper consonant in the alphabet, for example *ph* and *gh* for the sound of *f* (philter, rough), *ch* for the sound of *k* (chyle); in very many cases the digraph *gh* is employed simply as a memorial of an ancient etymology, as in plough, and not seldom for no discernible purpose at all, as in ghost; the form *rh* usually occurs in words of Greek origin, and recalls the Greek etymology (rhapsody), but again it is employed to suggest false Greek etymology (rhyme).

H. H. See JACKSON, HELEN MARIA FISKE HUNT.

Haarlem, hār'lĕm, Holland, the capital of the province of North Holland, 11 miles by rail west of Amsterdam, and five miles from the North Sea. The city is intersected by canals bordered by tree-lined avenues, and communicates with the Zuyder Zee by the Spaarne and the Ij. Its chief municipal building is the town hall, a 17th century palace of the counts of Holland, containing a library, art, and historical collections. In Haarlem wood a favorite pleasure resort is the Pavilion housing the Society for the Promotion of Industry, and containing the colonial and industrial museums. Chief among numerous educational institutions is the Teyler Museum, for the study of theology, natural science, and the fine arts. The finest ecclesiastical structure is St. Bavo's or the Groote Kerk, a 15th century late Gothic basilica, one of the largest churches in Holland, noted for its tower 260 feet high, and its large organ. Haarlem was important commercially as early as the 12th century, and although its manufacturing industries have declined, has cotton-mills, linen bleacheries, type foundries, breweries, etc. The town suffered during the revolt of the peasantry in 1492 and was deprived of its privileges by Albert of Saxony. During the war of independence it sustained a siege of seven months (1572–73) by the Spaniards, and capitulated only after a display of the noblest heroism and courage. It was retaken by the Prince of Orange in 1577. Pop. (1899) 64,069.

Haas, häs, **Johannes Hubertus Leonardus de**, Dutch painter: b. Hedel, North Brabant, 23 March 1832. A pupil of Jan van Os at Haarlem, he established his studio at Brussels in 1857, and attained an excellent reputation by his finely-colored animal studies and animal groups with background of Dutch landscape. In 1869 he received a gold medal at Munich for his 'Trio of Donkeys.' Others of his works are: 'The Three Comrades'; 'In the Dunes'; 'On the Bank of the Yssel'; 'Cattle at Pasture.'

Habakkuk, ha-băk'ŭk or hăb'a-kuk, the eighth of the twelve minor prophets. He was of the tribe of Levi, and flourished about 600 B.C. His prophecy commences with a lamentation for the corruption and social disorganization which the prophet sees around him. He cries to God for help, and is answered by threatenings of swift vengeance. The prophet is commanded to write the vision of God's retributive justice as revealed to his prophetic eye. The doom of the Chaldæans is first told in general terms and the announcement is followed by a series of denunciations pronounced upon them by the nations whom they had oppressed. The whole concludes with a magnificent psalm (chap. iii.), 'Habakkuk's Pindaric Ode,' as it is called by Ewald, a composition unrivaled for boldness, sublimity, and majesty of diction.

Hab'berton, John, American author: b. Brooklyn, N. Y., 24 Feb. 1842. At first a printer he subsequently served in the Federal army, and later undertook editorial work in New York. His best-known book, 'Helen's Babies' (1876), attained great popularity both in America and in Europe. He has published also 'The Barton Experiment' (1877); 'Other People's Children' (1877); 'The Worst Boy in Town' (1880); 'Who was Paul Grayson?' (1881); a humorous 'Life of Washington' (1883); 'One Tramp' (1884); 'Brueton's Bayou' (1886); 'The Chautauquans' (1891); 'A Lonely Lover' (1893); 'The Tiger and the Insect' (1902); 'The Bowsham Puzzle'; 'Country Luck'; 'Little Guzzy'; 'Caleb Wright'; etc.

Habeas Corpus, hā'bē-as kôr'pŭs, an ancient English writ addressed to him who has another in custody, and commanding him to produce the body of the person named at a certain place and time. One of the purposes for which it was used was to recover freedom when wrongfully taken away. Personal liberty was asserted by the common law from its earliest ages, and it was always assailed by kings who would be absolute, and with an earnestness proportionate to their tyranny. Hence it became imperatively necessary, if subjects were to retain the control and disposition of their own persons, that they should demand a recognition of this principle from their sovereign, and in England the principle was declared in the most solemn manner in Magna Charta. It is there said that "no man shall be taken or imprisoned but by the lawful judgment of his peers, or by the law of the land." It became necessary, however, in the course of time to put down the abuses by which the government's lust of power, and the servile subtlety of crown lawyers, had impaired so fundamental a privilege; and this was effected by the Habeas Corpus Act passed in 31 Charles II. (1679). Of the political and social effects of this measure Blackstone writes: "If once it were left in the power of any, the highest magistrate, to imprison arbitrarily whomever he or his officers thought proper, there would soon be an end of all other rights and immunities."

The provisions of the act may be stated generally thus: (1) That on complaint or request in writing, by, or on behalf of, any person committed and charged with any crime (unless committed for treason or felony expressed in the warrant; or as, or on suspicion of being accessory before the fact to any felony, or upon suspicion thereof, plainly expressed in the warrant; or unless committed or charged in execution by legal process), the lord-chancellor, or any of the judges in vacation, upon viewing a copy of the warrant or affidavit that a copy is denied, shall (unless the party has neglected for two terms to apply to any court for his enlargement) award a habeas corpus for such prisoner, returnable immediately before himself, or any of the judges; and upon the return made shall discharge the party, if bailable, upon security being given to appear and answer to the accusation. (2) The writ shall be returned, and the prisoner brought up within a limited time, according to the distance, not exceeding 20 days. (3) Officers and keepers neglecting to make due returns, or not delivering to the prisoner, or his agent, within six hours after demand, a copy of the warrant of commitment, or shifting the custody of a prisoner from one to another, without sufficient reason or authority (specified in the act), shall for the first offence forfeit £100; for the second £200, to the party grieved, and be disabled to hold their office. (4) No person once delivered by habeas corpus shall be recommitted for the same offence, on penalty of £500. (5) Every person committed for treason or felony may insist on being tried at the next assizes, or admitted to bail, unless the crown witnesses cannot be ready in that time; and if not tried at the second assizes or sessions, he shall be discharged from the imprisonment. (6) The prisoner may apply either to the Court of Chancery, or to the Courts of Queen's Bench, Common Pleas, or Exchequer, and any judge denying such writ is liable to a fine of £500. As the Habeas Corpus Act extended only to cases where persons are imprisoned on criminal, or supposed criminal charges, the other cases being left to the operation of the common law, which was found defective, the statute 56 George III. was passed, which extended the writ to other cases. Under this last act any person confined, or restrained of his liberty (otherwise than for criminal matters, and except persons imprisoned under a judgment or decree for debt), may apply to any judge of the common law courts for a habeas corpus, on showing by affidavit that there is a reasonable and probable ground for complaint.

In times of great political excitement, and suspected treasonable conspiracies, the operation of the Habeas Corpus Act has been suspended, as in Ireland in 1866, by 29 Vict. But such suspension does not enable any one to imprison without cause or valid pretext for so doing. It only prevents persons who are committed from being bailed, tried, or discharged during the suspension, leaving to the committing magistrate all the responsibility attending on illegal imprisonment. It is not uncommon therefore to pass an act of indemnity subsequently, for the protection of those who either could not defend themselves in an action of false imprisonment, without making improper disclosures of the information on which they acted, or who have done acts not strictly defensible at law, yet apparently justified by the necessity of the moment. The English statute has been copied in the United States without essential change.

In the Constitution of the United States it is provided that "the privileges of the writ of habeas corpus shall not be suspended unless when, in cases of rebellion or invasion, the public safety may require it." The scope of this provision came under discussion during the Civil War when the President of the United States authorized Lieut.-Gen. Scott, where in his judgment it seemed necessary, to suspend the writ. When on one occasion the general refused to obey the writ, Chief Justice Taney, who had issued it, uttered an opinion in which he declared that it was only in the power of Congress, and not of the President, to proclaim such suspension, a view which legal authorities seem inclined to agree with.

It has been decided by the Supreme Court, in view of possible conflicts of jurisdiction between State and Federal courts, that no State judge has a right to issue a writ of habeas corpus for the release of a person held under the authority of the Federal government. On the other hand the United States courts are more restricted in the power to issue such writs than the State courts. A Federal court may issue a writ of habeas corpus in cases coming within Federal jurisdiction. The circuit court may decide whether the person ought to be discharged, but cannot do this even in cases where the writ has been suspended There are also several provisions made by which an imprisoned person, whose testimony in a court of law is required, may be released by a writ of habeas corpus in order to appear before the judge. The Supreme Court has not the power to issue this writ, excepting in response to an appeal. Consult: Blackstone, 'Commentaries'; Hurd, 'Habeas Corpus.'

Haberstich, Samuel. See BITTER, ARTHUR.

Hack'berry, an American tree of the elm family and genus *Celtis*, growing in dry woods throughout the eastern United States and Canada. It is small or middle-sized, with the aspect of an elm. The fruit (a globular drupe) is sweet and edible, as large as the bird-cherry, and ripening in autumn. Two species exist.— *C. occidentalis*, the northern hackberry, sugar-berry or nettle-tree; and a southern one (*C. mississippiensis*). The soft, coarse-grained yellow wood is of little value. It is affected by the same insects as injure the elm (q.v.).

Häckel, Ernst H. See HAECKEL.

Hack'ensack, N. J., city, county-seat of Bergen County, on the Hackensack River, and on the New York, S. & W., and Erie R.R.'s, 16 miles from New York. It is a residential city, but has brick, silk, and other manufacturing interests. It has a public library, high school, gas and electric light, waterworks, electric street railways connecting with surrounding towns and cities and with New York, and an assessed property valuation of over $5,000,000. Hackensack was settled by the Dutch in the latter part of the 17th century, and during the Revolution was occupied in turn by the British and American armies. Pop. (1900) 9,443.

Hacker, Arthur, English artist: b. London 25 Sept. 1858. He studied at St John's College, London, was a pupil in art of the Royal Academy and of Léon Bonnet at Paris (1880–1), set up his studio in London, and painted, besides several portraits: 'Pelagia and Philammon'; 'By the Waters of Babylon'; 'Væ Victis'; 'Syrinx'; 'Sir Percival'; and other works.

Hack'ett, Horatio Balch, American Baptist clergyman and educator: b. Salisbury, Mass., 27 Dec. 1808; d. Rochester, N. Y., 2 Nov. 1875. He was professor of biblical literature at Newton (Mass.) Theological Seminary 1839–70, and of Greek at Rochester Theological Seminary, from the latter date. He was one of the committee of New Testament revision, and with Ezra Abbot (q.v.) edited the American edition of Smith's 'Bible Dictionary' (1868–70). His chief work was a 'Commentary on Acts' (1851); and he also wrote 'Memorials of Christian Men in the War' (1864); 'Tour in the Holy Land' (1860); etc.

Hackett, James Henry, American actor: b. New York 15 March 1800; d. Jamaica, L. I., 28 Dec. 1871. He went on the stage in 1826 and was particularly successful in impersonating Yankees and Westerners, but was best known by his Falstaff, which he played first about 1832. He was widely popular in the United States as well as in England. He published 'Notes and Comments on Shakespeare' (1863).

Hackett, James Keteltas, American actor: b. Wolfe Island, Ontario, Can., 6 Sept. 1869. He is the son of J. H. Hackett (q.v.). He was graduated from the College of the City of New York in 1891, made his début in 1892, became leading man of the Lyceum, New York, in 1896, and appeared in 'The Prisoner of Zenda,' 'Rupert of Hentzau,' 'The Pride of Jennico,' 'Don Cæsar's Return,' and 'The Crisis.'

Hackettstown, N. J., town in Warren County; on the Musconetcong River and on the Delaware, L. & W. railroad and the Morris Canal; about 59 miles from New York city, and 50 miles west of Newark. It is about 800 feet above the sea and within half a mile of the highest point in the State. Its chief manufactures are silk goods, carriages and wagons, and agricultural implements. The waterworks are owned and operated by the town, and the supply comes from springs on Schooley's Mountain, distant from the town about two and one half miles. It is the seat of the Centenary Collegiate Institute, under the auspices of the Methodist Episcopal Conference of Newark. Pop. (1900) 2,427.

Hackländer, Friedrich Wilhelm von, frēd'rĭн vĭl'hĕlm fōn häk'lĕn-dėr, German novelist and writer of comedies: b. Burtscheid, near Aix-la-Chapelle, Prussia, 1 Nov. 1816; d. Leoni, near Munich, 6 July 1877. After serving for a time in the Prussian artillery he began a literary career with 'Pictures of Soldier Life' (1841), followed by 'Soldier Life in Peace' (1844). Other works of this period were 'Daguerreotypes' (1842); and 'Pilgrimage to Mecca.' In 1849 he went to Italy, where he was present with Radetzky's army during the campaign in Piedmont, and afterward published 'Soldier Life in War' (1849–50). Among the best of his longer novels are 'Trade and Traffic'; 'Eugene Stillfried' (1852); and 'Anonymous Histories' (1851). His best comedies are the 'Secret Agent' (1850), translated into several European languages, and 'Magnetic Cures' (1851). With Zoller, in 1855, he started the illustrated weekly 'Over Land and Sea.'

Hackley, Charles Henry, American capitalist: b Michigan City, Ind., 3 Jan. 1837; d. Muskegon, Mich., 10 Feb. 1905. In 1856 he went to Muskegon, Mich., and worked in a lumber-mill as laborer and foreman; then attended a commercial school and was given a position as bookkeeper and later came to be partner with a mill firm. In 1880 he founded the firm of which he is the head, which is one of the most important in the State, and he has also been interested in many other industries. He has been a member of the board of education, and was elected regent of the University of Michigan, but declined the office. He has made large gifts to the city of Muskegon. In 1888 he gave a public library, which he endowed in 1891; in 1889 he had a park made in a central part of the city in which he erected a soldiers' and sailors' monument and other statues; in 1891 he built and endowed a manual training school; in 1901, he provided for the erection of a hospital with a training school for nurses, and erected a statue of McKinley, the first statue of the late President to be unveiled. The total value of his gifts is $1,380,525.

Hackmatack, hăk'ma-tăk, the American larch. See LARCH.

Hackney, England, a metropolitan borough in the northeast of London, three miles north-northeast of St. Paul's. It has a fine modern town hall. Hackney was formerly noted for its boarding-schools for young ladies. It is supposed that hackney-coaches were first established between this place and London, and derived their name from it. It has manufactories of chemicals, india rubber, etc.; and had formerly extensive silk-mills. Pop. (1901) 270,535.

Hackney Carriage or **Coach,** a four-wheeled enclosed vehicle drawn by two horses and seating four persons exclusive of the driver. They are usually let out for hire. The carriage derives its name from Hackney (q.v.).

Haddam, Conn., a town and one of the county-seats of Middlesex County, 26 miles southeast of Hartford, on the New York, New Haven & Hartford R.R., and on the west bank of the Connecticut River, 29 miles above its mouth. Among its educational institutions is Brainerd Academy. It has important granite quarries, lumber and saw-mills, and a paper mill. Pop. (1900) 2,015.

Haddock, a fish (*Melanogrammus æglefinus*) of the same family (*Gadidæ*) as the cod, and much resembling it in general appearance. From the cod it may be easily distinguished by the black lateral line and suprapectoral blotches, and the swollen bones of the shoulder girdle. The haddock scarcely exceeds a weight of 15 pounds, and is usually about 3 or 4 pounds. It is restricted in its range to the North Atlantic. The food is extremely varied, consisting of every kind of bottom-living invertebrate. Spawning occurs in late winter and early spring, according to locality, and the eggs are essentially like those of the cod. Haddock associate with cod on the Banks, but the principal American fisheries are in Massachusetts Bay, on the Nantucket shoals and other points off southeastern New England, where immense numbers are taken on trawl and hand lines, especially during the summer. Philadelphia and Boston furnish the best markets for fresh haddock, but the demand from the interior is constantly growing. Though considerable quantities are salted at Provincetown, the haddock when so prepared is much inferior to the cod. The Scotch method of drying and smoking produces the much superior "Finnan Haddies," and is largely practised at Portland and Boston.

Had'don Hall, an old English baronial mansion, the seat successively of Avenells, Vernons, and the Rutland family, stands on a slope overlooking the Wye in Derbyshire, 23 miles north-northwest of Derby. The styles of architecture range from Norman to the 16th century. Reference is made to it in Scott's 'Peveril of the Peak.' Although it is not inhabited it is in fine condition and remarkable as one of the most interesting extant examples of the country house of a great land owner in the late Middle Ages.

Haddonfield, N. J., a borough of Camden County, five miles southeast of Camden, a junction of two branches of the Camden and Atlantic railroad. Its industries are mainly agricultural; and it has also manufactures of stoves, tinware, watchcases, etc. Pop. (1900) 2,776.

Ha'den, SIR **Francis Seymour,** English etcher and surgeon: b. London 16 Sept. 1818. He studied at the Sorbonne and in the Paris and Grenoble medical schools, and in 1857 became a Fellow of the Royal College of Surgeons. The 'Etched Work of F. S. Haden' contains 185 plates by him and still others have been published in 'Études à l'Eau Forte' (1865–6). His work as an etcher is noted for both vigor and breadth. He is president of the Society of Painter Etchers, was knighted in 1894, and has written 'Rembrandt True and False'; 'Etched Work of Rembrandt' (1879–80); 'Lectures'; 'About Etching' (1881).

Hades, hā'dēz, the Greek name of a god, in large measure corresponding to the Roman Pluto, who reigned over the infernal regions. Both Greeks and Romans supposed the infernal regions to be in the centre of the earth. To enter these, the river Styx had to be crossed by the dead in the wherry of Charon. If, by any chance, the body lay unburied, the shade was detained 100 years on the banks of the Styx before crossing.

The Greek word Hades is rendered in the authorized version by the ambiguous term hell (q.v.). Expressions, most of them obviously figurative, used of Hades, represent it as subterranean; as having gates with keys in the hand of Christ, and as having, in a portion of it, souls in torment.

Had'is, or in Arabic plural, AHADIS, narrations or traditions, which relate to the Prophet Mohammed, and are not found in the Koran. There are numerous collections of these floating traditions, anecdotes and legends. A search for such data was first undertaken by Abdul Malik ibn Juraisch (d. 772 A.D.). Others consider that the collection of Imam Malik (d. 801) is the earliest extant. The following six Hadis collections are considered by the Sunnite Moslems to be canonical scriptures: 1. The Hadis of Mohammed Ismail al Buchari (d. 878). 2. Of Muslim ibn ul Hajaj (d. 883). 3. Of Abu Isa Mohammed al Tirmisi (d. 901). 4. Abu Daud al Sajistani (d. 897). 5. Of Abu Abd ur Rahmân al Nasâi (d. 925). 6. Of Abu Abdallah Mohammed Ibn Wajah (d. 895). None of these have ever been printed.

Hadley, Arthur Twining, American college president: b. New Haven, Conn., 23 April 1856. A son of James Hadley (q.v.), he was graduated from Yale in 1876, and took graduate studies in political science at Yale and the University of Berlin. In 1879–83 he was a tutor at Yale, and during that time wrote for several journals, including the 'Railway Gazette' and the 'Financial Chronicle.' He was commissioner of labor statistics for Connecticut (1885–7), and was in 1885 a witness before the Cullom State committee which prepared the Interstate Commerce Law. In 1886 he became professor of political science at Yale, and in 1899 was made president of the university. He was president of the American Economic Association for two years. In 1885 he published 'Railroad Transportation: Its History and Laws,' which is everywhere recognized as one of the chief authorities on the subject, and has been translated into French and Russian; his other works include 'Report on the Labor Question' (1885); 'Economics, an Account of the Relations between Private Property and Public Welfare' (1896), presenting the theories of political economy in accordance with the most modern research and thought; and 'The Education of the American Citizen' (1901). His writings show him to be not only a scholar, but also a man of affairs well acquainted with the business world, and in this regard he is one of the best representatives of the modern type of university presidents.

Hadley, Henry K., American composer: b. Somerville, Mass., 1871. He was a pupil of S. A. Emery and G. W. Chadwick in Boston, studied also in Vienna, and in 1895 returned to the United States and was appointed instructor in music at St. Paul's School, Garden City, L. I. His symphony, 'The Four Seasons,' received the prizes given by the Paderewski Fund and the New England Conservatory of Boston. His works further include a concert overture 'Hector and Andromache'; a symphony, 'Youth and Life'; a cantata, 'In Music's Praise'; a festival march; trios, quartettes, and more than 150 excellent songs and pianoforte compositions.

Hadley, James, American philologist: b. Fairfield, N. Y., 30 March 1821; d. New Haven, Conn., 14 Nov. 1872. When a boy he suffered an injury to his knee, which developed seriously, and crippled him for life. He was graduated from Yale in 1842, took graduate studies in mathematics and also a theological course. In 1844 he was tutor at Middlebury College, Vt., and in 1845 became a tutor at Yale. In 1848 he became assistant professor of Greek there, and in 1851, professor of Greek. He was familiar not only with Greek, Latin, and the chief modern languages, but also with Hebrew, Arabic, Armenian, Gaelic, Irish, Sanskrit, Gothic, and Old English, and won a high reputation as a linguist distinguished for exactness and thoroughness in detail, united with breadth of view; he also was successful and influential as a teacher. He published a 'Greek Grammar' (1861), based on Curtius, and wrote the 'Brief History of the English Language' in the 1864 edition of Webster's 'Dictionary'; after his death, his 'Introduction to Roman Law' (1873) and 'Philological and Critical Essays' (1873) were published.

Hadley, John, English mathematician and astronomer: b. 1682; d. 14 Feb. 1743. He became a Fellow of the Royal Society in 1717, and was the inventor of Hadley's quadrant (see SEXTANT) and of a reflecting telescope (1723). The credit of having invented the sextant is claimed for Hadley, Godfrey, and Newton, but each seems, nevertheless, to have made his own discovery independently. Hadley described his instrument, which he called an "octant," to the Royal Society in May 1731.

Hadley, Mass., town, which includes several villages, in Hampshire County; on the Connecticut River and on the Boston & M. Railroad; three miles northeast of Northampton and four miles southwest of Amherst. It was settled in 1659, and was first called Norwottack; but in 1661, when it was incorporated it was given the name Hadley, from Hadley in England. William Goffe and his father-in-law Whalley, who fled from England to America in 1660, and who lived for a time near New Haven, sought concealment in Hadley, in 1664, where Goffe died in 1679. According to tradition, when Hadley was at one time attacked by Indians, and the people were called from the meeting-house, they stood helpless until Goffe appearing, took the lead and repelled the enemy. Hadley is an agricultural region, and its industries are chiefly connected with farm products. Pop. (1900) 1,789.

Hadramaut, hā-drā-mât'. Arabia, the name given to the coast region from Aden to Cape Ras-al-Hadd. It consists of a plateau, parted from a mountain chain, the barrier of the interior desert, by a complex of valleys. Commerce, agriculture, cattle-breeding, and the chase are the chief occupations. The climate is dry but healthy. Pop. about 150,000.

Hadrian, ha'drĭ-an (PUBLIUS ÆLIUS HADRIANUS), Roman emperor: b. Rome 24 Jan. 76; d. Baiæ 10 July 138. For his ardor in the study of Greek he earned the nickname of Græculus. A nephew of Trajan, he was adopted by that emperor, fought under him against the Dacians with some glory, and, having been entrusted with the praefecture of the East and the command of the Roman armies in the East early in 117 when Trajan left the field, Hadrian, upon Trajan's death later in the same year was made emperor by his soldiers. He quickly realized that he could make no forcible head against the simultaneous attacks of the Parthians and, in Dacia and Moesia, of barbarian foes, to say nothing of revolt in Syria and Egypt. With the true insight of a diplomat he foresaw that the extreme East must be either surrendered voluntarily or lost, and chose the former alternative as the least costly. Hence he gave up Armenia, Mesopotamia, and Assyria, all comparatively new Roman provinces, to the Parthian power, and withdrew the Roman eagles to the west of the Euphrates. In 119, for the purpose of becoming acquainted with the state of the provinces, he began his celebrated journey, which he is said to have performed chiefly on foot, marching bareheaded 20 miles a day and sharing cheerfully the hard fare of the humblest soldier. He visited Gaul, Germany, Britain, where he built the famous wall extending from the Solway to the Tyne, Spain, Mauritania, Egypt, Asia Minor, and

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Greece, whence he returned to Rome after his circuit of the empire in 126 or 127 A.D., and received the title of «Pater Patriæ.» Hadrian spent the years 132 and 133 in Athens, which city he adorned with splendid and costly buildings. After once more visiting Syria and crushing a desperate Jewish revolt, he returned to Italy, and spent the last years of his life at Rome and his villa. During his reign the army was vigorously disciplined and reorganized. As a civil ruler he merits high praise for the just and comprehensive view he appears to have taken of his duties as a sovereign. Hence to him is attributed, more than to any other, the consolidation of the monarchical system of Rome. Hadrian also divided Italy into four parts under four consuls, to whom was entrusted the administration of justice. Hadrian had a passion for building: his most splendid edifices were a famous villa at Tibur (now Tivoli), and in Rome the Aelian bridge, built in 136, and now styled the Pont Sant' Angelo. This bridge leads to the emperor's splendid mausoleum, the Moles Hadriani. He likewise laid the foundation of several cities, the most important of which was Adrianopolis. He was a lover of the fine arts and set a high value on Greek literature. No fragment of ancient literature has been more famous than the verses attributed to the dying Hadrian:

Animula vagula, blandula
Hospes comesque corporis
Quæ nunc abibis in loca
Pallidula, rigida, nudula,
Nec ut soles dabis jocos?

David Johnston, in his ‹Translations, Literal and Free, of the Dying Hadrian's Address to his Soul› (1877), gives no fewer than 116 translations of all degrees of excellence. Among well-known writers, Byron, Prior, Pope, and Merivale have attempted renderings. Consult: Gregorovius, ‹Der Kaiser Hadrian› (1884); Durr, ‹Die Reisen des Kaisers Hadrian› (1881).

Hadrian's Wall, a wall in the north of England, called also the Roman Wall and the Wall of Severus. Before Agricola advanced into Scotland he established forts between the estuary of the Tyne and the Solway Firth, to protect him from attack in his rear. He adopted the same precaution before leaving the Lowlands of Scotland for the Highlands, placing encampments between the firths of Forth and Clyde. Afterward walls were constructed on these two lines. On the English side of the Border is a stone wall with a ditch on its north side. Attached to it are stationary camps, mile-castles, and turrets for the accommodation of the soldiery who manned it. To the south of the stone wall is a series of ramparts generally called the *vallum*. This fortification consists of three aggers or mounds and a ditch. The military way along which the soldiery moved lies between the *murus* or stone wall and the vallum. The wall was not intended as a mere fence to block out the Caledonians, but as a line of military strategy. Hadrian is now generally believed to have been the builder of the whole structure. Severus, however, repaired it before he advanced into Scotland. Agricola came to Britain in 78 A.D. Hadrian came toward the close of 119 A.D. Severus died in 211 A.D. Considerable portions of Hadrian's Wall yet remain. In two places the wall stands nine feet high. See Collingwood Bruce, ‹The Roman Wall› (1851); and ‹Handbook to the Roman Wall› (1863); Neilson, ‹Per Lineam Valli› (1891); Creighton, ‹Carlisle› (1889).

Hadrosaurus, hăd-rō-sâ'rŭs, or **Trachodon**, a genus of duck-billed dinosaurs of the Cretaceous rocks of North America. Compare CLAOSAURUS.

Haeckel, hĕk'ĕl, **Ernst**, German naturalist: b. Potsdam, Germany, 10 Feb. 1834. He studied at Berlin, Würzburg, and Vienna, taking his medical degree in 1858 and practising that profession a short time in the former city. During 1859 and 1860 he made a journey through Italy and Sicily in the interest of science, his work on ‹The Radiata› (1862), being a result. Later portions were added in 1887 and 1888. In 1861 he settled in Jena for the study of comparative anatomy, but soon turned to the specific investigation of zoology, and after holding subordinate positions, was appointed in 1865 full professor at Jena. His researches had to do especially with the lower ranks of marine animals, and above all, with deep-sea life in its simplest forms. The material for such study was gathered from many and extended experiences in the North Sea, the Mediterranean, the Canary Isles, and the Indian Ocean. These travels and researches were the basis of works like the ‹History of the Development of the Siphonophora› (1869); and ‹Biological Studies› (1870). These, however, were introductory to greater representative works on natural philosophy and the development theory, such as ‹Calcareous Sponges› (1872); ‹Natural History of Creation› (1868), — which has received the honor of translation into twelve languages, — and his master work ‹General Morphology of Organisms› (1866). More popular writings, making him known to a public much wider than the biologist ever addresses, are those ‹On the Division of Labor in Nature and Human Life› (1869), ‹On the Origin and Genealogy of the Human Race› (1870), ‹Life in the Great Marine Animals›; ‹The Arabian Corals› (1873); ‹The System of the Medusa› (1880); and ‹A Visit to Ceylon.› For many years he has devoted his attention to the deep-sea exploration of H. M. S. Challenger expedition, of which he has written voluminous reports in English. His general biologic conclusions regarding the life and growth of deep-sea organisms are given in his ‹Plankton Studies› (1890), while his ‹Monism as the Link between Religion and Science› may be considered as in a certain sense his confession of faith.

Hæmatemesis, hē-ma-tĕm'ĕ-sĭs, vomiting blood, which comes from the stomach, or œsophagus. It may result from alcoholism, poisoning, or cirrhosis of the liver. It is more frequent in later life than hæmoptysis (q.v.) but may occur in the acute perforating ulcers of the stomach in young women. It is frequently associated with cancer, but it results also from external violence.

Hæm'atin, or Hem'atin. See HÆMOGLOBIN.

Hæmatoxylin, hē-ma-tăx'ō-lĭn ($C_{16}H_{14}O_6$), the coloring matter of logwood, or *Hæmatoxylon Campechianum*, got from the extract by allowing it to stand some days in contact with ether, decanting, removing the ether, and adding water. Hæmatoxylin gradually deposits, and the crystals by pressure and recrystallization from water containing a little ammonium sulphite can be got nearly colorless. Combined with three molecules of water it forms dimetric, with one of water trimetric crystals. The crystals are large, transparent, and brilliant, and have a sweet taste. Hæmatoxylin dissolves sparingly in water, but it is taken up very freely by solution of borax, by hypo-sulphite of sodium, phosphate of sodium, and some other salts. It is also soluble in ether and in alcohol. By acids it is not readily affected, but it reacts at once with alkalies, forming colored solutions, and with metallic oxides forming precipitates of various colors. By joint action of air and bases hæmatoxylin is oxidized and becomes transformed into hæmatein.

Hæmaturia, hem-a-tū'rĭ-a, the presence of blood in the urine, which points to disease of the kidney or bladder. It is a symptom of some gravity. The treatment of the cause will probably remove this affection: in all cases complete rest is very important. See TREMATODA.

Hæmoglo'bin, or **Hemoglo'bin**, an organic coloring matter, which constitutes about nine tenths of the weight of dried red blood corpuscles, and serves as a carrier of oxygen from the lungs to the general tissues of the body. It is an exceedingly complex substance, and its formula is not certainly known. Zinoffsky gives it as $C_{712}H_{1130}N_{214}S_2FeO_{245}$; but this can hardly be regarded as more than a guess. According to many authorities, hæmoglobin is not a definite chemical compound, but a more or less variable mixture of simpler substances. It gives all the general reactions of the proteids, but, unlike most of the proteids, it may easily be obtained in crystalline form, its crystals commonly occurring in rhombic plates or prisms, varying somewhat in shape, according to the source from which the substance is prepared. The exceeding physiological importance of hæmoglobin depends upon the fact that it readily combines with oxygen to form a very unstable compound known as oxyhæmoglobin. The combination takes place as the blood corpuscles containing the hæmoglobin pass through the lungs; and the loosely-combined oxygen is given off again as the corpuscles pass through the capillaries, the oxyhæmoglobin being thereby again reduced to hæmoglobin. Hæmoglobin also combines with carbon monoxid to form a similar but far more stable substance known as carboxyhæmoglobin. In poisoning by the inhalation of coal-gas the carbon monoxid present in the coal-gas combines with the hæmoglobin in the lungs, and the carboxyhæmoglobin so formed does not break up again. As the absorption of the coal-gas proceeds, a continually increasing quantity of hæmoglobin is therefore destroyed, so far as its utility as an oxygen-carrier is concerned. In extreme cases of such poisoning, transfusion of blood is resorted to, in order that the patient may have a sufficient supply of hæmoglobin to transport the requisite quantity of oxygen from the lungs to the other tissues of the body.

The preparation of pure hæmoglobin is a difficult operation, and for its details reference should be made to Gamgee's 'Physiological Chemistry.' One of the best methods that have been proposed consists in adding to defibrinated blood about one sixteenth of its own volume of ether, and shaking the mixture. This treatment causes the red corpuscles to break up, and the fluid becomes lake-colored. After a time, varying from a few minutes to three days, according to the source of the blood, a heavy deposit of minute crystals of oxyhæmoglobin is thrown down. This may be purified by washing with 25 per cent alcohol, and subsequent recrystallization. Crystals of hæmoglobin itself have also been prepared. Pure hæmoglobin has a purplish color, which gradually passes into a scarlet or a yellowish red, as the substance absorbs oxygen and becomes thereby converted into oxyhæmoglobin. Carboxyhæmoglobin is even more brilliantly red than oxyhæmoglobin. All three of these substances exhibit marked absorption spectra when in solution, and very small quantities of them can be easily detected by the spectroscope. It is said that the presence of one part of hæmoglobin in ten thousand parts of water can be distinctly demonstrated by this means.

When oxyhæmoglobin is acted upon by acids or alkalies, or by the gastric juice, it is resolved into a proteid substance and a definite compound which has the probable formula $C_{68}H_{70}N_8Fe_2O_{10}$ and is known as hæmatin. Hæmatin may be best prepared by extracting blood clot, directly, with hot alcohol to which a small quantity of sulphuric acid has been added. The extract is next agitated with chloroform, which takes up the hæmatin. The chloroform is then separated, washed with water to remove the acid, and allowed to evaporate, when the hæmatin is deposited in the form of a bluish-black powder. Hæmatin is a very stable compound, and may be heated to 350° F. without decomposition. At higher temperatures it burns with evolution of hydrocyanic acid, leaving an ash composed chiefly of oxid of iron. It is insoluble in water, ether, dilute acids, and pure alcohol; but it dissolves readily in solutions of the caustic alkalies, and in alcohol to which a small quantity of sulphuric acid has been added. Consult Gamgee, 'Physiological Chemistry.'

Hæmophilia, a congenital inherited disease characterized by a tendency to obstinate bleedings. Women are very rarely affected, but transmission of the disease seems to be from the father through the daughters to the grandsons, and from father to son. The disease usually makes itself evident in early life, a slight wound being followed by abnormal hemorrhage, whereby the child becomes known as a "bleeder." The exact fault in nature's ordinary method in plugging blood-vessels has not been discovered: the shed blood will clot naturally. Besides the liability to excessive hemorrhage, these subjects are frequently afflicted with trouble in the joints, probably a chronic inflammation, the result of repeated small hemorrhages. Death is always imminent, as nothing can stop the flow of blood where large areas of the body are injured. Chlorides are used with some success for those mildly afflicted with the disease, particularly the chloride of calcium.

Hæmop'tysis, expelling blood from the lungs, larynx or bronchial tubes by coughing, which may be a symptom of phthisis. Morphine is useful immediately after such hemorrhages, but modern medicine rejects the use of styptics.

Hæmorrhoids (Greek, *haima*, blood, and *rheo*, to flow), literally, a flow of blood. Until the time of Hippocrates this word was used, conformably to its etymology, as synonymous with hemorrhage. It was afterward used in a narrower sense, to indicate the flux of blood at the extremity of the rectum, and in some other cases which were considered analogous to it; thus it was applied to the flow of blood from the nostrils, the mouth, the bladder, and the uterus. It is at present used to signify a particular affection of the rectum, although the disease is not always attended with a flux; in this sense the affection is also called piles. Certain general causes may produce a predisposition to this disease; in some cases, it appears to be the effect of a hereditary disposition; in general, it manifests itself between the period of puberty and old age, although infants and aged people are not entirely exempt from its attacks. Men are oftener affected than women, in whom it is sometimes produced by local causes. It often shows itself in subjects who pass suddenly from an active to a sedentary life, or from leanness to corpulency. Any circumstance which produces a tendency to pressure on the venous return of blood in the pelvis is to be reckoned as a local cause. The accumulation of fæcal matter in the intestines as in habitual constipation; efforts to expel urine; the pressure produced by polypi; the obstruction of any of the viscera, especially of the liver; worms; use of drastic purges, particularly of aloes; long continuance in a sitting posture; riding on horseback; pregnancy; the accumulation of water by ascites;— such are some of the ordinary causes of hæmorrhoids.

Several varieties of hæmorrhoids are distinguished. They are known as external when apparent at the anus; internal when concealed within the orifice; blind or open, regular or irregular, active or passive, periodical or anomalous, etc. There is also a great difference in the quantity of blood discharged; it is usually inconsiderable, but in some cases is so great as to threaten the life of the subject. The quality, color, etc., of the blood, also differ in different cases. The number, seat, and form of the hæmorrhoidal tumors likewise present a great variety of appearances. When the disease is purely local it is cured more readily; but in the greatest number of cases it is connected with some other affection, or with the constitution of the subject. In these cases, if the piles are not troublesome on account of their size, or if the bleeding is not very considerable, cure of the primary affection should be attempted. The best mode of treatment is then to recur to hygienic rather than medicinal influences. The subject should avoid violent exercises, but moderate exercise will be found beneficial. The standing position is to be avoided as much as possible, especially following defecation. The constipation (q.v.) with which the subjects of this disease are liable to be affected should be remedied by hygienic dieting. If the pain is considerable, recourse should be had to sedatives and local application of hot water. If the disease appears under a more severe form, more violent remedies will become necessary. If the discharge of blood becomes excessive, particular care must be taken to regulate it. If the tumors acquire a considerable volume, surgical operations are necessary. At the present time the operative treatment of persistent hæmorrhoids is both safe and efficacious.

Hafiz, hâ-fĭz', the pseudonym of Mohammed Shems ed dîn, Persian poet: b. Shiraz in the beginning of the 14th century; d. 1388. The surname Hafiz was given him because he knew the Koran by heart. He was also called *Shakarlab* (Sugar-lip), from the flowing melody of his ghazals or short lyrics; and *Lissan Elghaïb* (the Mysterious Voice), from the deep mystic meaning said by his warmest admirers to be contained in many of his poems. He preferred independent poverty as a dervish to a life at court, whither he was often invited by Sultan Ahmed. He became a sheik or chief of a fraternity of dervishes, and died at Shiraz where a monument was erected to him, still frequently visited by pious Moslems. He is the greatest lyrical poet of Persia, and he furnishes the safest guide to Persian thought and manners. The songs of Hafiz were collected into a *Divan* (a Persian word for a collection of poems) after his death, which was first published at Calcutta in 1791, and translated into German by the celebrated orientalist Hammer-Purgstall (1812–13). A complete English translation by Clarke appeared in 1891. A critical edition of the Persian text, with scholia, etc., was published by Hermann Brockhaus (1854–61). Consult Horn, 'Geschichte der persischen Litteratur' (1901).

Hag-fish, a name given to the species of the families *Heptatremidæ* and *Myxinidæ Myxine*, and *Bdellostonia* of the class of Cyclostomi (q.v.). They are eel-like in shape, lack all paired fins, have a suctorial mouth, without jaws; a single nostril at the tip of the head and either one (*Myxine*) or from 6 to 14 (*Polistotrema*) gill openings along the sides of the body. Around the mouth are eight barbels, and the nostril connects with the cavity of the mouth. The skin contains numerous mucus-glands and also numerous pockets of "thread cells," the protoplasm of which is converted into long threads, which, when discharged, unwind and, together with the mucus, form a jelly-like mass protecting the animal. The eggs are large, oval in shape and enclosed in a horny case provided with hooks on each end by which they are anchored to sea weed, etc., on the bottom. Where abundant the hag-fishes are among the greatest pests of the fishermen. They attach themselves to other fishes in the neighborhood of the gills or on the eyes, and thence work themselves rapidly into the interior of the body, devouring the viscera, muscles, etc., so that there remains "a living hulk of head, skin and bones." The California hag-fishes (*Polistotrema Stouti*) will devour a fish of 10 or 15 pounds in a single night, and it is believed that they enter the fishes after they are taken in the nets. The hag-fish of the eastern coast (*Myxine glutinosa*) ranges north of Cape Cod, and in the European seas, south to the English Channel. Other species occur in other parts of the world.

Hagar, hā'gar, an Egyptian handmaid in Abraham's house. She was presented by her mistress Sarah to Abraham, in order that Abraham might not die without descendants, Sarah herself being barren. Hagar bore Ishmael; but Sarah soon became jealous of her, and treated her severely. When Sarah bore Isaac, Hagar was sent away by Abraham, who, the Bible informs us, had received a divine order to dismiss her. She suffered much distress in the desert, but was relieved by an angel, and married her son to an Egyptian woman.

Hagen, Gotthilf, gŏt'hilf hä'gĕn, German hydraulic engineer: b. Königsberg, Prussia, 3 March 1797; d. Berlin 3 Feb. 1884. He studied at the University of Königsberg; in 1816 observed at Kulm the total eclipse of the sun, but later turned his attention from astronomy to engineering, and from 1831 to 1849 was professor of hydraulic engineering in the School of Engineering. The naval harbor of Wilhelmshafen, one of the strongest on the German Ocean, was built from his designs. In 1869 he became director of the Prussian building department. His most important work is his 'Handbuch der Wasserbaukunst' (1841–65), besides which he published numerous other volumes, including: 'Die Kanalisierung der obern Saar' (1866), and 'Untersuchungen über die gleichförmige Bewegung des Wassers' (1876).

Hagen, Theodor, tā'ō-dōr, German painter: b. Düsseldorf 24 May 1842. He became known through his landscapes of the Eifel Mountains and Westphalia, in 1871 was appointed professor in the Weimar art school, of which he was also director from 1877. In 1881 he resigned both posts and returned to Düsseldorf. He obtained a gold medal at the Berlin exposition of 1891. Among his works, distinguished by their forceful drawing and excellence of aërial perspective, are: 'The Kanderthal in Switzerland'; 'Sunset in the Siegenthal'; 'Spring Weather'; 'Swiss Landscape, with the St. Gothard Pass'; 'Town on the Lower Rhine — Evening.'

Ha'gerstown, Md., city, county-seat of Washington County, on Antietam creek, and on the Baltimore & O. the Cumberland V., the Norfolk & W. and the Western M. R.R.'s. Here are extensive manufactures of knit goods, bicycles, machinery, steam engines, lumber, etc. It is the trade centre of western Maryland and contains a court-house, high school, Bacon's School for boys and girls, electric light and street railways, three national banks, and an assessed property valuation of $7,000,000. Pop. (1900) 13,591.

Haggadah, ha-gā'da, one of two rabbinical biblical interpretations forming the Midrash (q.v.).

Haggai, hăg'ī, the tenth of the minor prophets, and first of those who prophesied after the captivity. He was born in Babylon, and joined the first band of exiles who, on the issue of the decree of Cyrus (536 B.C.) returned to their own land. He was buried among the priests at Jerusalem, as belonging to the family of Aaron. The book of Haggai consists of four distinct prophecies and has but one theme, the building of the second temple. The brevity of the several prophecies is so great, and the poverty of expression which characterizes them so striking, as to give rise to an idea that in their present form they are but the outline or summary of the original discourses. They were delivered in the second year of Darius Hystaspes (520 B.C.), at intervals from the first day of the sixth month to the twenty-fourth day of the ninth month in the same year. The closing prediction foreshadows the establishment of the Messianic kingdom upon the overthrow of the thrones of the nations.

Haggard, hăg'ard, **Andrew Charles Parker**, English novelist: b. Bradenham Hall, Norfolk, 7 Feb. 1854. He is a brother of H. R. Haggard (q.v.) and besides serving with distinction in the English army has published 'Dodo and I'; 'Polyglot Poems'; 'Under Crescent and Star'; 'Love Rules the Camp,' and other books.

Haggard, Henry Rider, English novelist: b. Bradenham Hall, Norfolk, England, 22 June 1856. At 19 he went as secretary to Natal, and served on the staff of Theophilus Shepstone during his mission to the Transvaal in 1877. In 1884 he was admitted to the bar of Lincoln's Inn, but has devoted his time mainly to authorship and agriculture. His novels of South African life have attained a wide popularity both at home and in the United States. Among his works are: 'Cetewayo and His White Neighbors' (1882); 'Dawn' (1884); 'The Witch's Head' (1885); 'King Solomon's Mines' (1886); 'Jess' (1887); 'She' (1887); 'Allan Quatermain' (1888); 'Colonel Quaritch, V. C.' (1888); 'Cleopatra' (1889); 'Beatrice' (1890); 'Montezuma's Daughter' (1894); 'Doctor Therne' (1898); 'History of the Transvaal' (1900); 'Lysbeth' (1901); 'Rural England' (1902); 'A Gardener's Year' (1905); etc.

Haghe, Louis, loo-ē hāg, Belgian painter and lithographer: b. Tournai 17 March 1806; d. London 9 March 1885. At first an architect, he turned to landscape painting, in 1832 went to London, there as a lithographer entered partnership with William Day, then became interested in water-color painting, and in 1873–84 was president of the New Water Color Society. He painted by preference old Flemish interiors, such as 'Audience Chamber at Bruges,' but also scenes from English history ('Cromwell with the Letter of Charles I.'), and other subjects. In oils he was less successful. He worked entirely with his left hand.

Hagiographa, hā-ji-ŏg'ra-fa, a Greek word, signifying sacred writings, first introduced by Epiphanius as the rendering of the Hebrew word *Ketubim* = writings. The third and last great division of the Old Testament books, the others being Torah (the Law) and Nebiim (the Prophets). The three-fold division is alluded to in the New Testament, the several parts being described as "the law" or "Moses," "the Prophets," and "the Psalms" (Luke xxiii. 44). In this passage the Psalms are the Hagiographa. When the division is twofold, the Law and the Prophets, the Hagiographa are merged in the second category (Matt. v. 17, xi. 13). In our present Hebrew Bibles the Hagiographa consist of 13 books thus arranged: Psalms, Proverbs, Job, Song of Solomon, Ruth, Lamentations, Ecclesiastes, Esther, Daniel, Ezra, Nehemiah, and I. and II. Chronicles, but the list is otherwise drawn up by many authorities.

Hagonoy, hā-gō-noi', Philippines, a pueblo of the province of Bulacán, island of Luzon, on the Grande de la Pampagna River, about three miles from Manila Bay, seven miles southwest of Malolos. Lake Hagonoy is partly within the precincts of the town; this lake dries up in the summer season, so that the lake bed can be cultivated. Pop. 20,100.

Ha'good, Johnson, American soldier: b. Barnwell, S. C., 21 Feb. 1829; d. there 4 Jan. 1898. At the beginning of the Civil War he entered the Confederate army and in 1862 became a brigadier-general. He fought against Gillmore at the siege of Charleston (1863), and was commander of Battery Wagner. With his brigade he participated in the battle of Cold Harbor, and subsequently was in the trenches at Petersburg. He took part also in the operations north of the James after the surrender of Fort Harrison, and commanded Bragg's rear guard at Fort Fisher.

Hague, hāg, **Arnold**, American geologist: b. Boston 3 Dec. 1840. He was graduated at the Sheffield Scientific School of Yale (1863); studied three years at the universities of Göttingen and Heidelberg, and in 1867 was appointed assistant geologist on the United States geological exploration of the 40th parallel. His published works are: 'The Volcanoes of California, Oregon, and Washington Territory' (1883); 'The Volcanic Rocks of the Great Basin' (1884); 'The Volcanic Rocks of Salvador' (1886); 'Crystallization in the Igneous Rocks of Washoe'; 'Geology of the Yellowstone National Park' (1899).

Hague, George, Canadian financier: b. Rotherham, Yorkshire, Eng., 1825. In 1854 he went to Canada, where in 1856–76 he was connected with the Bank of Toronto. Subsequently he became general manager of the Merchants' Bank. He was also elected first president of the Canadian Bankers' Association and of the Montreal Good Government Association, and made generous gifts to various charities.

Hague, The (Holland), one of the chief towns, practically the capital of the kingdom, 33 miles southwest from Amsterdam, 16 miles northwest of Rotterdam, within 3 miles of the sea. It is the residence of the queen and of the foreign ambassadors, and the seat of the States-General of the Netherlands, and of the principal part of the central administration of the kingdom. Among the most important structures are the royal palace, in the Nordeinde, the palace of the Prince of Orange, the palace of Prince Frederick of the Netherlands; the Binnenhof, a large irregular building, founded in 1249, and containing the hall of assembly of the States-General, and various government offices, the provincial government-house, a large roomy edifice; the town-hall; the ministry of justice; the municipal museum, containing pictures and antiquities; the royal library, containing 500.000 volumes, besides valuable collections of medals and cameos; a cannon foundry, one of the largest and most conspicuous buildings in the town, colonial office, war office, the national monument, erected to commemorate the restoration in 1813 of Dutch independence. There are many other monuments to attract attention, particularly the equestrian statue of William I. of Orange, in front of the royal palace, and the figure of Shinoya, placed opposite the house in which he lived, etc. The royal collection of pictures, in the Prins Mauritshuis, embraces a picture gallery chiefly confined to Dutch masters. The parks, gardens, markets and suburbs of the city are famous for their beauty and interest. The special educational facilities of the city are excellent, and there are good public schools. There are also many learned societies in the city, among which may be mentioned The Hague Society for the Defense of the Christian Religion, the Witte Society, the Physics Society and the Netherland-India Institute. The Hague is not a manufacturing or commercial city, its chief revenue being derived from the throngs of foreigners who visit the city and watering place on the coast.

The origin of The Hague may be traced to the building of a hunting seat here of the counts of Holland in 1250. It is the birth-place of William II., prince of Orange, and William III., prince of Orange and king of England. Here were held the International Peace Congresses in 1901–2 and 1907. Pop. (1900) 199.285.

Hague Court, The, a permanent tribunal for international arbitration established as a result of The International Peace Conference, held in May, June, and July 1899 at The Hague, the governmental seat of the Netherlands.

The Hague International Peace Conference was one of the most important events which marked the close of the 19th century, and has been justly styled "the first great parliament of Man". The Conference assembled in response to a rescript issued by Czar Nicholas II. of Russia, 24 Aug. 1898, inviting to a conference all governments with representatives accredited to the Imperial Court. The Conference was to occupy itself with the great problem of universal peace, especially through the international diminution of armaments by land and sea, and the prevention of armed conflicts by pacific diplomatic procedure. The invitation was accepted by all the governments to whom it was tendered, and the first meeting for the Conference was fixed for 18 May 1899 at The Hague,—the capital of the Netherlands being selected, as stated by the Russian minister of foreign affairs, because "His Imperial Majesty considered it advisable that the Conference should not sit in the capital of one of the Great Powers where so many political interests centre that might impede the progress of a work in which all the countries are equally interested". The Conference was held at the celebrated Huis ten Bosch — House in the Wood,— the members assembling in the historically decorated Orange Hall. Each nation was represented by prominent diplomats, jurists, men of affairs, soldiers, and sailors, the representatives of the United States being Ambassador Andrew D. White, Minister Newel, General Crozier of the army, Captain Mahan of the navy, Seth Low, mayor of New York, and F. W. Holls of the New York bar. The president of the Conference was Baron de Staal of the Russian delegation.

Three committees were formed to deal respectively with disarmament, regulations in warfare, and mediation and arbitration. The final act of the Conference, signed 29 July 1899, comprised three conventions or treaties embodying the results arrived at by the committees. The first and most important was the Convention for the Peaceful Adjustment of International Differences by the permanent institution of a Court of Arbitration in the midst of the independent powers, accessible to all. The second convention dealt with the laws and usages of war on land, and the third convention provided for the adaption to naval warfare of the principles of the Geneva Convention of 1864. Regulations also prohibited the throwing of projectiles and explosives from balloons; the use of projectiles intended solely to diffuse deleterious and asphyxiating gases (this was not accepted by the United States and Great Britain); and the use of soft expansive bullets. The last two conventions embodied the wisest and most humane principles of military conduct resulting from a study and discussion of these matters during the half-century preceding, and which had their first codification in the "Instructions for Guidance of the Armies of the United States" issued at the beginning of the Civil War.

The Convention for the Peaceful Adjustment of International Differences, however, was the crowning work of the Conference, and was a source of much gratification to the advocates of international arbitration, as bringing to fruition a sentiment which for centuries had hoped for the establishment by the nations of the earth of some permanent form of congress or court, which should be vested with functions to insure the preservation of peace and to deliver the world from the strife and carnage with which it had been afflicted in all the past ages.

During the last decade of the 19th century peace advocates had been persistent in their advocacy of a permanent court of arbitration. In 1894, at its meeting in Holland, the Interparliamentary Union, a voluntary organization of members of the national legislative bodies of the nations, adopted a declaration in favor of a permanent court of arbitration; and in 1896 resolutions to the same effect were unanimously adopted in the United States at the annual Mohonk Conference on international arbitration, and by the New York State Bar Association, the latter presenting to the President of the United States a memorial setting forth a permanent tribunal as the essential feature of any general scheme of arbitration. The honor of presenting such a proposition in The Hague Conference fell to Lord Pauncefote, chairman of the British delegation; Germany was antagonistic, but the sentiment was so strongly in its favor that the German delegates were induced to withdraw their objection, and provision was made for its consummation. The fourth division of the Convention in 47 articles provides for the creation of the Court, defines its jurisdiction and the principles which are to guide it, specifies the manner in which its members are chosen, the rules governing its procedure, its awards, and other necessary details. The Convention provides that each of the 26 signatory powers shall appoint for a term of six years as members of the Permanent Court not more than four persons "of recognized competence in questions of international law, enjoying the highest moral reputation." These persons constitute a Permanent Court of Arbitration, accessible at all times and acting in accordance with the prescribed rules of procedure; they do not, however, sit as a collective body, but when two or more nations have a case to submit to arbitration, they select by mutual agreement one, three, or five members, who will act as the tribunal to try the case. Thus it happens some members of the Court may never be called upon to discharge the functions of a judge. Also, although The Hague is designated as a place where the Court shall hold its sessions, another place may be designated by agreement of the litigant parties. Under the presidency of the Dutch minister of foreign affairs, the diplomatic agents of the signatory powers, in residence at The Hague, constitute a permanent council which serves as the office of the Permanent Court of Arbitration. The first cases adjudged by the Court were the Pious Fund Claim between Mexico and the United States in 1902, and the difficulties of Venezuela with the United States and various European nations in 1903.

For the erection of a Temple of Peace comprising a comprehensive library of international law, and a courthouse which could be used as a meeting place for the Permanent Court of Arbitration, Andrew Carnegie on 25 April 1903 donated the sum of $1,500,000 to be administered by the Government of the Netherlands as trustee for the other signatory powers of The Hague Convention of 29 July, 1899. Consult Foster, "Arbitration and The Hague Court" (1904); Holls, "The Peace Conference at The Hague" (1900); Penfield, "Some Problems of International Arbitration" (1904).

Hahn, hän, **August**, German Protestant theologian: b. Grossosterhausen, Saxony, 27 March 1792; d. Breslau, 13 May 1863. He studied at Leipzig, and was appointed in 1819 professor extraordinary of theology at Königsberg. In 1826 he became professor of theology at Leipzig, and in 1833 was called to Breslau, and in 1844 became general superintendent of the Province of Silesia. Among his best known works are his Hebrew Bible (1831) and his 'Bibliothek der Symbole und Glaubensiegeln der Apostolisch-Katholischen Kirche' (1842, 2d ed. 1878).

Hahnemann, hä'nĕ-män, **Samuel Christian Friedrich**, German physician: founder of the homœopathic system: b. Meissen 10 April 1755; d. Paris 2 July 1843. In 1775 he went to Leipsic, where, against his father's will, he studied medicine, and found the means chiefly by the translation of English medical works. At a later period he went to Vienna, and after some years he returned and completed his studies at Erlangen. He afterward practised medicine at various places, but gave it up for a time, until, in 1789, by the translation of Cullen's 'Materia Medica,' he was led to adopt a new method of cure. His system was fully explained in his 'Organon der rationellen Heilkunde' (1810). In 1820 the government prohibited him from dispensing medicines, and thereby, from his inability to have them prepared by druggists, obliged him to give up his practice. Duke Ferdinand of Anhalt-Köthen, however, gave him an asylum at Köthen, and conferred upon him the title of Hofrath. Here he remained till 1833, when he proceeded to Paris, where he hoped to find a wider sphere for his operations. The result equaled his expectations; and a royal decree issued in 1835 authorized him to practise homœopathy. Among his works should be named 'Dictionary of Materia Medica,' his 'Essays on Poisoning by Arsenic, and on the Effects of Coffee,' and his treatise on 'Chronic Affections.' Consult: 'Life and Letters,' by Bradford (1895). See HOMŒOPATHY.

Haidarabad, hī-da-ra-bäd'. See HYDERABAD.

Hail, small masses of ice or frozen rain falling from the clouds in showers or storms, varying in their form, being either angular, pyramidal, or stellated; as well as in their consistency, being sometimes as hard as ice and sometimes as soft as snow. The theory that the formation of hail is dependent on the presence of whirlwind phenomena in the upper atmosphere, has gained considerable acceptance. The formation of the alternate coatings of ice and snow is, on this theory, produced by a series of vertical ascents and descents to and from an upper snow region and a lower region where the temperature is rather higher.

Hail Columbia, a national song of the United States. The words written during a period of great political excitement in 1798, by Judge Joseph Hopkinson, were set to the melody of the 'President's March,' composed the same year in honor of President Washington, by Pfyles, orchestral leader at the John Street Theatre, New York. The composition first sung at a theatrical benefit attained great popularity, and on account of its patriotic sentiments has become a representative national song.

Hail Mary, Ave Maria, or **Angelical Salutation**, a prayer consisting of three parts: the first, the words by which the angel addressed the Blessed Virgin (Luke i. 24) with the word Mary after "Hail"; the second, the words by which Elizabeth addressed Mary (Luke i. 42), to which has been added the word Jesus; the third, the words: "Holy Mary, Mother of God, pray for us sinners now and at the hour of our death — Amen." The name, "Angelical Salutation," comes from the first part of the prayer, which is the salutation of the angel. The first and second parts, taken from the Bible, were in use in their present form in early times; but the words of the third part were varied until the 16th century when the present form was approved and adopted by Pope Pius V. The prayer is in general use among Roman Catholics and is found in many Anglican books of devotion.

Hailes, Lord. See DALRYMPLE, SIR DAVID.

Haileybury College, England, an institution at Hailey, near Hertford, 20 miles north of London, founded by the East India Company in 1806, as a training school for admittance to the service of the company. It attained a high reputation, and numbered among its alumni, the most distinguished names connected with the Indian administration of the 19th century. After the Indian Mutiny of 1857–8, and the government reorganization of the Indian Civil Service, the college was closed for four years. It was reopened under a royal charter in 1862 as a public school, and while maintaining many of the traditions of its famous predecessor is no longer an Indian service training ground. Handsome modern buildings have been added to the old college quadrangle, built in 1809; the surrounding grounds cover nearly 100 acres. Consult: Lowell, 'Colonial Civil Service' (1900); Monier-Williams, 'Memorials of Old Haileybury College' (1894).

Hailmann, hāl'man, **William Nicholas**, American educator: b. Canton Glarus, Switzerland, 20 Oct. 1836. He studied at the medical college of Louisville, Ky., was director of the German-American Seminary at Detroit in 1878–83, in 1894–8 was national superintendent of Indian schools, and in 1898 became superintendent of instruction at Dayton, Ohio. Among his writings are: 'History of Pedagogy' (1870); 'The Application of Psychology to Teaching' (1887); 'Place and Development of Purpose in Education' (1899).

Hair, strictly speaking, the peculiar epidermal covering of the body in mammals, although by analogy the term is loosely applied elsewhere, as to the setæ of annelids, the slender modified spines of caterpillars, etc. Hair is present in every mammal, although the amount may be greatly reduced so that in certain whales it occurs only in the fœtal stage, in others is limited to two bristles on the lips. The structure is best understood by following the development. In the earliest stage (Fig. 1) there is merely a thickening of the Malpighian layer of the epidermis (see SKIN) at the points where the hair is to be found. This thickening increases in amount, and thus forms a solid plug (Fig. 2) which projects into the underlying

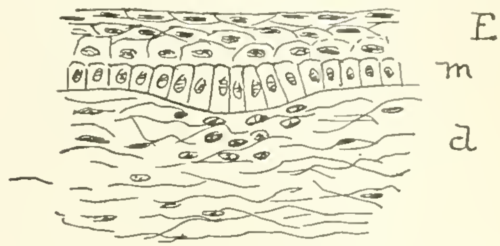

FIG. 1.—SECTION THROUGH THE EARLIEST STAGE OF HAIR FORMATION.

E, epidermis, showing in *m*, the Malpighian layer, the elongation of the cells; *d*, derma, with proliferation of cells to form the papilla shown in Fig. 2.

derma. At the same time the cells, which are scanty in most parts of the derma, become abundant beneath the ingrowing plug, and form the basis of the future papilla. Next a ring-shaped pit appears on the outer surface of the plug and gradually becomes deeper, cutting the epidermis into two parts, an outer root-sheath and an inner rod-like part, the hair itself, while

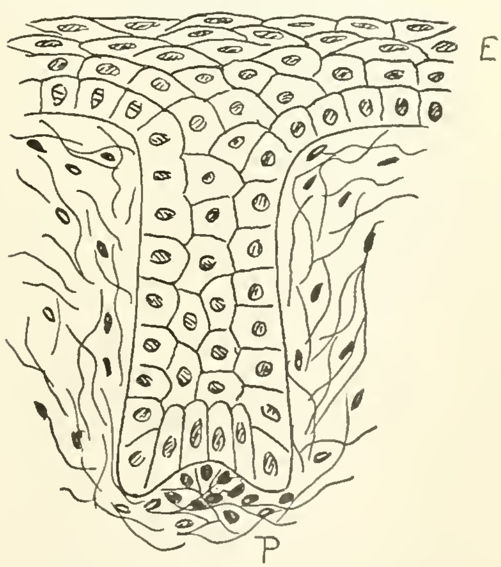

FIG. 2.— SECOND STAGE IN HAIR FORMATION.

The epidermis, *E*, has now formed a solid plug extending down into the derma; the papilla, *P*, has begun to form at the apex of the epidermal ingrowth.

the pit forms the follicle (see Fig. 3). The papilla grows into the base, bearing blood-vessels, while the Malpighian layer at this point forms the tissue from which the hair grows. In the hair itself several parts are recognized — a central pithy axis, the medulla; next, a layer of cells, the cortex, and outside this, forming the outer surface of the hair, the cuticle. Farther down in the follicle is the inner root-sheath, formed of two layers of cells known respectively by the names of the two anatomists, Henle and Huxley, who first described them. The Malpighian cells, at the base of the follicle, divide continually, and the new cells thus formed are pushed outward and are transformed into the hair. From this it will be seen that the hair is not a secretion but is composed of cornified cells. It is also apparent that the hair is not hollow.

The differences between the different kinds of hair are largely those of shape and of the amount of the various parts present. Thus in many animals two kinds of hair occur, longer and coarser hair on the outside, and beneath this a closer and softer under-fur. The coarser hairs may be enlarged into bristles, or still more enlarged to form spines, like those of the porcupines and hedgehogs. Again the hairs may become united to each other, the result being the formation of scales like those of the pangolins or horns like those of the rhinoceros. In some

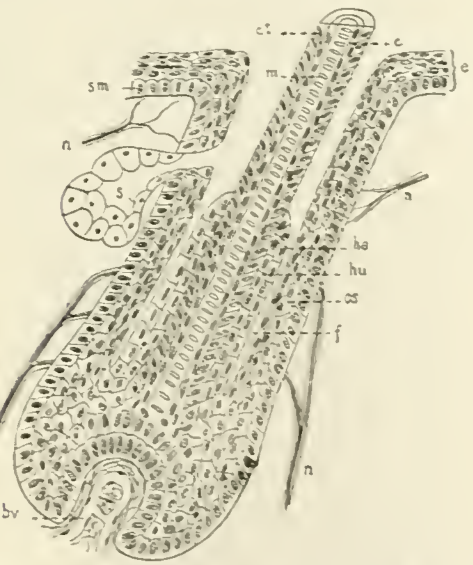

FIG. 3.— DIAGRAMMATIC SECTION OF HAIR AND HAIR FOLLICLE.

bv, blood vessel; c, cortex; ct, cuticle; e, epidermis; f, follicle; hs, Henle's layer; hu, Huxley's layer (hs and hu making up the inner root-sheath); m, medulla; n, nerve; os, outer root-sheath; s, sebaceous gland; sm, Malpighian layer of epidermis.

cases the hair is perfectly straight, again it may be curly. The straight hairs are circular in section, the curly are flattened, the amount of curl being proportional to the amount of flattening. Certain hairs (wool of sheep, etc.) have the property of felting. This depends upon the scale-like projections of the cells of the cuticular layer. The color of the hair is due to the presence of pigments belonging to the group of melanins.

Several accessory structures (Fig. 5) are connected with the hair: sebaceous glands which empty an oily substance into the follicle to keep the hair in a moist, soft condition; nerves which are distributed to the wall of the follicle and thus render the hairs to a certain extent organs of touch, as in the whiskers (*vibrissæ*) of cats; and muscles for the erection of the hair (*erectores pili*). This erection may be to increase the warmth of the body by entangling a layer of air among the hairs, or it may have the purpose of protection against injury, either by terrifying some enemy or by affording a loose envelope around the body some distance from

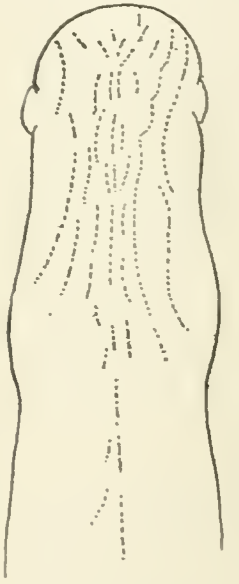

FIG. 4.— Hair tracts on the back of an embryo cat (after MAURER).

FIG. 5.— A HAIR. Vertical section of skin, showing hair-follicle and related parts: *a*, epidermis; *b*, hair; *c*, hair-bulb; *d*, *d*, oil-glands; *e*, fat-cells.

the flesh. Usually the hair is shed (molted) at regular intervals, but there are exceptions, as in the mane and tail of horses, as well as in the case of man.. The hair is not scattered irregularly over the body but occurs with more or less regular arrangement. In the early embryos it is not uncommon to find it distributed in regular lines (Fig. 4). Later the lines become broken up into groups of hairs, the arrangement being characteristic of the species, but without any broad morphological significance. It should be noted that although hair and pin-feathers closely resemble each other in general appearance they are very distinct structures, hair originating in a thickening of the epidermis, while feathers (q.v.) like scales are dermal in origin. Most of the literature relating to the hair is in German. Consult the writings of Maurer, Meigerle, Weber, and Poulton, 'Quarterly Journal of Microscopical Science,' Vol. XXXVI. (1894).

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Hair-dressing. As the hair is the greatest ornament of the human body, the arrangement of it has always been one of the most important duties of the toilet. The ancient Hebrews esteemed fine hair a great beauty, as several passages of Scripture show. The Hebrew women plaited their hair, confined it with gold and silver pins, and adorned it with precious stones. Herodotus informs us that the ancient Egyptians let the hair of the head and beard grow only when they were in mourning. Even in the case of young children they were wont to shave the head, leaving only a few locks on the front, sides, and back. The women, however, wore their natural hair long and plaited, often reaching down in the form of strings to the bottom of the shoulder-blades. A practice the very opposite seems to have prevailed among the ancient Assyrians, as regards men at least. In the Assyrian sculptures the hair always appears long, combed closely down upon the head, and shedding itself in a mass of curls on the shoulders. The beard was also allowed to grow to its full length. To the Greeks the hair was an object of great importance, and they devoted much time to it. Homer regularly applies to the Greeks an epithet denoting that they had ample flowing locks.

The Athenians curled their hair, and fastened it up with small golden ornaments shaped like grasshoppers, in token of their being "sons of the earth." Gold, pearls, precious stones, flowers, and ribbons were employed to ornament the tresses, and nets were also worn. False hair seems to have been latterly used, and in great quantities, both curled and frizzled. Married women were distinguished from the unmarried by the manner in which the hair was parted in front. The Romans generally wore no covering on their heads except at sacred rites, games, festivals, and in war. Women in later times wore great quantities of false hair, and dyeing the hair was common. They were particularly addicted to frizzling and curling their hair, raising it into stories of curls, some of great height. Long hairpins were used to fix the curls. Arranging the hair was a matter of great importance. Slaves frizzled and adjusted it, and a number of females learned in the art of the coiffeur superintended the process, while the fair dame herself watched the growing edifice of curls, gold, precious stones, crowns of flowers, in a mirror of polished steel, brass, tin, or silver.

On the introduction of Christianity the apostles preached against the prevailing fashion of dressing the hair. St. Paul regarded it as a shame for a man to have long hair, though the reverse for a woman. It then became common for men to cut the hair short; hence the clergy soon wore the hair quite short, and afterward even shaved their heads in part. In the time of Francis I., king of France, long hair was worn at court; but the king, proud of his wound on the head, himself wore short hair, in the Italian and Swiss fashion, which soon became general. In the reign of Louis XIII. the fashion of wearing long hair was revived, and as it became desirable to have the hair curling, the wigs were also restored.

Among the Anglo-Saxon women the custom prevailed of parting, curling, and turning the hair over the back. Anglo-Saxon men wore their hair long at the time of the Norman invasion, while the conquerors adopted the singular fashion of shaving the back of the head. Under Elizabeth, false hair was greatly worn, padded with cushions, under-propped, with forks, wires, etc., and adorned with gold, pearls, and precious stones. It is well known that the gallants of Charles I.'s time wore their hair in long flowing locks, while the closely-cropped hair of the Puritans brought the name of Roundheads down upon them. In the Queen Anne era, while the ladies wore their hair long, they generally tied it in a knot, and almost completely covered it up by extravagant head-dresses of wire and paste-board, or feathers and ribbons. At that time, and for long after, the coiffure of a lady was such a serious affair, and the hair-dressers were so fully employed, that fair wearers were often compelled to have that part of their toilet done two days before a ball, and pass the night on a chair for fear of disturbing the elaborate arrangement. This was the period of the prevalence of whitening the head with hair-powder, a preparation of pulverized starch and perfume. The custom of wearing it was introduced from France into England in the reign of Charles II. To make the powder hold, the hair was usually greased with pomade. In 1795 a tax was put upon the use of hair-powder in Great Britain, and at one time yielded $100,000 per annum, but the result was that hair-powder fell out of general use, and the French Revolution, which overturned so many antiquated customs, further contributed to throw it into disfavor. The chignon was introduced and had its day of popular favor in the 19th century, bringing back the fashion of false hair and padding to a greater or less extent. With respect to men's hair, short cutting is now universal, long hair being considered as a sign of slovenliness or eccentricity.

Hair Manufactures, the industries by which the hair of animals is employed in the production of commercial articles of ornament or utility. The strongest and most durable of haircloth is woven from the tails of horses. The horsehair from the mane is twisted into ropes and after being boiled and then dried in an oven is untwisted and in a half-matted condition employed for stuffing beds and cushions. The hair of cows is employed as a binder for plaster; in Europe it is sometimes woven into carpets, or hose. The Chinese use pig's hair for the same purposes. The stiff hair, or bristles from the ridge of the hog's back, are made into brushes, for the hair, teeth, or nails; as well as into brooms, and the larger painting and whitewashing brushes. Human hair is used for wigs, toupees and frisettes. See WIG.

Hair Pencil, in painting, a fine brush made of the hairs of the camel, sable, badger, squirrel, marten, raccoon, goat, etc. The various sizes require the quills of the crow, pigeon, goose, turkey, or swan. Hair pencils are used by artists in water colors, and by house and sign painters in fine work.

Hair-tail. See SCABBARD-FISH.

Hair-worm. See EELWORM.

Hairless Dogs. Several races of domestic dogs are bred in the warmer parts of the world, whose skins are nearly hairless. In China and Farther India a large dog of this description, called polygar, is used in hunting. Central Africa has a breed resembling a small black greyhound. A hairless dog is found mummified in prehistoric Peruvian tombs, and others were formerly prevalent in the West Indies, or is still known in Mexico. These have been cultivated by fanciers in the United States, and constitute a recognized show class. They are small and terrier-like, brownish or bluish-black, wrinkled, and have only a few straggling hairs on the body, with sometimes a tuft on the head.

Haiti, Hayti, or Santo Domingo, the second largest island of the West Indies, lying between Cuba and Porto Rico, the principal adjacent islands being La Gonave, at the entrance of Port-au-Prince, Tortuga Island, before Port de Paix, and Vache Island, before Cayes. The whole island is about 638 kilometres long with a surface of 75,074 square kilometres. It comprises two republics: the Republic of Haiti in the west and the Dominican Republic (q.v.) in the east, with a total population of 1,700,000. The land is very fertile, being irrigated by 47 rivers; 14 mountain chains are spread over the island. The mines are still to be worked and there is a large field for investment. Haiti is healthful. From June to September it is hot in the lowlands; but regular land and sea breezes moderate the temperature. In the mountains it is always cool. There is a dry and a wet season. There are no poisonous snakes or insects. The sanitary condition is excellent.

When, on 6 Dec. 1492, Columbus discovered Haiti, the island was divided into five states or "cacicats." The inhabitants, called Indians, had an easy life and were ruled by chiefs whose title was "cacics." The natives could not stand the hard work imposed on them by the Spaniards; they died rapidly. Then began the import from Africa of the black slaves. The Spaniards enjoyed alone their new possession until 1630, when the French adventurers known as "buccaneers" and "freebooters," after occupying Tortuga Island, undertook the conquest of what became St. Domingue.

From the intercourse between white and black, resulted in St. Domingue an intermediary class, the mulattoes. Most of the latter, on account of their relationship, were not slaves; and their black mothers, their relatives, and other slaves who could own enough money to redeem themselves, little by little obtained their freedom. These free colored people were not allowed any political rights. They at first did not resent it. They endeavored to become land-owners.

When the French Revolution broke out in 1789 these free men or "affranchis," who by that time had accumulated wealth, asked for equality of political rights. The Assemblee Nationale granted them those rights. But the French landlords or "colons" were not at all pleased to have the colored people for their fellow citizens. A hard struggle began. The "colons" called the English to their rescue.

At the end of the year 1793, the English took possession of a part of the island. St Domingue was considered lost to France, being occupied partly by the Spaniards, partly by the English, when Toussaint Louverture (q.v.) espoused the cause of France. This extraordinary man, who, up to 40 years of age, was a slave, revealed himself a great general and a first-class statesman. He succeeded in ridding the country of the Spaniards and in expelling the English, who, after an occupation of about five years, were compelled to abandon their prey. The French government rewarded him by appointing him major-general and governor of the island. Later on, Napoleon I. thought that Toussaint Louverture was too powerful. In 1801 he appointed his brother-in-law, Gen. Leclerc, governor of St. Domingue, and sent a formidable army to reduce the authority of Louverture. Toussaint Louverture, after a few skirmishes, surrendered and retired on one of his properties. Nevertheless, Gen. Leclerc caused him to be arrested and deported to France in June 1802; to that end the French general resorted to treachery.

The colored people took up arms against the French domination in September 1802 under the leadership of Gen. Dessalines. The fight was very severe. And at the end of the year 1803, Rochambeau, who, at the death of Gen. Leclerc, was in command of the French army, hard pressed in the city of Cape Haiti by the black troops, was compelled to capitulate. And on 1 Jan. 1804 Haiti proclaimed its independence, with Gen. Dessalines as its first ruler. Slavery was abolished. Haiti was then the first country to rid humanity of such a sad practice.

In 1822 the Spanish part came under the administration of Haiti; and the whole island was ruled by one government. But in 1844 the Spanish part seceded and established an independent government, known to-day as the Dominican Republic.

The Republic of Haiti is administered by a president, elected for seven years, by the House of Representatives and the Senate assembled in "Assemblée Nationale." The president is assisted by six ministers or secretaries of state. The House of Representatives is elected by the people for three years, and the Senate is elected by the House of Representatives for six years; but every two years the third part of the Senate is renewed.

The judiciary organization consists of a supreme court (Tribunal de Cassation) of civil, criminal, correctional courts, and of justices of the peace.

Education is compulsory and gratuitous. The primary as well as the high schools are freely open to all. Haiti devotes now a sixth of its revenues to education.

French is the language of Haiti, though the country people speak a patois called "creole."

The religion of the people is Roman Catholic. There are an archbishop, three bishops, and in every commune at least a priest. The pope entertains a diplomatic representative, a legate, at Port-au-Prince, and Haiti has a minister accredited to the Holy See. Freedom of conscience is, however, guaranteed; and all cults are protected. Haitian citizens only can own real estate. Any foreigner may easily be naturalized.

Haiti produces coffee, cocoa, logwood, mahogany, and cotton; tortoise-shells, all kind of cabinet wood, hides, honey, bees-wax, etc., are also exported; for home consumption, they make sugar, rum, soap, straw hats, pottery, matches, artificial ice, etc. There is a railroad from Cape Haiti to Grande Rivière and another one from Port-au-Prince to "L'Etang." These railroads are managed by Haitian companies; so are the inland telegraph and telephone lines. The area of the Republic is estimated at 26,000 square kilometres and the population (1900) 1,294,400.

J. N. LÉGER,

Envoyé Extraordinare et Ministre Plénipotentiaire d'Haïti aux Etats-Unis.

Hake, Alfred Egmont, English journalist and author. He is a son of Thomas Gordon Hake (q.v.) and cousin of General C. E. Gor-

MAIN STREET, PORT-AU PRINCE, HAITI

don (q.v.), whose life he has written in 'The Story of Chinese Gordon' (1883). Other works by him are: 'Paris Originals' (1878); 'Flattering Tales' (1882); 'The Unemployed Problem Solved' (1883); 'Events in the Taiping Rebellion' (1891); 'Suffering London' (1892); 'Gordon in China and the Soudan' (1896); 'Irish Finance' (1897).

Hake, Thomas Gordon, English poet and physician: b. Leeds 1809; d. London 11 Jan. 1895. He took his medical degree at Glasgow University in 1831, and practised his profession in East Anglia, later becoming the physician and friend of Dante Gabriel Rossetti. His poetry is thoroughly original, but very subtly philosophical. His works include: 'Poetic Lucubrations' (1828); 'Vates: A Prose Epic' (1839); 'Madeline with Other Poems and Parables' (1871); 'New Symbols' (1875); 'Maiden Ecstasy,' verse (1880); 'The Serpent Play, a Divine Pastoral' (1883); 'Memoirs of Eighty Years' (1892).

Hakes, Fishes of the family *Gadidæ* and chiefly of the genera *Phycis* and *Merluccius,* distinguishable from the cod and haddock by having only two dorsal fins. *Phycis* has a chin barbel and filamentous ventral fins, both of which are lacking in *Merluccius.* The squirrel-hake (*Phycis chuss*) and white hake (*P. tenuis*), both also called ling or codling, are common bottom fish on our Atlantic coast from Virginia northward. The silver hake or whiting (*Merluccius bilinearis*) has a similar range, but is less common in shallow waters and leads a roving life in search of herrings and other smaller fishes. Various other species occur in the North Atlantic and Pacific Oceans. The hake fishery is of considerable extent, and the product is salted and sold chiefly as boneless cod. The dried air-bladders are utilized in the manufacture of isinglass.

Hakim, ha-kēm', a Turkish word, signifying lord and frequently in the Koran applied to Allah, God, as in the Greek and English versions of the Jewish Scriptures the word Lord is used for Jehovah. It is now-a-days especially given as a title of honor to the imperial physician of the Sultan, who is Hakim bashi, that is to say, the chief of the physicians, always a Turk; whilst the physicians in the seraglio under him are western Europeans, Greeks and Jews.

Hakluyt, hăk'loot, **Richard,** English geographer: b. about 1553; d. London 23 Nov. 1616. He entered Christ Church College, Oxford, in 1570, and became so eminent for his acquaintance with cosmography that he was appointed public lecturer on that science. In 1582 he published a small collection of voyages and discoveries, forming the basis of a subsequent work on a larger scale. In 1584–88 he was in Paris as chaplain to Sir Edward Stafford. On his return he published (in 1589) his famous collection of 'The Principal Navigations, Voyages, and Discoveries of the English Nation, made by Sea, or over Land, within the Compass of these 1500 Years.' The first volume of a new edition of his great work was published in 1598, the second and third in 1599 and 1600. In 1602 he became prebendary, and in 1603 archdeacon, of Westminster, and next year he was appointed a chaplain of the Savoy. He was interred in Westminster Abbey. He published several other geographical works, among them 'Virginia Richly Valued, etc.' (1609), a translation from the Portuguese. An edition of his chief work appeared in 16 vols. 1885–90. The manuscript papers of Hakluyt were used by Purchas in his 'Pilgrims.'

Hakluyt Society, of Great Britain, organized in December 1846, for the purpose of printing and distributing among its members rare volumes on voyages and travels, and geographical records. Between 1847 and 1900 fully 100 volumes were issued under the editorial supervision of eminent authorities. Among these publications were: 'Select Letters of Columbus' (1849); Raleigh, 'Guiana' (1848); and 'Danish Arctic Expedition' (1897).

Halbig, Johann, yō'hän häl'bĭg, German sculptor: b. Donnersdorf, Lower Franconia, 13 July 1814; d. Munich 29 Aug. 1882. He studied at the Munich Academy, and elsewhere, finally establishing himself at Munich, where he became a professor in the Polytechnic School in 1845. His most important work is the quadriga with four colossal lions for the triumphal gateway, Munich. He also executed the Platen memorial at Ansbach, the bronze statue of Fraunhofer at Munich, the 'Emancipation' group in New York, the 'Crucifixion' group for Oberammergau, and numerous busts.

Haldeman, hâl'dĕ-man, **Samuel Stehman,** American naturalist: b. Locust Grove, Pa., 12 Aug. 1812; d. Chickies, Pa., 10 Sept. 1880. He was educated at Dickinson College, Pa., was professor of natural sciences at the University of Pennsylvania in 1851–5; and of comparative philology there 1869–80. He published 'Fresh-Water Univalve Mollusca of the United States' (1840); 'Zoological Contributions' (1842–3); 'Elements of Latin Pronunciation' (1851); 'Affixes in Their Origin and Application' (1865); 'Pennsylvania Dutch' (1872); 'Outlines of Etymology' (1877); 'Analytic Orthography' (1858); etc.

Hal'dimand, Sir **Frederick,** Swiss soldier in the English service: b. Canton of Neuchâtel, Switzerland, October 1718; d. Yverdun, Switzerland, 5 June 1791. He served in the army of Sardinia and in that of Prussia under Frederick the Great, later became a member of the Swiss guard at The Hague, and was there stationed when with Henry Bouquet (q.v.) he enlisted in 1756 in the British army for service in America. He organized, largely from Pennsylvania, a regiment composed of Swiss, Germans, and others and known as the 'Royal Americans,' and became its commander. In 1759 he won distinction by his successful defense of Oswego against the attack of 4,000 French and Indians, in 1767–73 commanded the garrison at Pensacola, Fla., and assisted Gage in the siege of Boston. From 1778 to 1784 he was governor of Canada, severely repressed Canadian sympathy with the Revolution, and offered an asylum to royalist refugees. His valuable official correspondence is in the possession of the British Museum. Upon his return to England actions for false imprisonment were successfully brought against him.

Hale, Charles Reuben, American Protestant Episcopal bishop: b. Lewiston, Pa., 14 March 1837; d. Cairo, Ill., 25 Dec. 1900. He was graduated at the University of Pennsylvania in 1858; entered the Episcopal ministry and in 1892 was made assistant bishop of Springfield, Ill., with the title of Bishop of Cairo. He was an authority upon matters pertaining to the Greek Church and his writings, all of a very scholarly cast, mainly relate to the history, liturgies and customs of that communion.

Hale, Edward Everett, American Unitarian clergyman and author: b. Boston, Mass., 3 April 1822. His father was Nathan Hale (q.v.), the first editor of the Boston *Daily Advertiser,* and the son was educated at the Boston Latin School and Harvard College. Later he studied theology and after being licensed to preach in 1842 was pastor of the Church of the Unity, Worcester, Mass., 1846–56. He then became pastor of the South Congregational Society in Boston, a Unitarian Church, and has been its pastor emeritus from 1901. In the Unitarian body he has long been one of its foremost men, and of a radical rather than a conservative type, while yet strongly loyal to the Unitarian faith. As a preacher he has always been popular, and his talents for organization have borne fruit in such humanitarian societies as the Harry Wadsworth Clubs, King's Daughters, Look Up Legions, and others. For several years he edited 'Old and New,' a magazine afterward merged in 'Scribner's Monthly,' and has edited 'Lend a Hand,' a journal of organized charity, since 1886. Since his retirement from active pastoral work he has been active in various denominational and other religious and social enterprises, and still continues to preach and lecture at frequent intervals. His 80th birthday was celebrated by a gathering in Symphony Hall, Boston, composed of representative persons from all denominations in his native city, as well as of civic and state officials, assembled to testify to the regard in which he was held, irrespective of creed or race. To Americans in general, however, he is best known as an author, and in spite of his countless clerical labors he has been one of the most voluminous of American writers. Much of his work is from necessity ephemeral in its nature, but when he has consciously wrought with an artistic end in view his level of attainment has been high. His short story, 'The Man Without a Country,' has long been accounted an American classic, and even more skilful in construction and perfect in finish, 'My Double and How he Undid Me,' and 'In His Name' have been almost equally popular. In extravaganzas like 'The Brick Moon,' such an absolute air of verisimilitude is preserved that the absurdest conceptions of the tale appear more than half credible. 'The Man Without a Country' was indeed accepted as a record of fact by many readers on its first appearance in 1863, although the theme is in its conception most improbable, and its author was obliged to state at a later date that it had no foundation in fact. The list of his published works is a long one, including nearly 70 titles and besides those already named may be cited 'Margaret Percival in America' (1850); 'Elements of Christian Doctrine' (1860); 'If, Yes, and Perhaps' (1868); 'Sybaris and Other Homes' (1869); 'The Ingham Papers' (1869); 'His Level Best and Other Stories' (1872); 'Philip Nolan's Friends' (1876); 'The Fortunes of Rachel' (1884); 'Boys' Heroes' (1886); 'Life of George Washington Studied Anew' (1887); 'They Saw a Great Light' (1889); 'The Story of Christopher Columbus' (1891); 'The Story of Massachusetts' (1891); 'The New Harry and Lucy' (1892); 'East and West or the New Ohio' (1892); 'A New England Boyhood' (1893); 'Fifty Years: Poems' (1893); 'If Jesus Came to Boston' (1894); 'Susan's Escort' (1895); 'Historic Boston' (1898); 'Lowell and His Friends' (1899); 'Memories of a Hundred Years' (1900). With his sister Susan Hale (q.v.) he has written a series of travel books entitled 'Family Flights through France, Germany, etc.,' and he has also edited numerous volumes from 'The Rosary' (1848) to 'Unpublished Essays of Emerson' (1895).

Hale, Eugene, American politician: b. Turner, Oxford County, Me., 9 June 1836. After study of law he was admitted to the bar in 1857, began practice at Ellsworth, Me., and was a member of the Maine legislature in 1867, 1868 and 1880. In 1868 he was elected representative to Congress, and in that capacity served until 1878, acting on the committee on appropriations, and during his last term being chairman of the Republican congressional committee. In 1868, 1876 and 1880 he was a delegate to the Republican national conventions of those years, in 1874 was offered the post of postmaster-general and in 1877 that of secretary of the navy, but declined both. He was a member of Grant's commission appointed for canvass of the Louisiana presidential vote in 1876. He succeeded Hannibal Hamlin in the United States Senate in 1881, and was re-elected in 1887, 1893, 1899 and 1905. In the Senate he became known as a Republican leader, interesting as a speaker and skilful in matters of legislative routine.

Hale, George Ellery, American astronomer: b. Chicago 29 June 1868. He was graduated from the Massachusetts Institute of Technology in 1890, studied also in the Harvard observatory and at Berlin, was professor of astrophysics at Beloit College in 1891–3, lecturer in astrophysics in Northwestern University, 1891–3, associate professor of astrophysics in the University of Chicago 1892–7; director of the Yerkes Observatory (Williams Bay, Wis.) of the university 1895–1905, professor of astrophysics 1897–1905, and in 1905 director of the Solar observatory of Carnegie Institution at Mt. Wilson, Cal. He edited the 'Astrophysical Journal' from 1895, and published papers on astronomical subjects.

Hale, Horatio, American ethnologist: b. Newport, N. H., 3 May 1817; d. Clinton, Ontario, 29 Dec. 1896. He was a son of Sarah J. Hale (q.v.). He was graduated from Harvard in 1837 and the next year was appointed philologist to the government exploring expedition under Captain Wilkes, and was thus enabled to study the languages of the Pacific Islands, North and South America, Australia, and Africa. The results of his observations were published in 'Ethnography and Philology' (1846). He then studied law, was admitted to the Chicago bar, and removing to Canada in 1855 practised law at Clinton. His other works are: 'Indian Migrations as Evidenced by Language' (1883); 'The Iroquois Book of Rites' (1883); 'A Report on Blackfoot Tribes' (1885). He was classed among the foremost philologists of his

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EDWARD EVERETT HALE

time and was a member of learned societies at home and abroad.

Hale, Irving, American soldier and electrician: b. North Bloomfield, N. Y., 28 Aug. 1861. He was graduated from the United States Military Academy in 1884, was assigned to the engineer corps, was instructor in engineering at the Military Academy in 1888–9, and in 1890 resigned from the army. He became manager of the General Electric Company for the district comprising Utah, Wyoming, Colorado, and New Mexico, with headquarters at Denver; upon the outbreak of the Spanish-American war was appointed colonel of the 1st regiment of Colorado volunteers, was promoted brigadier-general for distinguished service in the Philippines, and later brevetted major-general. In 1899 he was honorably discharged from the volunteer service. His writings include papers on electrical subjects in scientific and engineering journals and in the proceedings of the Colorado Scientific society.

Hale, John Parker, American legislator and diplomat: b. Rochester, N. H., 31 March 1806; d. Dover, N. H., 19 Nov. 1873. After graduation from Bowdoin in 1827 and study of the law at Rochester and Dover, he was admitted to the bar in 1830, in 1832 was elected a Democratic representative in the State legislature, and in 1834-41 was United States district attorney. In 1842 he was elected to Congress, where, though remaining a Democrat, he stoutly opposed the "gag-rule" which sought the exclusion of anti-slavery petitions. He was renominated; but previous to the election the annexation of Texas was made a plank of the Democratic platform, and the State legislature of New Hampshire directed its congressmen and senators to support the measure. Hale in a public statement refused to do this and the Democratic State Convention was then reassembled and his name stricken from the ticket. Hale ran as an independent Democrat, but no candidate received a majority. In 1846, after a spirited canvass known as the "Hale storm of 1845," he was elected to the lower house of the legislature, and became its speaker. In 1847 he was elected to the United States Senate, where he was the first, and, until joined by Salmon P. Chase in 1849, the only avowed anti-slavery member. He was an orator of fine abilities, and besides opposing the slave system, secured laws abolishing flogging and grog-ration in the navy. He was nominated for president by the Free-Soil Democrats in 1852, and received 157,685 votes. In 1855 he was elected to the Senate for the four years of the unexpired term of C. G. Atherton, deceased, and in 1858 for a full term. During the Civil War he supported the Lincoln administration. He was United States minister to Spain in 1865–9.

Hale, Lucretia Peabody, American author, sister of E. E. Hale (q.v.): b. Boston, Mass., 2 Sept. 1820; d. there 12 June 1900. She was very popular as a writer for young people, and in addition to 'The Lord's Supper and Its Observance' (1866); 'The Service of Sorrow' (1867); 'The Wolf at the Door' in the 'No Name Series' (1877), she published for young readers 'The Peterkin Papers' (1882), and 'The Last of the Peterkins' (1886). She also wrote 'The New Harry and Lucy' (with E. E. Hale). She will be longest remembered as the creator of the Peterkin Family, who have become widely recognized types of character.

Hale, Sir Matthew, English jurist: b. Alderley, Gloucestershire, 1 Nov. 1609; d. there 25 Dec. 1676. He was educated at Oxford and Lincoln's Inn, and is said to have studied 16 hours daily, extending his researches to natural philosophy, mathematics, history, and divinity, as well as the sciences more immediately connected with his profession. He was called to the bar before the commencement of the civil war; and in the conflict of parties which took place his moderation, accompanied as it was by personal integrity and skill in his profession, secured him the esteem of both royalists and parliamentarians in his own time. In 1654 he became a judge of the Common-bench (the former King's-bench), in which station he displayed firmness of principle sufficient to give offense to the Protector. He was a member of the parliament which restored Charles II., and one of the members most active in passing the Act of Indemnity. In 1660 he was knighted, and made chief baron of the Court of Exchequer. He was the last English judge who sanctioned the conviction of culprits for witchcraft. He was raised to the chief-justiceship of the King's-bench in 1671. After his death appeared his 'History of the Pleas of the Crown'; 'Jurisdiction of the Lords' House'; and 'The History of the Common Law of England. He also wrote several works on scientific and religious subjects.

Hale, Nathan, American revolutionary officer: b. Coventry, Conn., 6 June 1755; d. New York 22 Sept. 1776. He was graduated at Yale in 1773, and engaged as a teacher, first at East Haddam, and afterward at New London. His parents intended him for the ministry; but on the Lexington alarm in 1775 he wrote to his father, in a Connecticut regiment, saying "that a sense of duty urged him to sacrifice everything for his country," and soon after entered the army as lieutenant (1775) and in a few months was promoted to be captain (1776). While with the troops near Boston he was vigilant and faithful in every point of duty; and according to a tradition of doubtful authenticity, in September 1776, when in New York, he, with an associate, planned and effected the capture of a British sloop laden with provisions, taking her at midnight from under the guns of the man-of-war Asia, and distributing her prize goods to the American soldiers. After the retreat of the army from Long Island, when it was all-important to understand the plans of the enemy, Washington applied for a discreet and practised officer to enter the enemy's lines and procure intelligence, and Hale volunteered for the service. He passed in the disguise of a Dutch schoolmaster to the British camp and made full drawings and memoranda of all the desired information, but on his return was apprehended and taken before Howe, by whom he was ordered to execution the next morning. He was denied a Bible and the aid of a clergyman; and was hanged, saying with his last breath: "I only regret that I have but one life to lose for my country." A statue of Hale is in City Hall Park, New York. Consult the 'Life' by Johnston (1901); Holloway, 'Nathan Hale, the Martyr Hero' (1899).

Hale, Nathan, American journalist: b. West Hampton, Mass., 16 Aug. 1784; d. Brookline, Mass., 9 Feb. 1863. He was a nephew of the patriot Nathan Hale (q.v.) and father of E. E. Hale (q.v.). He was graduated from Williams College in 1804, and after studying law was admitted to the Boston bar in 1810, in 1811–4 was editor of the Boston 'Weekly Messenger,' and in 1814 purchased and became editor of the *Advertiser*, established in 1813 and the first New England daily. At first Federalist in politics, the *Advertiser* became successively Whig and Republican and was at all times very influential. In 1820 it opposed the Missouri bill, in 1854 the Kansas-Nebraska bill, and it was the first newspaper to advocate the settlement of Kansas by "Free-Soil" colonists. Hale was a founder of the 'North American Review' (1815), served at various times in both houses of the Massachusetts legislature, published a series of stereotyped maps after a method invented by himself (1830), and wrote pamphlets on topics of internal improvement.

Hale, Philip, American music critic: b. Norwich, Vt., 5 March 1854. Graduated from Yale in 1876, he was admitted to the bar in Albany (1880), studied music under Dudley Buck and later in Europe with Haupt, Bargiel, and Guilmant (1885–7), and was organist successively of Saint Peter's, Albany (1879–82), Saint John's, Troy (1887–9), and the First Unitarian Society of Roxbury, Mass. (1889). In 1889–97 he contributed music criticism to the Boston press, from 1891 was critic of the *Journal*, in 1897 became editor of the 'Musical Record,' and in 1901 of the 'Musical World.' He is known as one of the most discriminating and interesting of American writers on musical subjects.

Hale, Salma, American politician: b. Alstead, Cheshire County, N. H., 7 March 1787; d. Somerville, Mass., 19 Nov. 1866. He was early apprenticed to a printer of Walpole, N. H., in 1805 became editor of the 'Political Observer,' a Republican journal of Walpole, held various local offices, and in 1828 and 1844 was a member of the New Hampshire house of representatives, and in 1824 and 1845 of the State senate. In 1845 he was appointed secretary of the commission for the determination of the northeastern boundary line of the United States. He was elected to Congress in 1816 as a Republican (Democratic) representative, but declined a re-election. His 'History of the United States' (1821) won a prize of $400 and a gold medal, offered by the American Academy of Belles-Lettres, and appeared in many subsequent editions. He published also 'The Administration of J. Q. Adams' (1826); and 'Annals of the Town of Keene' (1826).

Hale, Sarah Josepha Buell, American author and editor: b. Newport, N. H., 24 Oct. 1788; d. Philadelphia 30 April 1870. Her husband dying in 1822 leaving her with five small children, she supported her family by literary work. She was editor of the Boston 'Ladies' Magazine' 1828–37, and when in 1837 this was consolidated with 'Godey's Lady's Book,' published in Philadelphia, she became editor of the latter also, continuing in the position for forty years. She retired from literary life in 1877. Her efforts in behalf of the Bunker Hill Monument fund, her interest in seamen, in foreign missions, and in the higher education of women, were untiring and successful. For many years she advocated the keeping of Thanksgiving Day as a national festival, as it has been observed since 1864, when President Lincoln adopted her suggestion. Her most enduring publication is 'Woman's Record: or Sketches of All Distinguished Women' (New York 1874).

Hale, Susan, American author and water-colorist: b. Boston 5 Dec. 1833. She has published 'Life and Letters of Thomas Gold Appleton' (q.v.) (1885), and with her brother, E. E. Hale (q.v.) has written the popular 'Family Flight' series of travel books for young people.

Hale, William Bayard, American writer: b. Richmond, Ind., 6 April 1869. He was graduated from Harvard and the Episcopal Theological School (Cambridge, Mass.), and was rector at Middleborough, Mass., 1892–9, and subsequently at Ardmore, Pa., retiring from the ministry in 1901. He has published 'The Making of the American Constitution'; 'The Eternal Teacher' (1895): 'The New Obedience' (1898); 'Phillips Brooks'; etc.

Hale, William Thomas, American writer: b. Liberty, Tenn., 1 Feb. 1857. He practised law for several years and has since been connected editorially with St. Louis and Tennessee journals. He has published 'Poems and Dialect Pieces' (1894); 'Showers and Sunshine,' verse (1896); 'The Backward Trail' (1899); 'An Autumn Lane and Other Poems' (1899); 'Great Southerners' (1900).

Halévy, Jacques François Fromental Elie, zhăk frän-swä frō-mōṅ-täl ā-lē ä-lä-vē, French composer: b. of Jewish parentage, Paris 27 May 1799; d. Nice, France, 17 March 1862. He studied counterpoint under Cherubini for five years, and in 1819 was sent to Italy to finish his education. The first of his pieces performed was a little comic opera, 'L'artisan,' given at the Théâtre Feydau, in 1827. His chef d'œuvre, 'La Juive,' appeared in 1835, and rapidly obtained a European celebrity, and has been frequently sung in the United States. Among his other works are 'L'Eclaire'; 'Guido et Ginevra'; 'La Reine de Chypre'; 'Le Val d'Andorre'; 'La Fée aux Roses.' The melodies of Halévy are always soft and flowing, the harmony correct and pleasing; but his works display on the whole more talent than genius.

Halévy, Joseph, zhō-zĕf, French Orientalist and traveler: b. Adrianople, Turkey, 15 Dec. 1827. In 1868 he traveled in Abyssinia; and for the Academie des Inscriptions he traversed (1869–70) Yemen, where he obtained copies of not less than 680 inscriptions, largely Himyaretic and Sabæan. He was appointed assistant librarian of the Asiatic Society, and adjunct-professor of Ethiopic in the Ecole des Hautes Etudes. Well known also as a Biblical critic and Assyriologist, he founded (1893) the 'Revue Sémitique d'épigraphie et d'histoire ancienne,' and published numerous works, including: 'Archæologic Mission to Yemen' (1872): 'Journey to Nedjran' (1873): 'Sabæan Studies' (1875); 'The Origin of Babylonian Civilization' (1876); 'Miscellany of Criticism and History Regarding Semitic Peoples' (1883).

Halévy, Ludovic, lü-dō-vēk, French dramatist and novelist: b. Paris, France, 1 Jan. 1834

He is a nephew of J. Halévy (q.v.) and, unsuccessful at first, he finally worked his way into public favor, especially after associating his pen with that of Henri Meilhac. In collaboration with the latter, he wrote many of the librettos of Offenbach's most brilliant and satiric operettas, including 'The Perichole,' 'The Brigands,' the 'Belle Hélène,' and 'The Grand Duchess of Gérolstein.' Several serious librettos of high excellence are from the same hands, including that for Bizet's 'Carmen.' In spoken drama, 'Frou-Frou' and 'Tricoche and Cacolet' are among the most popular plays the two dramatists produced together. In 1881 he ceased writing for the stage, and turned to fiction. 'L'Abbé Constantin,' the first of his novels, is also the most popular, and opened to him the French Academy. It was for more than one season the French story of the day. It is a charming story, full of fresh air and sun, simply and skilfully told. It presented a view of American character and temperament not usual in French fiction; and irreproachable in its moral tone, has become a sort of classic for American schools and colleges. 'La Famille Cardinal' (The Cardinal Family) and 'Crichette' are studies in fiction of aspects of Parisian life. 'Notes and Souvenirs' embody observations during the Prussian invasion of 1871. They are interesting, as giving faithful pictures of the temper of the people during those days. Among his short stories, 'Un Mariage d'Amour' (A Marriage for Love) is one of the best.

Half Blood, in law, the relationship of persons born of the same father but not of the same mother, which is called a consanguinean relation; or of those born of the same mother but not of the same father, which is termed uterine. In the succession to real or landed property a kinsman of the half blood inherits next after a kinsman of the whole blood in the same degree, and after the issue of such kinsman when the common ancestor is a male, but next after the common ancestor when such ancestor is a female. So that brothers consanguinean inherit next after the sisters of the whole blood and their issue; and brothers uterine inherit next after the mother.

Half-breeds, the children of parents of different races; a term usually confined to whites and American Indians. There are two tribes of Indian half-breeds, at Red River Settlement, chiefly employed in agriculture and hunting. The rise of independent half-breed tribes is "the first step toward the evolution of a distinct race."

Half-caste, a person born of a European father and a Hindu or Mohammedan mother, or more rarely of a Hindu or Mohammedan father and a European mother; an East Indian.

Half-crown, a British silver coin of the value of two shillings and sixpence (60 cents).

Half-dollar, a silver coin of the United States of the value of 50 cents. Authorized in April 1792, its coinage at a weight of 208 grains was begun in 1794; its issue was suspended from 1798 to 1800 inclusive and in 1816. In 1853 its weight was reduced to 192 grains. The half-dollar is legal tender to the amount of ten dollars.

Half-eagle, a gold coin of the United States of the value of five dollars, so called from the national emblematic bird which figures upon the reverse. Authorized in 1792 the coinage was begun in July 1795; there was no issue in 1816 and 1817.

Half-King, the name given by the English to a Seneca Indian, chieftain of an Ohio tribe, who accompanied Washington during his expeditions in 1753–54, and was present at the defeat of the French at Great Meadows. His summary of the prowess of the respective combatants was that "the English acted like fools and the French like cowards."

Half Moon, the name of the vessel commissioned by the Dutch East India Company in 1609, and commanded by Henry Hudson for a voyage of exploration in search of a Northwest Passage. In this ship he entered New York Bay and explored the river which bears his name.

Half-tones, pictures produced by printing from plates made by the half-tone process, which will here be described. Except that used in line-drawing, until early in the eighties there was no process by which paintings, wash-drawings, or photographs could be done into the form of a surface printing-block for the press, and the introduction then of the half-tone block marked a revolution in the history of photographic illustration. The development of the process was the result of a kind of evolution of Bullock's (1866). Meisenbach of Munich patented a half-tone process in 1882.

The American Frederic Eugene Ives and others have since experimented and published results, and by them within a few years the process as it now exists was practically established. Americans were first in the field with an improved device for breaking up the image into dots, which was so much superior to anything invented in Europe that almost every other method was dropped in its favor. The diamond-ruled screen, which was introduced in this country by Max Levy, is essential to advanced work in half-tone. To make one of the screens, a sheet of the finest plate-glass is coated with a varnish of asphalt and wax, and placed on the bed of an automatic ruling-machine capable of ruling lines of any fineness up to 500 to the inch. The cutter is diamond-pointed and gauged to cut lines of any desired width. The lines are ruled diagonally at 45° across the glass, the number to the inch varying as required. The ruled surface is treated with hydrofluoric acid, which eats into or etches the lines laid bare by the diamond and forms a channel which is filled up with an opaque pigment. This enamel is baked in the lines in an oven, and then the surface is polished until the lines are perfectly level and the spaces represented by the clear glass are bright and transparent. Two of these ruled glasses are required for each screen, laid together with the lines crossing at right angles and cemented with Canada balsam.

To produce a half-tone block from a picture, wash-drawing, or photograph, this ruled grating is placed in front of the sensitive plate, not in contact with it, but at a distance which must be nicely determined by experience. Everything is represented by dots so accurately graded in relation to the light and shade of the original that the eye scarcely detects them, and the half-tone picture appears as a practical *facsimile* of the original from which it was photographed.

Most half-tone blocks are now etched on copper, and the sensitizing solution generally employed for this metal is a compound of fish-glue, albumen, chromic acid, water, and bichromate of ammonia. The copper is cleaned with tripoli and washed; the sensitizing solution is flowed over it two or three times; it is placed on a revolving table and rapidly whirled to spread the coating thinly and evenly; the coating is dried by gentle heat in a yellow-lighted room, and the plate is now ready for exposure under the half-tone negative. Three to ten minutes' exposure to an electric arc-light completes the printing, then the plate is given a bath in cold water, and is soaked and washed under a spray of water until the compound not acted upon is dissolved out. The image on the metal at this stage is almost invisible. To facilitate an examination of the film, the plate is dipped into a solution of methyl-violet, which stains the film and brings the picture into view. If all is right, the surface is dried either by flowing it with methylated alcohol or by gentle heat. The next operation is the hardening of the glue-picture into a substance resembling enamel — hence the "enameline process." The plate is highly heated over the flame of a large Bunsen burner; during the progress of this "burning in" or enameling, the blue picture gets pale, then gray, and vanishes; as the plate gets hotter, the image appears as a faint brown, and increases in strength to a rich chestnut-brown tint, when the heat must be withdrawn, and the plate cooled off. The plate has now upon it a picture formed of a strong, hard, impermeable coat of enamel which will bear any reasonable etching without further protection.

The etching-bath is made up of neutral perchloride of iron dissolved in water, and of a strength which registers 35° with a Baumé's hydrometer. The plate is first subjected to a general etching, so that it may be inked over with a printer's roller, and a first proof of the photo-etched picture be pulled in the press. The dulling of the general effect caused by the interposition of the necessary screen-grating has to be removed as far as possible, and this is done by artists who are specially trained for the work. The parts of the picture which are in shadow and are usually correctly rendered by a properly exposed negative are covered over with varnish, and the next tones are etched again; then these tones are covered up and the high lights are treated until the resulting picture, when proofed, correctly represents the original. The plates are then trimmed by engravers, beveled to admit of being riveted to the wood-mounts, and are mounted type-high for use in the printing-press.

Invention and experiment are now active toward the next great step in half-tone work, the production of surfaces without the mechanical smoothness hitherto so persistent. What is aimed at is the making of pictures which are free from mechanical effect, and are yet sufficiently delicate in texture to retain the finer details.

Half-way Covenant, a concession in church requirements made by the New England Synod convened at Northampton in 1657, whereby persons who had been baptized in their infancy, who assented to the doctrines of faith, entered into covenant with the church, and led decent and respectable lives, were admitted to the privileges and prerogatives of church-membership with the exception of the Lord's Supper, although they might give no evidence of conversion and had neither the ability nor willingness to make profession of religious experience. This "half-way covenant" as it came to be called aroused bitter controversy which did not die out until the 19th century; among its most strenuous opponents were Jonathan Edwards and his followers. The contention is baseless that it entailed certain civil privileges in relation to the State franchise, its chief aim being to admit children to baptism and to transmit to them the same degree of church membership as their parents. Consult Walker, 'Creeds and Platforms of Congregationalism' (1893).

Haliburton, hăl'ĭ-bėr-tŏn, **Thomas Chandler**, Canadian humorist: b. Windsor, Nova Scotia, December 1796; d. Isleworth, near London, 27 Aug. 1865. He practised law in Halifax, and in 1842 became judge of the supreme court of Nova Scotia, but subsequently gave up his profession, and went to live permanently in England. His first work was a 'Historical and Statistical Account of Nova Scotia' (1829). In 1835 he contributed a series of letters to a Halifax newspaper, under the pseudonym of "SAM SLICK," clock-peddler. These were published with considerable alterations and additions, in a collected form in 1837, under the title of 'The Clockmaker, or Sayings and Doings of Samuel Slick of Slickville,' and became very popular. A second series followed in 1838, and a third in 1840. In 'The Attaché, or Sam Slick in England,' his hero is represented as attaché of the American embassy at the court of St. James, and again appears in 'Sam Slick's Traits of American Humor' (1852). Another work of his of some importance is 'Rule and Misrule of the English in America' (1851). In 1859 Haliburton was elected member of parliament for Launceston.

Hal'ibut, the largest of the flat fishes (*Hippoglossus vulgaris*), and one of the most important and highly prized food-fishes. It occurs in all Northern waters, south to France, New York and San Francisco. It reaches a weight of 400 pounds, and is characterized by having the eyes on the right side, the ventral fins and mouth symmetrical, and the lateral line arched in front. It is dark brown on the right side, and white on the left or lower side. It was formerly very abundant along the whole eastern coast of the United States, at times proving a nuisance from its numbers to the cod-fishers. It has gradually become scarcer, and at the same time the appreciation of it as a food-fish has increased, so that the halibut fishers have gone farther and farther for it until now a good proportion of the catch comes from the waters around Iceland. A second species, the Greenland halibut (*Reinhardtius hippoglossoides*) occurs in the Arctic Atlantic, but is not very common. It is yellowish brown and has a straight lateral line. In the trade this is not distinguished from the common species. Halibut are taken with hook and line (or trawls) using fresh fish (herring, etc.) for bait.

Hal'ifax, Charles Montague, EARL OF, English politician: b. Horton, Northamptonshire, 16 April 1661; d. 19 May 1715. He first attracted notice by his verses on the death of Charles II.;

1. City of Halifax from the Citadel

2. North West Arm

and in 1687, in conjunction with Matthew Prior, wrote 'The Town and Country Mouse,' a parody on Dryden's 'Hind and Panther.' He became a lord of the treasury in March 1692, in 1694 was made chancellor of the exchequer; in 1695 carried out the much needed re-coinage, appointing Newton warden of the mint; and in 1696 he devised the system of exchequer bills. His administration was distinguished by the adoption of the funding system, and by the establishment of the Bank of England. In 1700 he was raised to the peerage, under the title of Baron Halifax. In the reign of Anne he remained out of office, but he actively exerted himself to promote the union with Scotland, and the Hanoverian succession. George I. created him an earl, and bestowed on him the order of the Garter. The 'Life and Miscellaneous Works of Lord Halifax' were published in 1715, and his poems were included in the edition of 'English Poets' by Dr. Johnson.

Halifax, Canada, the capital of the province of Nova Scotia, and county-seat of Halifax County, a city and port of entry on Halifax Harbor, on the Intercolonial and Dominion, and Canadian Pacific R.R.'s. The harbor, originally known as Chebucto, "chief of havens," is one of the best in the world. It is 16 miles long from north to south, with an average width of a mile, and terminates in Bedford Basin, a beautiful sheet of water four miles wide, affording 10 square miles of safe anchorage. The North West Arm, an inlet on the west of the city, is a charming bay, on the shores of which are many of the villa residences of the wealthier Haligonians. The harbor is protected by 11 forts and batteries. A citadel crowns the hill, on the slopes and at the base of which the town is built. The streets are regularly laid out on a rectangular plan, are lighted by gas and electricity, and have electric street-car lines. The public buildings are built chiefly of freestone; the houses of wood. The most notable structures include Government House, the official residence of the lieutenant-governor, the armories, the post-office, the custom-house, the Province building, court-house, city-hall, Masonic Temple, Academy of Music, the Admiralty House, the Wellington barracks, several hospitals, and other charitable institutions, the Roman Catholic and Anglican cathedrals, and Saint Paul's church, the oldest Protestant church building in British North America. Among the higher educational institutions are the non-sectarian Dalhousie University and College (q.v.), the Roman Catholic College of Saint Mary, the Presbyterian Theological College, the Halifax Ladies' College and Conservatory of Music, and a high school. The city maintains a free library, an excellent waterworks system, and fine parks, including Point Pleasant Park, and the handsome public gardens covering 17 acres. Halifax is the chief British naval station in North America, and has extensive dockyards; besides Esquimalt it is the only military post in Canada garrisoned by British imperial troops; in 1901 the garrison amounted to 1,784 soldiers. Halifax has railroad communications with all parts of the Dominion and the United States, and steamship lines connecting with Great Britain, the West Indies, Boston, and New York. A United States consul-general is resident in Halifax. The chief occupations of the inhabitants are commerce and fisheries. The city has considerable West Indian trade, exporting lumber, fish, and agricultural products, and importing sugar, rum, molasses, and other sub-tropical products; most of the commerce of the province is carried on through Halifax. The principal manufactures are iron castings, machinery, agricultural implements, nails, paints, gunpowder, cordage, leather, boots and shoes, clothing, soap and candles, cotton and woolen goods, and woodenware; there are also sugar refineries, distilleries, and breweries.

Halifax was founded in 1749 by the Hon. Edward Cornwallis, and named in honor of the Earl of Halifax. The following year it was made the capital of Nova Scotia, then including New Brunswick, in place of Annapolis; in 1817 it was declared a free port; in 1842 it was incorporated as a city. It is governed by a mayor, elected annually, and by 18 aldermen, elected triennially. The city and county send two members to the Canadian House of Commons, and three to the Provincial Legislature. Pop. (1901) 40,832.

John Forrest,
President Dalhousie College.

Halifax Commission, the designation for the commission of representatives of Great Britain and the United States which met at Halifax, Nova Scotia, in 1877, to determine the amount of compensation to be paid by the United States for the privileges which under the provisions of the fisheries treaty of 1871 between the two countries, had allowed the fishermen of the United States to take fish along the shores of Canada and Newfoundland. The great value of the British fishing waters was admitted and the sum of $5,500,000 was awarded Great Britain. The ten-year treaty which went into operation in 1873 was terminated by the U. S. government in 1885, and an attempt to renew it by the Chamberlain-Bayard Treaty in 1888 was frustrated by the rejection of the United States Senate. A *modus vivendi*, however, was arranged for, which the Dominion Parliament enacted as a law in 1890.

Hal'ite, the mineralogical name for native common salt, rock salt, or sodium chlorid, NaCl. Halite crystallizes in the isometric system, usually in cubes. It has a hardness of 2.5, and a specific gravity of 2.135 when pure, though it often occurs mixed with calcium sulphate, and with the chlorids of calcium and magnesium, the specific gravity being modified accordingly. Halite is usually colorless or white, though it is sometimes colored by impurities. Its refractive index for yellow sodium light is 1.5442, and transparent crystals of it are used somewhat in the manufacture of prisms and lenses, since the mineral is far more transparent than glass to the infra-red rays of the spectrum. Tyndall made extensive use of it in this way, for example, in his researches on radiant heat. (Consult his 'Contributions to Molecular Physics in the Domain of Radiant heat.') See Salt; Sodium.

Hall, Alexander Wilford, American editor and author: b. Bath, N. Y., 18 Aug. 1819; d. 1902. He became known as an evangelist especially through attacks on Universalist doctrine and the theory of evolution presented by Darwin, Huxley, and Haeckel. In 1881 he established

'The Microcosm,' and in 1893 became president of the Society for Philosophical Research. In 1891 he was elected fellow of the Philosophical Society of Great Britain. His works include: 'Universalism Against Itself'; 'The Problem of Human Life'; 'The Immortality of the Soul'; and 'The Hygienic Secret of Health.'

Hall, Anna Maria Fielding, British novelist: b. Dublin, Ireland, 6 Jan. 1800; d. East Moulsey, Surrey, England, 30 Jan. 1881. In her 15th year she went to London, where she was married to the well known writer, S. C. Hall (q.v.). She published 'Sketches of Irish Character' (1828); 'The Buccaneer' (1832); 'Tales of Woman's Trials' (1834); 'The Outlaw' (1835); 'The French Refugee,' a drama; 'Uncle Horace' (1837); 'Lights and Shadows of Irish Character' (1838); 'Marian' (1839); 'Midsummer Eve' (1843); 'The Whiteboy' (1845); etc. Her 'Stories of the Irish Peasantry' appeared originally in 'Chambers's Journal.' Besides assisting her husband in writing 'Ireland: its Scenery, etc.' (1841–3) and other works, she assisted in the establishment of a hospital for consumptives, and the Nightingale Fund, which resulted in the endowment of a training-school for nurses.

Hall, Arthur Crawshay Alliston, American Protestant Episcopal bishop: b. Benfield, Berkshire, England, 12 April 1847. He was graduated from Christ Church, Oxford, in 1869, took orders, entered the Society of St. John the Evangelist (Cowley Fathers), in 1874 became assistant minister of the Church of the Advent, Boston, and from 1882 to 1891 was there minister of the mission church of St. John the Evangelist. In 1894 he was consecrated bishop of Vermont, after release from the Cowley order. His publications include: 'Confession and the Lambeth Conference' (1879); 'Meditations on the Creed' (1880); 'Meditations on the Collects' (1887); and other doctrinal and devotional works.

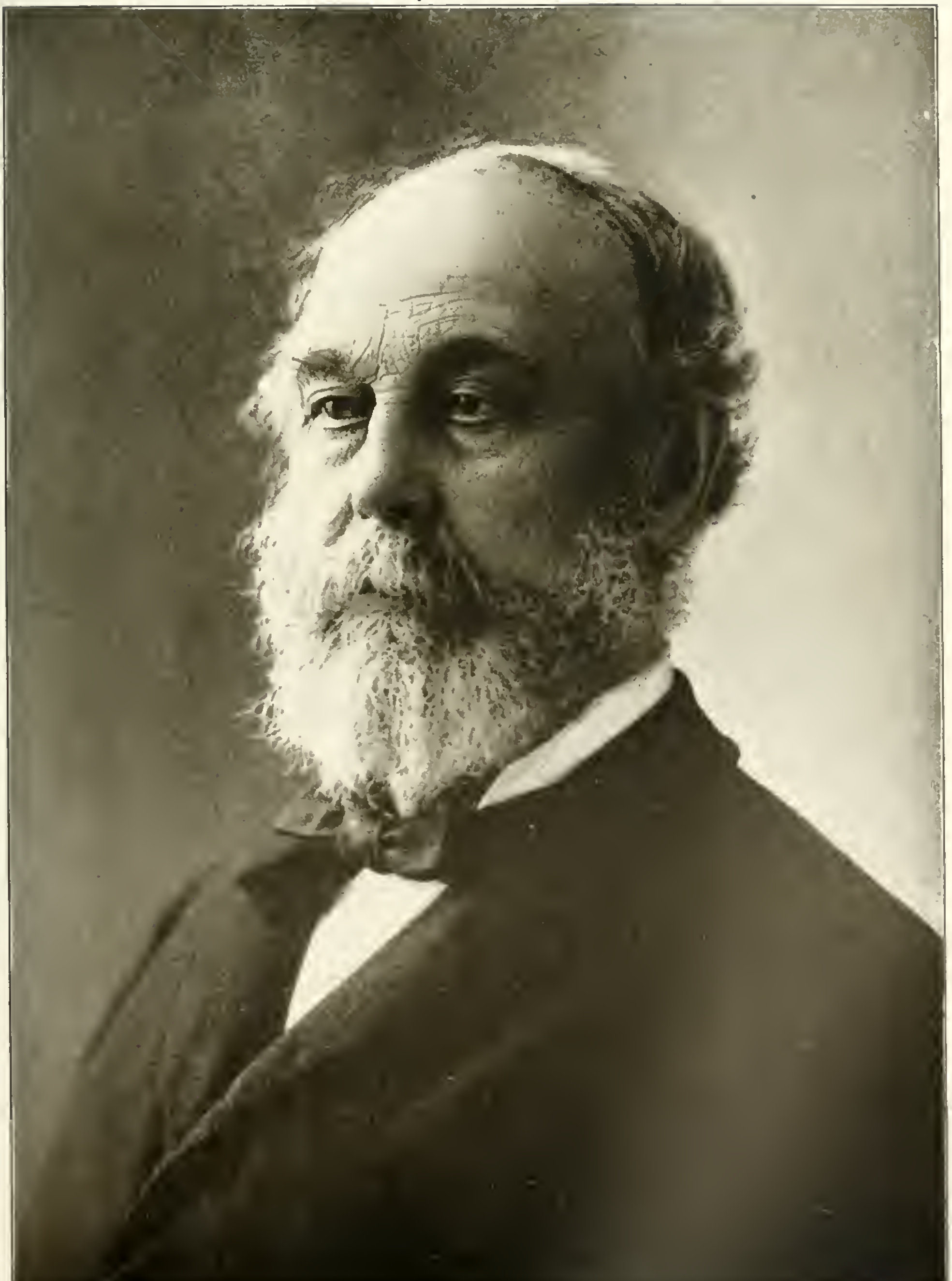
Hall, Asaph, American astronomer: b. Goshen, Litchfield County, Conn., 15 Oct. 1829. He learned the carpenter trade but after private study attended Central College, McGrawville, N. Y., in 1854–5, was for a term a pupil of Francis Brünnow at the University of Michigan, taught at Shalersville, Ohio, and later was appointed assistant to Bond in the Harvard observatory. He became assistant in the Naval Observatory at Washington in 1862, and in 1863 professor of mathematics in the navy, with relative rank of captain. He continued in the government service until 1891, when he was retired on account of age, with relative rank of captain. While at the Naval Observatory, he was despatched on several expeditions, including those for observation of solar eclipses to Bering Strait in 1869, to Sicily in 1870, and to Colorado in 1878. He was also in charge of the American party sent to observe the transit of Venus at Vladivostock, Siberia, in 1874, and chief astronomer of the expedition to San Antonio, Tex., for the transit of 1882. Among his many discoveries the most important is that of the moons of Mars (August 1877), which he named Deimos and Phobos, and whose orbits he calculated. Among his later work is a valuable study of double stars. In 1895–1901 he was professor of astronomy at Harvard. He received the Lalande prize of the French Academy of Sciences in 1878, its Arago medal in 1895, and the gold medal of the Royal Astronomical Society in 1879. In 1902 he was president of the American Association for the Advancement of Science.

Hall, Basil, British naval officer and writer: b. Edinburgh 31 Dec. 1788; d. Portsmouth, England, 11 Sept. 1844. He entered the navy in 1802, accompanied Lord Amherst's expedition to China in 1815, a trip which supplied him with the materials of his first work, 'A Voyage of Discovery to the West Coast of Corea, and the great Loo Choo Island in the Japan Sea.' This work, first published in 1818, had a very extensive circulation. In 1827 he made a tour in Canada and the United States, and published his 'Travels in North America' (1829), a work which excited much adverse criticism in the United States by reason of its outspoken and somewhat supercilious comments and observations. 'Fragments of Voyages and Travels' appeared in 1831–33, and was followed by 'Schloss Hainfield, or a Winter in Styria' and 'Patchwork' (1841).

Hall, Bolton, American lawyer and lecturer: b. Ireland 1854. A son of John Hall (q.v.), he was graduated from Princeton in 1875, became known as a writer and lecturer in connection with various reforms, and has been identified with the University extension movement. Among the causes advocated by him are the cultivation of vacant lots by the unemployed, and the restoration of the land to the people. His publications include: 'Even as You and I.'

Hall, Charles Cuthbert, American Presbyterian clergyman: b. New York 3 Sept. 1852. He was graduated from Williams College in 1872, studied theology at the Union Theological Seminary 1872–3, and at the Presbyterian College in London and the Free Church College, Edinburgh. He was pastor of the Presbyterian Church, Newburg, N. Y., 1875–7, and of the 1st Presbyterian Church, Brooklyn, N. Y., 1877–97. In the year last named he was elected president of Union Theological Seminary. He has published 'Into His Marvellous Light: Studies in Life and Belief' (1891); 'Does God Send Trouble?' (1894); 'The Children, the Church and the Communion' (1895); 'The Gospel of the Divine Sacrifice' (1896).

Hall, Charles Francis, American Arctic explorer: b. Rochester, N. Y., in 1821; d. Thank God Harbor, Greenland, 8 Nov. 1871. Becoming interested in the fate of the Franklin expedition, he devoted his leisure to gathering information about Arctic America, and made two search expeditions, in 1860–2 and 1864–9, living alone among the Eskimo, and bringing back relics of the Franklin expedition and the supposed bones of one of Franklin's company. Natives whom he encountered in 1869 near the southern shore of King William Land gave him a report of the fate of 79 of the 105 who perished by starvation in that region. He thus contributed much to the details of the expedition's final history. In 1871 he sailed in command of the government ship 'Polaris,' on an expedition to the North Pole. On 29 August he reached 82° 11′ N., at that date the highest north latitude ever reached. Then turning south he went into winter quarters at Thank God Harbor, Greenland (81° 38′ N.). Here he was taken suddenly ill, and died. Over his grave a grateful epitaph was placed by the British polar expedition in 1876. His compan-



ASAPH HALL,

PROFESSOR OF ASTRONOMY, HARVARD UNIVERSITY.

ions left Thank God Harbor in August, 1872, but in October, through the ice-anchor slipping, 19 men were left with stores on a floe, and only after five months of severe sufferings were they rescued by a sealer off the Labrador coast in the following April. The 'Polaris' drifted to the coast of Greenland, at a point not far south of Smith Sound, and thence in the spring the party set out in boats and was rescued by the Scotch whaler 'Ravenscraig,' off Cape York. Among the valuable results of Hall's work were the exploration of Kennedy channel, the discovery of Robeson Channel and Hall Basin, and the extension of Greenland and Grinnell Land 1½° N. Hall was less a scientist than a fearless and resourceful explorer. He published 'Arctic Researches, and Life among the Esquimaux' (1864); and mainly from his papers was compiled the 'Narrative of the Second Arctic Expedition' (1879).

Hall, Charles Winslow, American lawyer and author: b. Chelsea, Mass., 2 Nov. 1843. He was admitted to the Suffolk bar in 1866 and besides editing various New England journals has written: 'Arctic Rovings' (1861); 'Twice Taken' (1867); 'Adrift in the Icefields' (1877); 'Drifting Round the World' (1881); 'Legends of the Gulf'; 'Cartegena, or the Last Brigade'; 'Regiments and Armories of Massachusetts.'

Hall, Chester Moor, English inventor: b. Leigh, Essex, England, 9 Dec. 1703; d. Sutton, Essex, 17 March 1771. He was a large landowner in Essex, and convinced from study of the human eye that achromatic lenses were possible, he discovered two varieties of suitable glass in 1729, and in 1733 made several telescopes later declared by experts to be achromatic. Indifferent to his claims of priority, he did not appear at the trial of Dollond *v.* Champness. Later his invention of the achromatic telescope in the year 1733 was adjudged by Lord Mansfield conclusively proven.

Hall, Christopher Newman, English Congregational clergyman: b. Maidstone, England, 22 May 1816; d. London 18 Feb. 1902. He was educated at Highbury College and ordained in 1842, his first charge being at Hull. In 1854 he was made pastor of Surrey Chapel, Blackfriar's Road, London, from which place he moved with his congregation into Christ Church, Westminster Bridge Road, erected mainly through his exertions, and of which he became pastor emeritus in 1893. During the Civil War he did much by tongue and pen to give his countrymen correct ideas of the nature of the struggle in the United States. In 1865 he visited this country and again in 1873 when he delivered lectures in the principal cities. He was the author of 'The Christian Philosopher'; 'Land of the Forum and the Vatican'; 'Lectures in America'; and of a famous tract 'Come to Jesus' (1840) of which millions of copies have been issued, etc.

Hall, Edward Henry, American Unitarian clergyman and author: b. Cincinnati, Ohio, 16 April 1831. He was graduated from Harvard in 1851, ordained to the Unitarian ministry in 1859, and was pastor at Plymouth, Mass., 1859–67; Worcester, Mass., 1869–82; and at Cambridge, Mass., 1882–93. His writings include, besides a volume of 'Discourses'; 'Orthodoxy and Heresy in the Christian Church'; 'Lessons on the Life of St. Paul'; 'Papias and his Contemporaries: a Study of Religious Thought in the 2d Century' (1899).

Hall, Fitzedward, American philologist: b. Troy, N. Y., 21 March 1825; d. Marlesford, England, 1 Feb. 1901. He was graduated from Harvard in 1846; spent many years in India; made a thorough study of its tongues, and contributed to its local journals original translations and original articles. In 1850 he became tutor, in 1853 professor, in the government college at Benares; in 1855 was transferred to Ajmere as inspector of schools for Ajmere and Maiwara; and in 1856 to a like post in the Central provinces. In 1862–79 he was professor of Sanskrit, Hindustani, and Indian jurisprudence in King's College, London; in 1864 became examiner in Hindustani and Hindu to the civil-service commission; in 1880 examiner in Sanskrit to succeed Max Müller; and in 1887 also examiner in English. He was the first American to edit a Sanskrit text—'The Atmabodha, with its Commentary, and the Tattvabodha' (1852). He prepared also an edition of the 'Vishnupurâna,' containing numerous quotations from manuscripts owned by him; and editions of many other Sanskrit books. His collection of 1,000 Oriental manuscripts and 1,000 works on special subjects, he gave to Harvard. He wrote further: 'Modern English' (1873), 'Doctor Indoctus' (1880), and other works on English philology, and contributed to the 'New Oxford Dictionary.'

Hall, Florence Marion Howe, American author and lecturer: b. Boston 25 Aug. 1845. She is a daughter of Julia Ward Howe (q.v.). Prominent in the women's club movement, she became vice-president of the General Federation of Women's Clubs, and chairman of the educational department of the New Jersey State federation of women's clubs. In 1893–1900 she was president of the New Jersey Women's Suffrage Association. Her writings are: 'Social Customs' (1887); 'The Correct Thing' (1888).

Hall, Francis J., American Episcopal theologian: b. 24 Jan. 1856. He was graduated from Racine College, Wis., and the General Theological Seminary, New York, and has been professor of dogmatic theology in the Western Theological Seminary from 1886. He has published 'Theological Outlines' (1892–5); 'Historical Position of the Episcopal Church' (1896); 'The Kenotic Theory' (1898).

Hall, George Henry, American artist: b. Boston 1825. He studied art at Dusseldorf, Paris, and Rome; established his studio in New York; and became known as a still-life and figure painter. In 1868 he was elected a national academician. Among his works are 'April Showers'; 'Studies of Grapes'; 'The Seasons'; and 'Bric-a-Brac of Damascus'.

Hall, Gertrude, American writer: b. Boston 8 Sept. 1863. She has written 'Far from To-day,' a collection of short stories; 'Allegretto,' a book of verse; 'Foam on the Sea, and Other Tales'; 'The Hundred and Other Stories' (1898); 'The Age of Fairy Gold,' verse (1899); 'April's Sowing' (1900). Her work, both in verse and prose, is distinctively original.

Hall, Gordon, American missionary at Bombay: b. Tolland, Mass., 8 April 1784; d. Bombay 20 March 1826. He was graduated at

Williams College in 1808 and having studied theology, offered himself as a missionary to the American board of commissioners for foreign missions. Ordained at Salem in February 1812, he sailed the same month for Calcutta and arriving at Bombay in 1813, spent 13 years in missionary labors. No missionary in western India has been more respected among the Brahmins and higher classes than he. Beside publishing several missionary tracts he revised the Mahratta New Testament.

Hall, Granville Stanley, American psychologist and college president: b. Ashfield, Mass., 6 May 1845. He was graduated from Williams College in 1867, studied also at Berlin, Bonn, Heidelberg, and Leipsic, was professor of psychology in Antioch College (Ohio) in 1872–6, and lecturer on psychology at Harvard and Williams in 1880–1. From 1881 to 1888 he was professor of psychology in the Johns Hopkins University: and in 1888 became president of Clark University, then newly founded at Worcester, Mass., and professor of psychology in the institution. He soon became known as an authority on education and a leader in the "new psychology." As editor of the 'Pædagogical Seminary' and the 'American Journal of Psychology,' he published: 'Aspects of German Culture' (1881); 'Hints toward a Select and Descriptive Bibliography of Education' with Mansfield (1886); 'Methods of Teaching History'; 'How to Teach Reading'; etc.

Hall, Isaac Hollister, American Oriental scholar: b. Norwalk, Conn., 12 Dec. 1837; d. Mount Vernon, N. Y., 2 July 1896. Graduated from Hamilton College in 1859, he was there tutor until 1863, in 1865 was graduated from the Columbia Law School, and until 1875 was a practitioner in New York. In 1875–7 he was professor in the Syrian Protestant College at Beirut, and later at Cyprus aided Gen. di Cesnola, then United States consul, in the arrangement of the Cypriote collection now in the Metropolitan Museum of New York. From 1884 until his death he was curator of sculpture and archæology in the Metropolitan Museum. He also lectured on New Testament Greek at the Johns Hopkins University; published (1884) an account, with facsimile pages, of the Syrian manuscripts of the Gospels, Acts, and the larger part of the Epistles, discovered by him (1876) at Beirut; and compiled a 'Critical Bibliography of the Greek New Testament' (1884).

Hall, Sir James, English geologist and chemist: b. 1761; d. Edinburgh 23 June 1832. Early interested in geological questions, he made the acquaintance of James Hutton (q.v.) and Playfair, and himself states that he came to adopt Hutton's system after three years of almost daily discussion with its founder. In the examination of this system, whose leading principle explains the conformation of the earth's crust by the action of constant natural changes, he traveled in Scotland, the Alps, Italy, and Sicily. Hall was the first geologist directly to apply chemical laboratory tests to the hypotheses of geology, but published no results of his work in this field until after the death (1797) of Hutton who objected to the judgment of the vast operations of nature through "having kindled a fire and looked into the bottom of a little crucible." He was elected president of the Royal Society of Edinburgh, invented a machine for the regulation of high temperatures, and in 1807–12 represented Michael (or Mitchell), Cornwall, in Parliament. He wrote various scientific memoirs.

Hall, James, American lawyer and author: b. Philadelphia 19 Aug. 1793; d. near Cincinnati, Ohio, 5 July 1868. He served in the army 1812–18, and subsequently studying law became judge of the circuit court of Illinois, and also State treasurer. In 1833 he took up his residence in Cincinnati, and devoted himself to banking and literature. His chief works are: 'Legends of the West'; 'Harpe's Head, a Legend of Kentucky' (1833); 'Sketches of the West' (1835); 'Tales of the Border' (1835); 'Notes on the Western States' (1838); 'History of the Indian Tribes' (1838–44) with McKenney; 'The Wilderness and the War-Path' (1845); 'Romance of Western History' (1859).

Hall, James, American geologist and palæontologist: b. Hingham, Mass., 12 Sept. 1811; d. near Bethlehem, N. H., 7 Aug. 1898. He studied at the Rensselaer Polytechnic School for six years, and was subsequently professor of geology there, and in 1837 was appointed to a position on the New York Geological Survey. In 1855 he was appointed State geologist of Iowa. In 1850 he was elected by the Royal Geographical Society of London one of its 50 foreign members, and in 1858 received the Wollaston Medal from that scientific body. He was a distinguished member of many scientific societies at home and abroad and was held in the highest esteem for his attainments in geology and palæontology. Among his publications may be named 'Geology of New York' (1843); 'Palæontology of New York' (1847 *et seq.*); 'Graptolites of the Quebec Group' (1865); as well as parts of the Geological Reports of Iowa (1858–9); and Wisconsin (1862).

Hall, John, American Presbyterian clergyman: b. near Armagh, Ireland, 31 July 1829; d. Bangor, County Down, Ireland, 17 Sept. 1898. He was educated at Belfast College and after holding several pastorates in Ireland, in 1867 became pastor of the Fifth Avenue Presbyterian Church, New York. He was chancellor of the University of the City of New York 1882–90, and was also trustee of Princeton University, Union Theological Seminary, and of Wellesley College. He was noted for his simple eloquence and impressive sincerity and was one of the most prominent clergymen in his denomination. He wrote 'Family Prayers for Four Weeks' (1868); 'Papers for Home Reading' (1871); 'Questions of the Day' (1873); 'God's Word through Preaching' (1875); 'Foundation-Stones for Young Builders' (1879); 'A Christian Home: how to Make and how to Maintain It' (1883).

Hall, John M., American railroad president: b. Willimantic, Conn., 16 Oct. 1841; d. New Haven, Conn., 27 Jan. 1905. He was graduated from Yale in 1866 and from the Columbia Law School in 1868. He took up the practice of law in his native town and became a judge of the superior court in 1889, resigning in 1893 to become vice-president of the New York, New Haven and Hartford Railroad Company. On the death of President Clark in 1899, Judge Hall succeeded him as president.

Hall, Joseph, English prelate: b. near Ashby-de-la-Zouch, Leicestershire, 1 July 1574; d. near Norwich 8 Sept. 1656. While yet in college he published his 'Virgidemiarum,' a series of poetical satires, remarkable for elegant and energetic versification, strong and lively coloring, and masterly traces of genuine humor. Having taken orders he obtained the rectory of Halsted, near St. Edmund's Bury, where he published a very popular work, 'A Century of Meditations.' In 1617 he became dean of Worcester, and was raised to the see of Exeter in 1627. After the open rupture between the king and Parliament, he came forward in defense of the liturgy and discipline of the church, against the views which the leading Nonconformists had published, in a treatise called, after the initials of the names of its authors, 'Smectymnuus' (q.v.). In the end of 1641 Bishop Hall was translated from the see of Exeter to that of Norwich, but was later imprisoned in the Tower with the other prelates who had protested against their expulsion from the House of Peers. In 1643 he was specially named in the ordinance passed for sequestering what were called "notorious delinquents." His prose works edited by Philip Wynter were published in 1863. Among the latter, the best known and most popular is his 'Contemplations,' which still finds many readers.

Hall, Lyman, American patriot: b. Wallingford, Conn., 12 April 1724; d. Burke County, Ga., 19 Oct. 1790. He was graduated from Yale in 1747, studied medicine, and began practice in Wallingford, Conn., but finally settled near Sunbury, Ga., where he became a leading physician. The settlers in this locality were from New England, and on the outbreak of trouble with England, they with Hall as leader took active part in the rebellion, though Georgia was slow in joining the patriot cause. Hall was sent by them as a representative to the Continental Congress, where he was admitted by a unanimous vote, and took part in all debates, but did not vote when the vote was taken by colonies, until Georgia was represented as a colony. In 1776 it was so represented, and Hall continued a member of the Congress till 1780, being one of those who signed the Declaration of Independence. He was elected governor of Georgia in 1783, and in an energetic administration of one year, he did much to repair the damage done by the war, established land offices and schools, and then retired from public life. Consult: Dwight, 'Signers of the Declaration' and an article, 'Lyman Hall' in the 'Magazine of American History,' XXV. 35.

Hall, Marshall, English physician and physiologist: b. Basford, near Nottingham, 18 Feb. 1790; d. Brighton, England, 11 Aug. 1857. In 1809 he commenced the study of medicine at the University of Edinburgh, and took his degree in 1812. In 1817 he commenced practice at Nottingham, and soon rose to eminence. In 1826 he settled in London, where he carried on a most successful practice. He paid especial attention to the symptoms of illness and in 1817 published 'Diagnoses of Diseases,' and in 1824 his 'Medical Essays' appeared. His 'Essay on the Circulation of the Blood' (1831) contained an account of his discovery of the so-called "caudal heart" in the tail of the eel. The more important of his other writings are: 'Lectures on the Nervous System and its Diseases' (1836), 'Theory and Practice of Medicine' (1837); 'Theory of Convulsive Diseases' (1848). His services to the cause of humanity were numerous and valuable, and among these one of the most widely known is the method which he invented of restoring suspended respiration, now generally adopted in the case of persons partially drowned. It is known as the "Marshall Hall Method." See DROWNING.

Hall, Robert, English Baptist clergyman: b. Arnsby, Leicestershire, England, 2 May 1764; d. Bristol, England, 21 Feb. 1831. He studied at the Baptist College at Bristol and King's College, Aberdeen, and entered the Baptist ministry, becoming in a few years not only the most prominent minister in his denomination but one of the very foremost of English orators. He was also widely known as a master of prose style, his most noted writings being 'Apology for the Freedom of the Press' (1793); 'Modern Infidelity' (1800); 'Reflections on War' (1802). He was subject to attacks of insanity but in spite of this misfortune accomplished a vast amount of intellectual work and was a tireless student. His complete works in six volumes reached an 11th edition in 1853.

Hall, Robert Henry, American soldier: b. Detroit, Mich., 15 Nov. 1837. He was educated at West Point and served in the Federal army during the Civil War, and was in command of a brigade during the war in the Philippines. He became a brigadier-general in the United States army in 1901. He has published 'Register of the United States Army 1789–98'; 'History of the Flag of the United States'; 'History of United States Infantry Tactics.'

Hall, Ruth, American novelist: b. Schoharie, N. Y., 10 April 1858. Besides more or less journalistic work she has written: 'In the Brave Days of Old' (1898); 'The Boys of Scrooby' (1899); 'The Black Gown,' a novel of colonial Albany (1900); 'The Downrenter's Son,' a novel of the anti-rent troubles in New York State (1902); 'The Golden Arrow' (1903).

Hall, Samuel Carter, English miscellaneous writer: b. Topsham, Devonshire, England, 1801; d. 16 March 1889. For over 40 years he was the editor of the 'Art Journal,' which he founded in 1839. With his wife (Anna Maria) (q.v.) he published: 'Ireland, its Scenery and Character' (1841–3); 'Book of Royalty' (1838); 'A Woman's Story' (1857); 'The Book of the Thames' (1859); 'A Companion to Killarney' (1878); and others. His separate works were: 'A Book of Memories'; 'Book of British Ballads'; 'Baronial Halls'; 'Retrospect of a Long Life' (1883).

Hall, Thomas, American inventor: b. Philadelphia 4 Feb. 1834. He was educated at the University of Pennsylvania, and subsequently studied mechanics in Europe, and at the Paris exposition in 1867 placed a keyed typewriter on exhibition. His numerous inventions include a mechanism for printing by touching keys; a keyed typewriter, the Hall typewriter, first offered for sale in 1881; several sewing-machines, as well as drill-grinding and other machinist tools, etc.

Hall, Thomas Cuming, American theologian: b. Armagh, Ireland, 25 Sept. 1858. He was graduated from Princeton in 1879, from the Union Theological Seminary in 1882, studied also in Berlin and Göttingen, and was a pastor in

Omaha and Chicago. In 1898 he became professor of theology in the Union Seminary. Among his works are: 'The Power of an Endless Life' (1893); 'The Social Significance of the Evangelical Revival in England' (1899); and 'The Synoptic Gospels' (1900).

Hall, a large room or apartment, the term having its origin in the castles and mansions of the Middle Ages. Here the king or the lord of the manor gave audience, administered justice, and received and entertained his retainers and guests. At one end of the hall was a raised platform or dais, on which the table of the lord of the manor and his honored guests was placed. This end of the hall was usually lighted with large oriel windows, and communicated with a building which contained the lords' solar, or bedroom and parlor, on the upper floor, and the wine cellar below. The retainers sat at a table which ran along the lower part of the hall. The entrance was at the lower end of the hall, where a passage gave access to the kitchen, pantry, and buttery. Above the passage a gallery for musicians was frequently constructed. Survivals of such mediæval dining halls may be found in the Oxford and Cambridge colleges; also in the halls of the Inns of Court and of some of the London guilds. The hall partook of the style of architecture prevailing at the time when it was built, and being a large and important apartment was generally ornamental in its character. The hall of the king's palace, now known as Westminster Hall, built by William Rufus and restored by Richard II., is the finest example in England, being 300 feet long and 100 feet broad. In the United States Nassau Hall, Princeton; Carnegie Hall, New York; Faneuil Hall, Boston; Independence Hall, Philadelphia, are examples of the modern hall.

Hall-marks. See PLATE-MARKS.

Hall of Fame, a memorial to famous Americans, at the New York University. The institution received a gift of $100,000 with which it built a colonnade 500 feet long on University Heights, a beautiful site in upper New York, overlooking the valleys of the Harlem and the Hudson. Large panels to the number of 150, two feet by eight, will bear simple inscriptions of the names and dates of birth and death of the famous native Americans who are chosen as the 150 greatest men. Of these, 50 were chosen in 1903, and five every five years thereafter till the year 2000. The public was invited to make nominations; and such nominations as were seconded by the Senate of the University were submitted to 100 judges, representing every State in the Union. These judges were university and college presidents, professors of history, scientists, publicists, editors, authors, and judges of the supreme court, national and state. Ninety-seven of these sent in their votes, and 29 great men, native and 10 years dead, chosen by this vote, and thereafter ratified by the Senate of the University, are the first of these immortals.

Naturally George Washington headed the list, with Abraham Lincoln second, and Daniel Webster came third. The names of Bryant, Poe, and Cooper are likely to be added hereafter. Lowell was not dead 10 years and was not yet eligible. Bryant failed by three votes, Greeley by five, Motley by nine. The most animated discussion was provoked by the selection of General Robert E. Lee. But since only a minority of the judges were Southern men, the vote for him was at least not sectional. The names of 21 other great men will be added to the list. The following shows the roll of names chosen for the Hall of Fame, and the number of votes that each received:

George Washington	97
Abraham Lincoln	96
Daniel Webster	96
Benjamin Franklin	94
Ulysses S. Grant	92
John Marshall	91
Thomas Jefferson	90
Ralph Waldo Emerson	87
Henry Wadsworth Longfellow	85
Robert Fulton	85
Washington Irving	83
Jonathan Edwards	81
Samuel F. B. Morse	80
David Glasgow Farragut	79
Henry Clay	74
Nathaniel Hawthorne	73
George Peabody	72
Robert E. Lee	69
Peter Cooper	69
Eli Whitney	67
John James Audubon	67
Horace Mann	67
Henry Ward Beecher	66
James Kent	65
Joseph Story	64
John Adams	61
William Ellery Channing	58
Gilbert Stuart	52
Asa Gray	51

Hall of Odin, a tradition among the Scandinavian peoples, which tells of the rocks from which the Berserkers, when tired of life, flung themselves into the sea; so named because they were regarded as the portals of the Scandinavian Valhalla.

Hallam, hăl'am, **Arthur Henry**, English essayist: b. London 1 Feb. 1811; d. Vienna 15 Sept. 1833. He was a son of Henry Hallam (q.v.), and was graduated in 1832 from Trinity College, Cambridge, entered the Inner Temple and later the office of a conveyancer of Lincoln's Inn; and died during a visit to the Continent. At Cambridge he met Alfred Tennyson, whose 'In Memoriam,' through which he is best known, employs his sudden and untimely death as a basis for the exposition of a poet's philosophy. His 'Remains in Prose and Verse' (1834), largely justify the high hopes entertained for him, especially in the critique of Rossetti's 'Disquisizione sullo spirito antipapale,' and the essay on Cicero.

Hallam, Henry, English historian: b. Windsor 9 July 1777; d. Penshurst, Kent, 21 Jan. 1859. He was educated at Oxford, and in 1818 made his appearance as an author by his 'View of the State of Europe during the Middle Ages,' which at once established his reputation, and is acknowledged as a standard work. His next work, the 'Constitutional History of England' (1827), is justly regarded as a model at once of laborious research and scrupulous impartiality — an impartiality so scrupulous, that his readers are sometimes perplexed to discover to which side his judgment inclines. His 'Introduction to the Literature of Europe' (1837–9), if it could not add to his reputation, certainly did not detract from it. His eldest son, Arthur Henry (q.v.), died in early manhood; the great hopes buried with him may be gathered from a most affecting 'Memoir' printed by his father for private circulation, while Tennyson's

'In Memoriam,' of which Arthur Hallam is the subject, has raised to him a durable monument.

Hallé, häl-lā, Sir **Charles**, Anglo-German pianist: b. Hagen, Westphalia, 11 April 1819; d. Manchester, England, 25 Oct. 1895. He studied first at Darmstadt, and afterward at Paris, where his reputation was established by his concerts of classical music. But the revolution of 1848 sent him to England, and he made his home in Manchester. There he established in 1857 a series of subscription orchestral concerts which did much to raise the popular standard of musical taste by familiarizing the British public with the great masters of classical music. The orchestra which he conducted some forty years was the most finely trained body of musicians in the United Kingdom. He was knighted in 1888, and married the same year the famous violinist, Madame Norman-Neruda.

Hallé, Wilma Maria Francesca Neruda, Lady, Austrian violinist: b. Brunn, Moravia, 1840. She made her debut at Vienna in 1846, exciting the greatest enthusiasm by her wonderful execution. Her first husband was a Swedish musician, Ludwig Norman, and as Madame Norman-Neruda she was famous in England and America long before her marriage to Sir Charles Hallé (q.v.) in 1888. After the death of the latter she visited the United States on a concert tour.

Halle, häl'lĕ, or **Halle an der Saale**, än-dĕr-zä'lĕ, Germany, a town and important railway junction of six lines, in Prussian Saxony, about 20 miles northwest of Leipsic, on the river Saale. It consists of the mediæval town with narrow, crooked streets and ancient dwellings, separated by boulevards on the site of the old ramparts, from extensive and handsome suburbs. Among notable public buildings are the restored mediæval Rathaus; the "Red Tower" in the market place, a 15th century clock-tower; the decaying Moritzburg, formerly a citadel and archiepiscopal residence; the modern Gothic Ratskeller; the extensive buildings of the University (q.v.); a deaf and dumb asylum; a lunatic asylum; the 12th century Moritzkirche with fine wood carvings; the 16th century Protestant cathedral; and the 16th century Gothic church of the Virgin, with four towers and noted for its handsome interior. In the suburb of Glaucha the Waisenhaus, "orphan house," or institution founded by the Rev. Francke about 1693 forms a small town in itself. Besides the orphan asylum it includes different grade schools, attended by between 3,000 and 4,000 pupils; a printing and publishing establishment; and a laboratory where medicines are prepared and sold. The trade and manufactures of Halle are extensive. The latter include starch, beet-root sugar, chemicals, oil, machinery, etc., besides the celebrated ancient salt works. The salt workers form a distinctive colony with special exemptions and privileges and are known as "Halloren." Halle is mentioned as Halla as early as 806; in the 12th century it had developed considerable trade, and in the next two centuries was an important member of the Hanseatic League. In 1806 it was taken by the French; in 1813 it was annexed to Prussia. Pop. (1900) 156,661.

Halle, University of, Germany, a celebrated institution founded in 1694 by King Frederick I. in the interests of the jurist Thomasius, when he was followed to Halle by several students after his retirement from Leipsic owing to the envy of his fellow professors. It attained a high degree of prosperity, but owing to its strong Prussian proclivities was suppressed by Napoleon in 1806 and in 1813. It was re-established in 1815 and in 1817 was united with the University of Wittenberg. Its buildings which are very extensive, especially those accommodating the medical faculty, date from 1832. There are faculties of theology, law, medicine, and philosophy. From its foundation Halle was recognized as one of the principal schools of Protestant theology, and has numbered among its professors some of the most eminent names of Germany. Connected with the university is an ever-increasing library of over 220,000 volumes and MSS., a medical and surgical clinical institute; a maternity hospital; an observatory; a theological and normal seminary; and a botanical garden; especial attention is devoted to agriculture. In 1903 the university had nearly 2,000 students.

Halleck, hăl'ĕk, **Fitz-Greene,** American poet: b. Guilford, Conn., 8 July 1790; d. there 19 Nov. 1867. At 18 he became a clerk in a New York bank, in which employment he remained for 20 years. For a long period after this he was the confidential agent of John Jacob Astor, and was named by him one of the original trustees of the Astor Library. In 1849 he retired to his native town. He wrote verses in his boyhood, but these early effusions were excluded from the collected editions of his poems. In 1819 he assisted Joseph Rodman Drake (q.v.) in the humorous series of 'Croaker' papers, contributed to the New York *Evening Post.* Drake's death in the succeeding year was commemorated by Halleck in a most touching poem. In 1819 was published Halleck's longest poem, 'Fanny,' a satire, in the measure of Byron's 'Don Juan,' on the fashions, follies, and public characters of the day. From the variety and pungency of the local and personal allusions it enjoyed a great but fleeting popularity. In 1827 he published an edition of his poems in one volume, two of the best in the collection, 'Alnwick Castle' and 'Burns,' having been suggested by scenes and incidents of foreign travel. This edition also included the spirited lyric, 'Marco Bozzaris,' by which he will probably be longest kept in mind. Consult Wilson, 'Life and Letters of Fitz-Greene Halleck' (1869).

Halleck, Henry Wager, American soldier: b. Westernville, N. Y., 16 Jan. 1815; d. Louisville, Ky., 9 Jan. 1872. He was graduated at the United States Military Academy in 1839, was assistant to the Board of Engineers at Washington 1840–1, and in 1841–6 assistant engineer in the repair of the New York harbor fortifications. In the Mexican War he was on the Pacific coast, and in 1847–9 was secretary of State for California under the military government. After service as inspector and engineer of lighthouses (1852–4) and as engineer of the board for fortifications on the Pacific coast (1853–4), he resigned from the service in 1854, and practised law in San Francisco. On the outbreak of the Civil War he re-entered the army, and in November 1861, was appointed commander of the department of the Missouri, then in a state of thorough disorganization. He quickly reduced the department to order, outlined the western campaign of 1862, directed this campaign in person from 11 April, and took Corinth, with its 15 miles of entrenchments, on 30 May. In July he became general-in-chief of the armies of the United States; and henceforth directed from Washington the movements of the generals in the field, till, in March 1864, he was superseded by Gen. Grant. Halleck was chief of staff till 1865, commanded the military division of the James in 1865, that of the Pacific, 1865–9, and that of the South from 1869 until his death. He wrote a work on 'The Elements of Military Art and Science' (1846), largely used as a manual in the Civil War; 'Bitumen' (1841); 'A Collection of Mining Laws of Spain and Mexico' (1859), and other volumes.

Halleck, Reuben Post, American educator: b. Rocky Point, L. I., 8 Feb. 1859. He was graduated from Yale in 1881, was instructor in the Male High School, Louisville, Ky., 1883–96, and principal from the latter date. He has published: 'Psychology and Psychic Culture' (1895); 'The Education of the Central Nervous System' (1890); 'History of English Literature' (1900).

Hallelujah, hăl-e-loo'ya, **Halleluia,** or **Alleluia** (Hebrew), "Praise ye the Lord"; an expression which occurs often in the Psalms, and which was retained when the Bible was translated into the various languages, probably on account of its full and fine sound, which, together with its simple and solemn meaning, so proper for public religious services, has rendered it a favorite of musical composers. The Roman Catholic Church does not allow it to be sung on the Sundays during Lent, on account of the mournful solemnity of the season; and in that church it is not sung again before Easter. It is no longer sung in masses for the dead as formerly. In the time of Augustine the African Church used this doxology only from Easter to the feast of Pentecost. The Greeks made an earlier or more common use of the Hallelujah than the Latin Church. The Jews call the Psalms cxiii.-cxvii. the Great Hallelujah, because they celebrate the particular mercies of God toward the Jews, and they are sung on the feast of the Passover, and on the feast of Tabernacles.

Haller, Albrecht von, äl'brĕʜt fōn häl'lĕr, Swiss anatomist, botanist and poet: b. Bern 16 Oct. 1708; d. there 12 Dec. 1777. Having chosen the medical profession, he went to the University of Tubingen, where he studied comparative anatomy under Duvernoy; and in 1725 removed to Leyden, then the first medical school in Europe. After extensive travels in England and France he went to Basel in 1828 to study mathematics under Bernoulli. Here he first imbibed a taste for botany, and composed his poem 'Die Alpen', followed by various ethical epistles and other pieces, which gave him a reputation in Germany. In 1729 he returned to his native city, and entered on his professional career as a public lecturer on anatomy. In 1736 he became professor of anatomy, surgery, and botany, in the newly founded University of Göttingen, and through his influence the university was enriched with a botanical garden, an anatomical theatre, a school for midwifery, and a college of surgery. In 1747 appeared the first edition of his 'Primæ Lineæ Physiologiæ,' which, long after the death of the author, was used as a text-book in schools of medicine. In 1752 he first advanced his opinions on the properties of sensibility and irritability as existing in the nervous and muscular fibres of animal bodies; doctrines which attracted much attention, and excited great controversies in the medical world. Disagreements with his colleagues induced him to return, in 1753, to Bern, where his countrymen received him with the respect due to his fame and talents. Having been elected a member of the sovereign council of the state, he soon obtained by lot one of its magistracies, and entered with zeal on the duties of a citizen, though he did not neglect his scientific pursuits. He was elected in 1754 one of the foreign associates of the Paris Academy of Sciences. In 1758 he became director of the public salt-works at Bex and Aigle, and in the course of his superintendence introduced many improvements in the manufacture of salt. His later published works include: 'Elementa Physiologiæ Corporis Humani' (1757–66); 'Bibliotheca Botanica' (1771); 'Bibliotheca Anatomica' (1774); 'Bibliotheca Chirurgica' (1774); 'Bibliotheca Medicinæ Practicæ' (1776–88).

Haller is considered one of the greatest German poets of the 18th century. His philosophical and descriptive poems display depth of thought and richness of imagination. His 'Elegiac Poems' (Die elegischen Gedichte) are still frequently republished in Germany. He wrote in prose three philosophico-political romances — 'Usong,' 'Alfred the Great,' and 'Fabius and Cato' — designed to exhibit the respective advantages of different forms of government, and corresponded in German, Latin, Italian, English, and French with all parts of Europe.

Hal'lett, Benjamin Franklin, American statesman: b. Barnstable, Mass., 2 Dec. 1797; d. Boston 30 Sept. 1862. Graduated from Brown University in 1816, he studied law, was admitted to the bar, and was connected with the Providence (R. I.) press, but later went to Boston, and there became editor of the Boston *Advocate*, the official mouthpiece of the Anti-Masonic party. From 1827 to 1831 he edited the Boston *Daily Advertiser*, which he made extremely unpopular through his vigorous enunciation of his views on masonry, temperance, and emancipation. He afterward became a Democrat and an influential factor in his party. For years he was chairman of its national committee, and it was he who drafted the Cincinnati platform of 1856. President Pierce, whose nomination he had helped to secure, appointed him United States district attorney in 1853.

Hal'lettsville, Texas, city, county-seat of Lavaca County; on the San Antonio & A. P. railroad; about 100 miles southwest of Houston. It is in an agricultural and stock-raising region, and special attention is given to cotton and cattle. It has a cotton-seed oil mill and a number of cotton-gins. Large shipments are made each year of live-stock, cotton, and cotton-seed oil. Pop. (1900) 1,457.

Halley, hăl'ĭ, **Edmund,** English mathematician and astronomer: b. Haggerston, near London, 29 Oct. 1656; d. Greenwich, Kent, 1742. Before he was 19 he published 'A Direct and Geometrical Method of Finding the Aphelia and

Eccentricity of Planets,' which supplied a defect in the Keplerian theory of planetary motion. By some observations on a spot which appeared on the sun's disk in July and August 1676, he established the certainty of the motion of the sun round its own axis. August 21, the same year, he fixed the longitude of the Cape of Good Hope by his observation of the occultation of Mars by the moon. In 1679 he published 'Catalogus Stellarum Australium, sive Supplementum Catalogi Tychonici,' etc., and in 1683 his 'Theory of the Variation of the Magnetical Compass,' in which he endeavors to account for that phenomenon by the supposition of the whole globe of the earth being one great magnet, having four circulating magnetical poles or points of attraction. For the purpose of making further observations relative to the variation of the compass he set sail on a voyage in 1699, and having traversed both hemispheres arrived in England in September 1700. The spot at St. Helena where he erected a tent for making astronomical observations is still called Halley's Mount. As the result of his researches he published a general chart, showing at one view the variation of the compass in all those seas with which English navigators were acquainted. He was next employed to observe the course of the tides in the English Channel, with the longitudes and latitudes of the principal headlands, in consequence of which he published a large map of the channel. In 1703 he was elected Savilian professor of geometry at Oxford, and in 1720 he received the appointment of astronomer-royal at Greenwich, where he afterward resided, devoting his time to completing the theory of the motion of the moon. In 1721 he began his observations, and for the space of 18 years scarcely ever missed taking a meridian view of the moon, when the weather was not unfavorable. In 1752 appeared his 'Astronomical Tables,' and he was the author of a great number of papers in the 'Philosophical Transactions.' For the comet called by his name, see COMET.

Halliwell-Phillipps, hăl'ĭ-wĕl-fĭl'ĭps, **James Orchard**, English antiquary and Shakespearian scholar: b. Chelsea, London, 21 June 1820; d. Hollingsbury Copse, near Brighton, 3 Jan. 1889. He was educated at Cambridge. In 1839 he was elected Fellow of the Royal and Antiquarian Societies. Gradually he came to concentrate his studies on Shakespeare alone, and more particularly on the facts of the poet's life, discrediting the internal evidence of the plays and sonnets, and devoting his attention to a minute and patient study of local tradition and the records of 32 towns besides Stratford. The successive editions of his 'Outlines of the Life of Shakespeare' (1848; 8th ed. 1889) recorded the growing results of his discoveries. Apart from Shakespeare, his 'Nursery Rhymes and Nursery Tales of England' (1845), and 'Dictionary of Archaic and Provincial Words' (1847; 6th ed. 1868) will keep his name from being forgotten. His magnificent folio edition of the 'Works of Shakespeare,' probably the richest storehouse extant of Shakespearian criticism (1853–65), was published at a price prohibitive to most students. To the Smithsonian Institute he gave (1852) a collection of accounts, inventories, and bills illustrative of the history of prices current in the years 1650–1750.

Hal'lock, Charles, American journalist and author: b. New York 13 March 1834. He was graduated from Amherst in 1854, was editor of the New Haven *Register* in 1855–6, of the New York *Journal of Commerce* in 1856–61, of the St. John (N. B.) *Telegraph and Courier* in 1863–5. In 1873 he founded 'Forest and Stream,' and in 1896–7 was editor of the 'Northwestern Field and Stream.' In 1874 he founded the International Society for the Protection of Game. He did field-work and collecting for the Smithsonian Institution, and published numerous works, such as: 'The Fishing Tourist' (1873); 'Camp Life in Florida' (1876); 'Vacation Rambles in Michigan' (1877); 'Dog Fanciers' Directory' (1886); 'The Salmon Fisher' (1890). He was a son of Gerard Hallock (q.v.).

Hallock, Gerard, American journalist: b. Pittsfield, Mass., 18 March 1800; d. New Haven, Conn., 4 Jan. 1866. He was graduated from Williams College in 1819, in 1824 founded the Boston *Telegraph* (united with the *Recorder* in 1825), in 1827 purchased a part interest in the New York 'Observer,' and in 1828 became associated with David Hale on the *Journal of Commerce*. A leader in journalistic enterprise, he started (1833) a pony-express between Philadelphia and New York, and operated the Evening Edition, a schooner which met incoming ships at Sandy Hook, and brought foreign news. A pro-slavery man, he was a founder of the Southern Aid Society (1854), intended to succeed the American Home Missionary Society when the latter refused support to slave-holding congregations. In 1861 the *Journal of Commerce* was forbidden the use of the United States mails, and Hallock thereupon sold his interest, and never afterward wrote for the press. He was a founder of the Associated Press.

Hallock, Joseph Newton, American Presbyterian clergyman and religious journalist: b. Franklinville, N. Y., 1834. He was graduated from Yale in 1857 and from the Yale Theological Seminary in 1860, and after holding pastorates of several Presbyterian churches became editor and proprietor of 'The Christian at Work.' Among other works he has published 'The Christian Life' (1890); 'Family Worship' (1892); 'What is Heresy?' (1894); 'Mormonism' (1896); 'Life of D. L. Moody' (q.v.) (1900).

Hallowe'en, hăl-ō-ēn', or **Hallow-Even**, the evening of 31 October, so called as being the eve or vigil of All Hallows, or festival of All Saints, which falls on 1 November. It is associated in the popular imagination with the prevalence of supernatural influences, and is clearly a relic of pagan times. In the north of England, hallowe'en is known as Nutcrack Night. In Scotland the ceremonies of the eve were formerly regarded in a highly superstitious light, and Burns' 'Hallowe'en' gives a humorous and richly imaginative presentment of the usual ceremonies as practised in Scottish rural districts in his day. The principal object of curiosity in consulting the future was to discover who should be the partner in life. Popular belief ascribed to children born on hallowe'en the faculty of perceiving and holding converse with supernatural beings.

Hal'lowell, Richard Price, American author and wool merchant: b. Philadelphia 16 Dec. 1835; d. Medford, Mass., 5 Jan. 1904. He was prominent in the abolition movement, was appointed by Gov. Andrew of Massachusetts special agent to recruit negro regiments, and subsequently was vice-president of the New England Woman Suffrage Association. He published 'The Quaker Invasion of Massachusetts' (1883), etc.

Hallowell, Me., city in Kennebec County, on the Kennebec River, and on the Maine Central railroad; two miles south of Augusta and four miles north of Gardiner. The first permanent settlement was made in 1754. It was incorporated as a township in 1771, and chartered as a city 29 Aug. 1850. At the time of its becoming a chartered city it included within its limits Chelsea, Manchester, and Farmingdale. The city is governed by a mayor and a council of seven members elected annually. It has two banks with a combined capital of $150,000. The industries of the city include granite works, shoe manufactories, glue works, cotton goods, machinery, etc. The Hubbard Free Library and the Maine Industrial School are public institutions. Pop. (1904) 3,000.

Hall'statt Epoch, a name taken from the necropolis of Hallstatt, Upper Austria, not far from Salzburg, and applied to that culture in Europe — parts of Germany, France, Italy, and in Switzerland, Bohemia, etc. — distinguished as the last bronze and first iron stage, dating back at least as far as 1000 B.C. According to some ethnologists in the eastern highlands of the Alps this culture was of a higher evolution than that of a partially Oriental cast in the west during the Neolithic epoch.

Hällström, Ivar, ē'vär hĕl'strĕm, Swedish composer: b. Stockholm 5 June 1826; d. there 11 April 1901. He studied law at Upsala, then turned his attention to music, in 1861–72 was director of the institute founded by Lindblad, and from 1881 instructor to the Royal Opera. His works include the operas 'Den Bergagna' ("The Mountain King" 1874); and 'Neaga' (libretto by Carmen Sylva, 1885); cantatas, numerous songs, and an 'Idyle' for orchestra, chorus, and solo voices, for which he received (1860) a prize from the Stockholm Musical Union.

Hallucina'tions, are morbid conditions of mind in which the patient is conscious of a perception without any impression having been made on the external organs of sense. Hallucinations are to be distinguished from delusions, for in these there are real sensations, though they are erroneously interpreted. All the senses are not equally subject to hallucinations; the most frequent are those of hearing; next, according to many, come those of sight, smell, touch, and taste; and hallucinations of several senses may exist simultaneously in the same individual. They may also be complicated with certain delusions. Often even the hallucination of one sense is confirmed by the delusion of another, so that it is neither possible nor necessary always to distinguish hallucinations from delusions. The simplest form of hallucinations of hearing is the tingling of the ears; but the striking of clocks, the sounds of musical instruments and of the human voice are often heard, and in these instances, as in those of the perturbations of the other senses, there must be a diseased sensorium, though there should be no structural derangement of the nerves. Hallucinations are not confined to those whose mental faculties have been alienated, but occasionally assail and torment even the sane. The second Earl Grey was haunted by a gory head, but he could dismiss it at will. Swedenborg had a similar faculty; and Bernadotte, king of Sweden, was besieged in his rides by a woman in a red cloak, being perfectly conscious of the hallucination under which he labored. Lord Brougham proposed that the existence of hallucinations should be established as an authoritative test for the existence of insanity; but, as will have been seen, this would be no test at all. The proportion of the hallucinations of the various senses has been by some tabulated thus: — hearing, 49; vision, 48; taste, 8; touch, 3; smell, 1. All are more frequent in mania than in monomania, and in mania errors of vision are more numerous than those of hearing. See APPARITIONS; DREAMS; GHOSTS; INSANITY.

Hallux Valgus, a deformity of the great toe consisting of a turning of the toe toward its neighbor, with a marked enlargement of the head of the bone. The synovial sac on the inner side of the toe is often chronically inflamed from constant pressure, forming a bunion. Advanced cases may require the excision of the bony outgrowths, but early cases may be relieved by a properly adjusted shoe.

Halmahera, häl-mä-hä'rä. See GILOLO.

Halo, the name given to colored circles sometimes seen around the sun or moon, and to other connected luminous appearances. Sometimes as many as three circles are seen round the sun. A white band across the sun, parallel to the horizon, is also sometimes seen; and sometimes a second white band, perpendicular to the first. These bands form a cross, and stretch out so as to cut the circles of the halo. It is on these bands that parhelia or mock suns are formed. The explanation of halos is complex and difficult. Marriotte attributed the colored rings to refraction of light through small crystals of ice in the air, and calculation appears to confirm his hypothesis. The third circle is probably due to refraction of light that has undergone internal reflection in the crystals in a way similar to that which occurs in the formation of the rainbow. On the other hand, the white bands crossing the sun must be due to reflection of light from the surfaces of the crystals. See LIGHT; PARHELION; SUN.

Halogen, hăl'ō-jĕn, in chemistry, an element, or inorganic radical, which unites directly with a metal to produce a saline substance, such as common salt. The term is usually confined to the elements fluorin, chlorin, bromin, and iodin, and the compound known as cyanogen.

Halophytes, hăl'ō-fīts, a group of plants considered with reference to their habitat, and including those which inhabit salt marshes, and by combustion yield barilla, as *Salsola*, *Salicornia*, and *Chenopodium*. For further examples see BEACH-PLANTS and DESERT PLANTS

Hal'pine, or Halpin, Charles Graham, American soldier and author: b. Oldcastle, County Meath, Ireland, 20 Nov. 1829; d. New York

3 Aug. 1868. After study at Trinity College, Dublin, he came to Boston, Mass., in 1851, was there assistant editor of the *Post*, and with B. P. Shillaber began the 'Carpet Bag,' an unsuccessful humorous periodical. Later Washington correspondent of the New York *Times*, he then went to New York, where he was connected with the *Herald*, and wrote much ephemeral matter for magazines. Upon the outbreak of the Civil War he enlisted in the 69th New York volunteer infantry, and was afterward on the staff of Hunter as assistant adjutant-general, of Gen. Halleck with the rank of colonel. In 1864 he resigned from the service and was brevetted brigadier-general of volunteers. He was best known for his burlesque verses, written in the character of an Irish private, "MILES O'REILLY," over which pseudonym they appeared. 'Life and Adventures, Songs, Services, and Speeches' was published in 1864, and his complete 'Poetical Works' in 1869.

Hals, häls, **Frans**, Dutch painter: b. Anwerp about 1584; d. Haarlem 7 Sept. 1666. When young he went to Haarlem, where he studied painting under Karel van Mander, and he was one of the civic guard, director of an art school, and chief of the painters' guild. His first dated work is a portrait belonging to the year 1613, his next, the 'Banquet of the Officers of the Haarlem Corps of Arquebusiers of St. George' (1616), one of the earliest pictures belonging to the Dutch school of genre painting, of which Hals is sometimes regarded as the founder. He executed 'The Jolly Trio,' 'Herring Vender,' and 'Fool Playing a Lute,' and seems to have found in genre painting a scope and a possibility of humor much to his taste. He executed also many single-figure pieces, as 'Hille Bobbe' (National Gallery, Berlin; replica in the Metropolitan Museum), and numerous portraits, all of high value artistically. Hals is ranked among the foremost of portrait artists, being notably successful in illuminating the character of the face. Adrian van Ostade, Wouwerman, and Adrian Brouwer were among his pupils. He is said to have been improvident in his habits, and latterly received a pension from the municipality of Haarlem. His brother DIRK, d. Haarlem May 1656, and his son, FRANS HALS, THE YOUNGER, b. about 1620; d. about 1669, were also excellent painters.

Hal'sey, Francis Whiting, American journalist: b. Unadilla, N. Y., 15 Oct. 1851. He was a member of the editorial staff of the New York *Tribune* 1875–80, and was attached to that of the New York *Times* 1880–1902, editing the *Times* 'Saturday Review' from 1896. He has published 'Two Months Abroad' (1878); 'The Old New York Frontier' (1901); 'American Authors and their Homes'; 'Essays'; 'Our Literary Deluge' (1902).

Hal'stead, Murat, American journalist: b. Ross, Butler County, Ohio, 2 Sept. 1829. At 18 he began writing for newspapers, studied at Farmers' College, near Cincinnati, and did local newspaper reporting on several Cincinnati papers. In 1853 he became manager of a department on the Cincinnati *Commerciol*. The following year he acquired a pecuniary interest in the paper, which began rapidly to increase in circulation and influence, so that in a few years it was considered one of the most influential newspapers in the West. The *Commercial* combining with the *Gazette*, its rival, the Cincinnati *Commercial-Gazette*, became the recognized organ of the Ohio Republicans. In 1890 he removed to Brooklyn, N. Y., where he edited the *Standard Union*. Later he was a contributor to magazines and special correspondent, and in the latter capacity went to the Philippines during the Spanish-American War. He wrote: 'The Story of Cuba'; 'Life of William McKinley'; 'The Story of the Philippines'; 'History of American Expansion'; 'Life of Admiral Dewey'; 'The Boer and British War.'

Halsted, George Bruce, American mathematician: b. Newark, N. J., 25 Nov. 1853. He was graduated from Princeton in 1875 and since 1884 has been professor of mathematics in the University of Texas. He has published 'Mensuration' (1881); 'Elements of Geometry' (1885); 'Elementary Synthetic Geometry' (1892); 'Pure Projective Geometry' (1895).

Ham, one of the three sons of Noah, from whom the earth after the Deluge was peopled. He is first mentioned between the other two — Shem, Ham, and Japheth; but afterward is expressly designated the younger son of Noah, that is, relatively to the other two. He had four sons — Cush, Mizraim, Phut, and Canaan. The three first traveled southward, and from them chiefly sprang the tribes that peopled the African continent, as Canaan became the father of the tribes that principally occupied the territory of Phœnicia and Palestine. Ham is also used as a designation of Egypt, probably on account of its population having sprung from a son of Ham, and the name Ammon, by which the chief god of the northern Africans was often called and worshipped, may very likely derive its origin from the same source.

Ham, the joint which unites the thigh and the leg of an animal, but more generally understood to mean the cured thigh of the hog. Ham-curing is now an important branch of business, especially in Great Britain and America, and the details of the process are generally the same everywhere. The meat is first well rubbed with salt, and a few days after it is rubbed again with a mixture of salt, saltpetre, and sugar, though sometimes the saltpetre is omitted. After lying in the tub for eight or ten days it is ready for drying. Wet-salting requires three weeks, and dry-salting four. The smoking of hams is carried on in smoke-houses, the meat being hung as high as possible, and subjected to the smoke of a fire kindled on the ground-flat, and which ascends through holes in the flooring. The process of smoking is for the most part carried on in winter, the fire being kept in a smouldering state for five or six weeks. Wood is used in preference to coal in the process of smoking. See PORK.

Ham-beetle, or Paper-worm, a small clerid beetle (*Necrobia rufipes*), sometimes a pest of considerable importance because of the occurrence of its larvæ or "worms," the paper-like cocoons and beetles on hams in such numbers as to render them unmerchantable. Its injuries are generally confined to the exterior and are due to carelessness in packing and to the cracking of the ham coverings. This is one of three cosmopolitan species of the same genus, all of which are carnivorous scavengers.

Ham-fly, a name of the cheese-fly (q.v.), due to the occasional appearance of its maggots or «skippers» in the fatty exterior portions of preserved hams.

Hama, hä'mä, or **Hamah**, Syria, the Biblical HAMATH, a very ancient city, on the El-Asi (Orontes), 110 miles northeast of Damascus. It is surrounded by gardens, and has narrow, crooked streets, with houses built of timber, and sun-dried bricks. There are manufactures of yarn and coarse woolens, and a general domestic and caravan trade. Hamath is frequently mentioned in Old Testament history as in conflict with the Assyrians; first as early as 854 B.C. After the Græco-Macedonian conquest it became known as Epiphania. In 639 it was captured by the Moslems. Abulfeda, the Arabian geographer, was prince of Hama from 1310–31. In 1812 Burckhardt here discovered the four Hittite stones, the inscriptions of which are still undeciphered. Pop. (est.) 45,000.

Hamadryad, hăm'a-drī-ăd. (1) A baboon (q.v.). (2) The king-cobra (*Naja bungarus*), one of the Oriental cobras, found from Southern India to China and the Philippines, and closely allied in structure, markings, and habits to the cobra di capello, but much larger, reaching the length sometimes of 13 feet, making it the longest of venomous serpents. It is also the most fierce in disposition, but fortunately is nowhere common, and feeds wholly on other snakes. Consult Fayrer, 'Thanatophidia of India' (1874).

Hamadryads, in Greek mythology, the eight daughters of Hamadryas. They received their names from trees, and are the same as the Dryads (q.v.). They were conceived to inhabit each a particular tree, with which they were born, and with which they perished.

Hamame'lis. See WITCH HAZEL.

Haman, hā'man, a minister of the Persian king Ahasuerus. Because Mordecai the Jew refused to pay him homage, he resolved on the destruction of all the Jews in the Persian monarchy. By falsehood and intrigue he succeeded in obtaining a decree for this purpose; but Esther, the Jewish consort of Ahasuerus, interposed for their deliverance, and Haman was hanged on the very gibbet he had caused to be prepared for Mordecai. His history is contained in the book of Esther.

Hamath, hā'măth. See HAMA.

Ham'blin, Joseph Eldridge, American soldier: b. Yarmouth, Mass., 1828; d. New York 3 July 1870. Not long after the commencement of the Civil War, he became adjutant of the 5th New York, later was transferred to the 65th, whose commander he soon became, and with which he participated in Sheridan's victorious movements in the Shenandoah. For services at Cedar Creek he was brevetted brigadier-general, and was mustered out in 1866 with full rank of brigadier and brevet of major-general. Subsequently he was active in the affairs of the New York State National Guard.

Hamblin, Thomas Sowerby, American actor: b. Pentonville, near London, England, 14 May 1800; d. New York 8 Jan. 1853. He was early a member of the corps of the Sadler's Wells and Drury Lane theatres, was a tragedian at Bath, Brighton, and Dublin, came to the United States in 1825, appeared at the Park Theatre, New York, and acted in leading American cities. He was manager of several New York theatres, and among his rôles were those of Macbeth, Hamlet, Othello, Rolla, Pierre, Virginius, and Coriolanus. He was esteemed second only to Forrest and the elder Booth, and made the standard drama a feature of his management, under which the Bowery Theatre saw its historic days.

Hamburg, hăm'bėrg (Ger. häm'boorg), Germany, a free city and state of northwestern Germany, the city occupying 30 square miles of the state's total area of 157.18 square miles. The city is the greatest commercial port on the European continent, the chief of the three Hanse towns, and the seat of the upper Hanseatic court. It is situated at the junction of the Alster and the Bille, on the right bank of the northern branch of the Elbe, about 93 miles from the North Sea. With its connecting suburbs Altona and Ottensen it has a river frontage of over five miles. The river is spanned by two fine bridges, and there are numerous bridges across the canals which intersect the east and lower part of the city in all directions, and across the Alster which flows through the city and forms two ornamental pieces of water, the Aussen-Alster and the Binnen-Alster or Alster-Bassin. The latter is surrounded by fine quays, the Alter Jungfernstieg and the Neuer Jungfernstieg, lined with handsome residences, hotels, and stores, and constituting the chief thoroughfare in the city. The harbor accommodation is extensive; the principal quays along the Elbe where the ocean steamships lie are the Kaiser-Quai and the Sandthor-Quai. The boulevards or Anlagen occupy the site of the ancient encircling walls, removed since 1815. The modern portion of the city, rebuilt since the destructive fire of 1842 in a magnificent and expensive style, is in striking contrast to the older low-lying portion, with its back streets, bordered by warehouses, and the meaner class of dwelling houses. The most important public buildings are the Exchange, a noble edifice consisting chiefly of a magnificent hall surrounded by a fine colonnade and containing a large commercial library; the modern Rathaus in Renaissance style, and the Deutsches Schauspielhaus. Among ecclesiastical structures are the 19th century Gothic church of St. Nicholas with a tower and spire 473 feet high; the 18th century Renaissance church of Saint Michael's, with a spire 426 feet high, the 15th century church of St. Catherine's, the 14th century church of St. James, and a fine Jewish synagogue. Besides the numerous private and public schools the educational institutions include the Johanneum institution founded in 1528, containing a college, museums, and the city's extensive library; the Kunsthalle with a large art collection; and zoological and botanical gardens, etc. Among the many charitable and benevolent institutions are well endowed hospitals, orphan, and insane asylums, and there is also an organized system of municipal poor relief. The sewerage system has been modernized, and the general sanitary conditions improved, especially since the severe choleraic epidemic of 1892. The municipal waterworks, dating from 1531, have been added to at various dates and a modern filtering plant installed since 1893; municipal bath and wash houses are maintained; food adulteration is keenly looked after; the gas and electric lighting plants are civic property; and a large revenue is obtained from the electric street railroads, which are operated by private companies, paying state subventions.

The importance of Hamburg is due to its great marine commerce, which has been facilitated by the engineering enterprises of the inhabitants in deepening the bed of the river, cutting canals, and since 1890 in the construction at Cuxhaven, at the mouth of the river, of enormous docks. Seven railroad lines enter the city, which is connected also by rivers and canals with nearly all parts of the German empire. In 1900, 12,912 vessels with a net tonnage of 8,148,218 tons entered, and 14,030 with a net tonnage of 8,293,252 cleared the port. The exports by sea in 1901 amounted approximately to 4,695,469 tons, valued at $454,886,750; the imports by sea in the same year were approximately 9,701,346 tons, valued at $540,177,750. Raw materials, foodstuffs, especially coffee, and manufactured articles are the chief imports, the last item constituting also the bulk of the exports. The city's manufacturing interests, though large, are less important, including ship-building, iron-founding, tobacco and cigar making, sugar refining, distilleries, breweries, and numerous other domestic industries. The banking, exchange, and marine assurance business of Hamburg has been on an extensive scale since the establishment of the Hamburg giro-bank in 1619, and is one of the most important in the world.

The city-state has a democratic constitution and is administered by an executive senate of 18 life-members, including a first and a second burgomaster elected biennially among the members, and by the legislative House of Burgesses composed of 160 members elected every six years, one half of whom retire every three years. The population of the city is second to that of Berlin in the German empire; in 1900 it was 705,738.

The city was founded by Charlemagne, who, between 808 and 811, built a citadel and a church on the heights between the Elbe and the east bank of the Alster as a bulwark against the neighboring pagan Slavs. In 831 it became an episcopal see. It was frequently devastated by Danes and Slavs, but in the 12th century had become an important commercial city, and in 1241 and 1249 combined with Lübeck and Bremen in forming the Hanseatic League. It was declared an imperial city by Maximilian in 1510, but was not formally acknowledged until 1618. During the Thirty Years' War its population and prosperity increased owing to the immunity of its position, and in the following century extensive commercial relations with North America were developed. In 1810 it was incorporated in the French empire as the capital of the department of the Mouths of the Elbe, but was occupied by the Russians in 1813. They were driven out by the French under Davoust, two months later, and the city underwent severe financial spoliation at the hands of the conqueror and extensive depopulation. In 1815 it became an independent state of the German federation, forming with Lübeck, Bremen, and Frankfort, the curia of the free cities. Its trade and importance have increased ever since. In 1871 it united with the German empire as a free city-state; but did not join the Zollverein or German Customs Union until 1888.

Hamburg Fowls. See Poultry.

Hamilcar, hă-mĭl'kar, a name of common occurrence at Carthage, and borne by several of its most distinguished citizens, among whom the chief was Hamilcar Barca ("lightning"): b. Carthage; d. Spain 228 B.C. He was the father of the celebrated Hannibal. While a young man he was appointed to the command of the Carthaginian forces in Sicily, in the 18th year of the first Punic war, 247 B.C. He established himself with his whole army on Mount Hercte (now Monte Pellegrino), where he not only succeeded in maintaining his ground, but sent out squadrons to plunder the coasts of Sicily and Italy. In 244 he quitted his strong position, and, landing at the foot of Mount Eryx, converted the town of that name into a fortified camp for his army. For two years he defied all the efforts of the Romans to dislodge him; but the Carthaginian admiral, Hanno, having been totally defeated off the Ægate Islands, 241 B.C., he reluctantly consented to withdraw from Sicily. His inability to perform the promises which, to keep them in obedience, he had made to his mercenary troops, brought about their revolt after returning from Sicily, and as they were joined by almost all the native Africans, Carthage was brought to the brink of ruin. The incapacity of Hanno, who had been entrusted with the suppression of the revolt, led all parties to concur in the appointment of Hamilcar. He defeated the enemy with great slaughter, reduced their towns to subjection, and after several alternations of fortune, and the appointment of Hanno to a share in the command, the war was brought to a successful close, 238 B.C. Hamilcar now projected the formation of a new empire in Spain, to be a source of strength to Carthage, and the point whence hostilities might be renewed against Rome. This policy was ably prosecuted after his death by Hasdrubal and Hannibal. Hamilcar penetrated into the heart of the country, reduced some cities and tribes, and acquired vast wealth. He passed nine years in Spain, and fell in a battle against the Vettones.

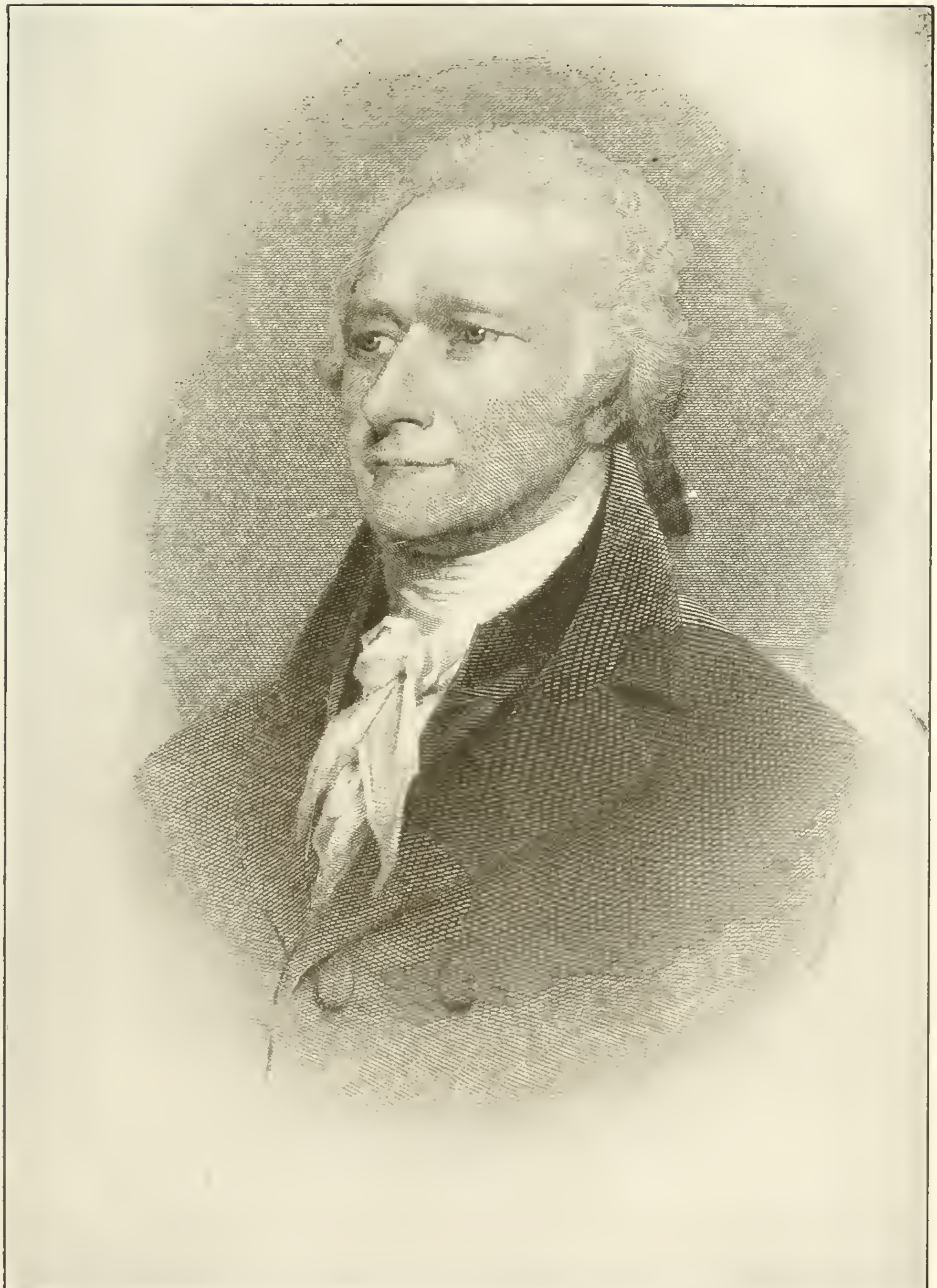
Hamilton, Alexander, American statesman and soldier: b. Charles Town, in the island of Nevis, W. I., 11 Jan. 1757; d. New York 12 July 1804. His parentage is uncertain, but it is generally accepted that he was the son of James Hamilton, a Scotch merchant in Nevis, and Rachel Levine, the daughter of a French physician. Hamilton's father was unfortunate in his business ventures, and having become a bankrupt it was necessary for Alexander, at the age of 12 years, to earn his own living. He secured a position as clerk in the counting-house of Nicholas Cruger of Saint Croix. His "genius for affairs" was soon apparent, and after two years we find him entrusted with the full management of the business. But ambition for something more than a commercial career had already taken hold of the young man's mind, and he began to write for the local press. A very strong and vivid description of a West Indian hurricane, which had devastated the islands, attracted general attention and aroused the lad's friends to provide the necessary funds to enable him to come to America to complete his education. He arrived at Boston in 1772, and was put in a school at Elizabethtown, N. J., where he industriously prepared himself for college, and in 1774 he entered King's College (now Columbia University), and made a brilliant record as a student. The friction between England and the American colonies was constantly growing more serious, and after studying the question and being convinced that the colonists were right, Hamilton began the advocacy of their cause in a speech at a public meeting, 6 July 1774. The meeting assembled to discuss the calling of a general congress and was held in the fields (now City Hall Park). He also published two pamphlets, asserting the colonists' position in relation to the Crown and to Parliament, and justifying their appeal to arms. The pamphlets were at first thought to be productions of well-known leaders, and when their authorship became known it gave Hamilton a national reputation. Hamilton now turned his attention to preparation for military service in the Revolution. He secured a commission as captain of the first Continental artillery company and entered the patriot service in March 1776. His natural aptitude for organization and command soon made the company a model of discipline and efficiency. He participated in the battles of Long Island, White Plains, Trenton and Princeton, and won the commendation of his superiors for his skill and courage. On 1 March 1777 Hamilton was appointed lieutenant-colonel and aide-de-camp on the staff of Washington, whose entire confidence he secured, becoming the general's confidential secretary. He took an active part in his chief's battles, assisted in planning campaigns and in devising means for the support of the army, and was entrusted with the important and delicate mission of going to Albany to obtain troops from Gen. Gates (who had previously been ordered to send troops to Washington and had failed to do so) — a duty which Hamilton performed with skill and success. It was while on this mission that he first met Elizabeth Schuyler, the daughter of Gen. Philip Schuyler of New York, whom he afterwards married (14 Dec. 1780). Having received a reprimand from Washington for a supposed delay he took offense and resigned from the staff 16 Feb. 1781. He had no intention, however, of resigning from the Continental Army, and becoming the head of an infantry regiment, he took part in the siege of Yorktown, heading a storming party and capturing one of the strongest British redoubts. The war was now practically ended, and there being no further opportunity for success in the army, Hamilton returned to civil life. He was yet but 24 years old, but by his natural abilities and capacity for leadership he had attained a foremost place among the great men of his day.

The activity of Hamilton's mind is seen in the fact that while still in active military service he found time to study the great questions of government and finance. In a letter to James Duane he clearly set forth his views on the Constitution, that: "Congress should have complete sovereignty in all that relates to war, peace, trade, finance, and to the management of foreign affairs." A letter to Morris on the establishment of a national bank induced him to offer Hamilton the place of receiver-general of Continental taxes, which he accepted and originated a new system of national taxation. The receiver's office did not prove congenial, and he was relieved of its duties by his election to the Continental Congress from New York 1 Oct. 1782. Congress proved a disappointment. Such were the deplorable conditions then prevailing, the looseness of the Constitution and the financial chaos of the government, that Hamilton's efforts to carry through reforms utterly failed. He resigned from Congress in 1783 and returned to the practice of law in New York, where his melodious voice, dignified deportment and unanswerable logic of reasoning, soon placed him in the highest rank of his profession.

The condition of the States at this time is graphically depicted by Senator Lodge in his 'Life of Hamilton': "Divided among themselves, with no army, no navy, no cohesion, floundering wilfully and helplessly in a sea of unpaid debts and broken promises, bankrupt in money and reputation alike." To secure some relief the Annapolis Convention (q.v.) was held 11 Sept. 1786, five States only being represented — New York, New Jersey, Pennsylvania, Delaware and Virginia. Hamilton was one of the delegates from New York. This convention adopted an address, drafted by Hamilton, reciting the intolerable conditions and calling for a convention to meet the following May in Philadelphia to form a Federal Constitution. (See CONSTITUTION, FRAMING OF THE.) Upon his return to New York he was elected to the State Legislature which convened in January 1787, and began a fight to induce the State to send delegates to the Philadelphia convention. In this he succeeded, and three delegates were appointed, of which Hamilton was one: but the other two were Anti-Federalists, bitterly opposed to Hamilton's idea of a strong general government. When the convention met the vote of his own State was cast against him on every question: the Anti-Federalists withdrew from the convention, leaving New York without a vote. Hamilton, however, presented his views of a plan of government to the convention — an aristocratic republic, with a president and senators chosen for life, and the State governors appointed by the Federal government. After the presentation of this plan, which found no support in the convention, Hamilton withdrew, only returning to engage in the final debates, and at the close he heartily embraced the work of the convention and signed the Constitution as actually adopted.

The Constitution was still to be ratified by the States. New York was opposed to its adoption. There were numerous internal strifes and jealousies, but with great power and determination, Hamilton combated and won over all opponents in the legislature, and by his essays in the 'Federalist,' assisted by Madison and Jay, he successfully fought the great battle for the Constitution, winning a hostile majority to its support. Of these essays George William Curtis declared they 'gave birth to American constitutional law, which was thus placed above arbitrary construction and brought into the domain of legal truth."

Washington was inaugurated President in April 1789. In September 1789 Congress passed an act establishing a Treasury Department, and Washington at once made Hamilton the first



ALEXANDER HAMILTON.

Secretary of the Treasury. His creative, constructive and practical mind was now confronted with the problem of giving to his country a workable system of national administration. With a master's hand he organized the Treasury Department; reduced the confused finances to order; provided for a funded system and a sound system of national taxation; induced Congress to assume the State debts; authorized methods for the establishing of a national bank and a mint, the raising and collection of internal revenue, the management of the public lands, and the purchase of West Point by the government. In 1791 his Report on Industry and Commerce appeared, wherein he discussed with profound ability and clearness the economic problems of his time, and inaugurated, in a very moderate way, the protective tariff system. His methods to strengthen the national government were vigorously opposed by those antagonistic to centralization, chief among whom was Thomas Jefferson (q.v.), and the controversies that then divided parties have been continued by the rival political parties to the present. Engrossed as he was with the home affairs of the government, Hamilton was nevertheless a deep student of foreign relations and advocated a position of strict neutrality on the part of the American government with regard to the difficulties of nations. He ably sustained Washington in his proclamation of strict neutrality between France and England, both in the cabinet and in the public press, and when M. Genêt, the ambassador of the French republic, tried to involve this country in a war with England, Hamilton was vigorous in his condemnation. It was at this time that Jefferson, then Secretary of State, took sides with editor Freneau of the Philadelphia 'National Gazette,' in his criticism of the administration and especially of the treasury department. Hamilton replied and the controversy became typical of the two great political parties — the Federalists and the Republicans. Jefferson's position in the cabinet was most uncomfortable and he resigned 1 Jan. 1794. In 1794 the Whiskey Insurrection (q.v.) occurred in Pennsylvania in opposition to the excise laws passed by Congress. Hamilton advised a vigorous policy and when troops were sent by Washington against the insurgents, Hamilton accompanied them and the «rebellion» quickly faded away.

Desiring to give more attention to his private interests Hamilton resigned from the Cabinet 31 Jan. 1795. He declined the office of Chief Justice of the United States Supreme Court and returned to his law practice in New York city where he was at once acknowledged the leader of the bar. But he still continued to take an active interest in political affairs. In 1794 Chief Justice John Jay (q.v.) was nominated by Washington as envoy extraordinary to negotiate a commercial treaty with Great Britain. With Lord Granville a treaty was drawn up known as Jay's Treaty (q.v.), the terms of which were so hard and unjust that when the treaty was published there was a violent outburst of indignation. Hamilton, however, in a series of essays signed «Camillus,» defended the treaty as the best obtainable and after a severe struggle in Congress it was ratified. Washington thoroughly appreciated the judgment and genius of Hamilton, often consulted him on important matters, and received much help from him in the preparation of his messages and speeches. The «Farewell Address would have been less perfect as a composition,» says Renwick, «had it not passed through the hands of Hamilton.»

Hamilton had supported John Adams (q.v.) for the Presidency, but Adams was jealous of the power and influence of Hamilton over members of the Cabinet, and made war upon him, expelling his friends from office and assailing him personally. Hamilton blamed Adams for the loss of the elections in New York State, and denounced him bitterly. Adams was renominated in 1800 for the Presidency, but he was beaten by Jefferson, and the Federalist party never won another election. Owing to a defective clause in the Constitution (see JEFFERSON-BURR IMBROGLIO) the election was thrown into the House of Representatives, Jefferson and Burr having received an equal number of votes Hamilton exerted his great influence with the Federalists and Jefferson was elected.

In 1804 the Federalists nominated Aaron Burr (q.v.) for Governor of the State of New York. The contest was a bitter one and again Hamilton was instrumental in Burr's defeat, and the latter challenged him to a duel on the ground of an alleged insult. Under the idea that the continuance of his personal influence and the peculiar condition in which the affairs of the country were at the time demanded his acceptance of the challenge, he consented to meet Burr, and the duel was fought at Weehawken, N. J., 11 July 1804. Hamilton was wounded and died the following day, universally mourned by his countrymen.

American history presents no more striking character than Alexander Hamilton. He was not popular, nor did he strive after popularity, but after 100 years his name still holds a noble eminence. He lived for the public good. Eloquent and refined, able and brilliant, the embodiment of devotion, integrity and courage, he has left as deep a mark upon our political institutions as any other statesman our country has produced. Hamilton's works were published by H. C. Lodge in nine volumes (1885–6). Consult: Hamilton, 'History of the Republic of the United States as Traced in the Writings of Alexander Hamilton and His Contemporaries' (4th ed. 1879); Morse, 'Life of Alexander Hamilton' (2 vols. 1876); Lodge, 'Alexander Hamilton' (1882). For his writings, etc., consult 'Bibliothica Hamiltonia' (1886).

GEORGE EDWIN RINES,
Editorial Staff 'Encyclopedia Americana.'

Hamilton, Andrew, American lawyer: b. Scotland about 1676; d. Philadelphia 4 Aug. 1741. His early career is unknown. He was for a time called Trent, and it is not certain at what period he took the name of Hamilton. About 1697 he appeared in Accomac County, Virginia, where he opened a classical school. In 1716 he went to Philadelphia, the next year became attorney-general of Pennsylvania. From 1721 to 1724 he was in the provincial council, and in 1727 was elected from Bucks County to the provincial assembly, continuing to hold his seat, with a year's exception, until 1739, and in 1729 was speaker. He is best known for his gratuitous defense of John Peter Zenger, a New York printer, who was charged with libel in publishing in a newspaper owned by him statements regarding the interference by the governor with the process of the law-courts. Hamilton's defense was based on the truth of the statements in the alleged libel. He was successful, was granted the freedom of New York, and, having thereby secured a freer discussion of public officers, was termed by Morris the "day-star of the Revolution." He became judge of the vice-admiralty court of Pennsylvania in 1737.

Hamilton, Anthony, COUNT, English courtier, and man of letters: b. probably Roscrea, Tipperary, Ireland, 1646; d. St. Germain-en-Laye, France, 6 Aug. 1720. He was descended from a younger branch of the family of the dukes of Hamilton in Scotland. His parents were Catholics and Royalists, and removed to France after the death of Charles I., and young Hamilton became domiciliated there. He, however, made frequent visits to England in the reign of Charles II. His sister was married to Count Grammont (q.v.). On the ruin of the royal cause he accompanied James to France, where he passed the rest of his life. Hamilton is chiefly known as an author by his 'Memoirs of Count Grammont,' a lively and spirited production, exhibiting a free and, in the general outline, a faithful delineation of the voluptuous court of Charles II. It is an admirable chronicle of the frivolous life of the French and English courts of that time. His other works are 'Poems' and 'Fairy Tales,' which, as well as the 'Memoirs,' are in French, and are really masterpieces of grace and sprightliness.

Hamilton, Edward John, American educator: b. Belfast, Ireland, 29 Nov. 1834. He was graduated at Hanover College, Indiana, in 1853, and at Princeton Theological Seminary in 1858; was professor of mental philosophy at Hanover College in 1868–79, and of philosophy at Hamilton College, Clinton, N. Y., in 1883–91. In 1895 he became professor of philosophy in the State University of Washington. He is the author of what is known as 'Perceptionism' (a system of metaphysical philosophy), and has published 'A New Analysis of Fundamental Morals' (1870); 'The Human Mind' (1883); 'The Modalist' (1883); 'The Perceptionalist or Mental Science' (1899).

Hamilton, Frank Hastings, American surgeon: b. Wilmington, Vt., 10 Sept. 1813; d. New York 11 Aug. 1886. He was graduated from the medical department of the University of Pennsylvania in 1833; in 1861 went to the war as surgeon of the 31st New York volunteers, was made brigade surgeon after the battle of Bull Run, and surgeon of Gen. Keyes' corps in 1862. A year later he became medical inspector of the United States army. He was one of the founders of Bellevue Hospital Medical College in 1861, and was professor of surgery there till he resigned in 1875. Dr. Hamilton was associated with Drs. Agnew and Bliss in the care of President Garfield. He wrote on the principles and practice of surgery three works, regarded as standard on the subjects treated: 'Treatise on Fractures and Dislocations' (1860); 'Practical Treatise on Military Surgery' (1861); and 'The Principles and Practice of Surgery' (1872).

Hamilton, Gail. See DODGE, MARY ABIGAIL.

Hamilton, Gavin, Scottish painter: b. Lanark, Scotland, 1730; d. Rome, Italy, 1797. Sent when very young to Rome, he there devoted himself during the remainder of his life to historic painting. One of his greatest works was his 'Homer,' consisting of a series of pictures representing scenes taken from the 'Iliad.' He published in 1773 'Schola Picturæ Italiæ,' composed of a number of fine engravings by Cunego, making part of the collection of Piranesi; he there traces the different styles from Leonardo da Vinci to the Carraccis; all the drawings were made by Hamilton, and this admirable collection now forms one of the principal treasures in the first libraries in Europe. He spent the latter part of his life in conducting archæological excavations in various localities near Rome.

Hamilton, Lord George Francis, English politician: b. Brighton 1845. He was a Conservative member of Parliament for Middlesex in 1868–85, for Ealing division in 1885–1902, in 1874–8 was under-secretary of state for India, and in 1878–80 vice-president of council. In 1885–6, and again in 1886–92 he was first lord of the admiralty, and from 1895 until his resignation in 1903 was secretary of state for India. His naval reconstruction plan of 1889 was the most extensive of the kind ever adopted by Great Britain. As secretary for India he displayed great ability in dealing with the numerous difficulties which arose during his administration.

Hamilton, James, American statesman: b. Charleston, S. C., 8 May 1786; d. at sea 15 Nov. 1857. He was educated for the bar, but entered the army and served with credit as a major in the Canadian campaign of 1812. At the end of the war he resumed the practice of law in Charleston. For several successive years Hamilton was chosen mayor, or, as it was then termed, intendant of Charleston. To his vigilance and activity was chiefly due the detection of a formidable conspiracy in 1822 among the negro population, led by Denmark Vesey, a free mulatto from Haiti. In the same year he was elected to the State legislature, and was also chosen a representative in Congress, of which he soon became a prominent and popular member. He became noted for intense and energetic opposition to the protective system and favored direct taxation, regarding all indirect processes for raising revenue as frauds upon the people, and as disparaging to the popular intellect, as well as popular morals. He quitted Congress to become governor of South Carolina in 1830, at a period when the State had resolved upon nullifying the tariff laws of the federal government. On the settlement of this question by Clay's compromise, Hamilton retired from public life for a time. Later he became interested in the cause of Texas, to which he devoted his personal services, and a large portion of his private fortune. In 1841, while Texas was an independent republic, he was her minister to England and France, where he procured the recognition of her independence. On the death of Calhoun in 1852, he was appointed his successor in the United States Senate, but declined the office.

Hamilton, John Church, American biographer and historian, son of Alexander Hamilton (q.v.): b. Philadelphia 1792; d. 1882.

Besides editing his father's works (1851), he wrote: 'Memoirs and Life of Alexander Hamilton' (1834–40): 'History of the Republic' (4th ed. 1879); 'The Prairie Province' (1876), sketches of travel.

Hamilton, John Taylor, American Moravian clergyman: b. Antigua, W. I., 30 April 1859. He was graduated from the Moravian College, Bethlehem, Pa., in 1875, and from the Moravian Theological Seminary there in 1877. He was pastor of the Second Moravian Church in Philadelphia, 1881–6, and has been a resident professor at the Moravian College and Seminary from the latter date. He has published 'History of the Moravian Church in the United States' (1895); 'History of the Moravian Church during the 18th and 19th Centuries' (1900); 'History of Moravian Missions' (1900).

Hamilton, John William, American Methodist bishop: b. Weston, Va., 18 March 1845. He was graduated from Mount Union College (Ohio) in 1865, and from Boston University in 1871, was ordained an elder of the Methodist Church in 1870. He was subsequently pastor of various congregations, including that of the People's Church, Boston, founded by him. In 1900 he was appointed bishop. He was corresponding secretary of the Freedmen's Aid and Southern Education Society (1892–1900), and has published 'Memorial of James Lee' (1875); 'Lives of the Methodist Bishops' (1883); 'People's Church Pulpit' (1884): and other works.

Hamilton, Kate Waterman, American novelist: b. Schenectady, N. Y., 12 Nov. 1841. Since 1870 she has lived in Bloomington, Ill. She is the author of 'We Three'; 'Vagabond and Victor' (1879); 'Rachel's Share of the Road' (1882); 'Tangles and Corners' (1882); 'The King's Seal' (1887); 'The Parson's Proxy' (1896); 'The Kinkaid Venture' (1900); 'How Donald Kept Faith' (1900); etc.

Hamilton, Patrick, Scottish reformer and martyr: b. probably Glasgow about 1504; d. St. Andrews 29 Feb. 1528. Adopting during a short residence on the Continent, the principles of the Reformation, when he settled at St. Andrews in 1523 he naturally cherished his new convictions, and in 1526 announced them with a decision that attracted the notice of Archbishop Beaton, who proceeded to have him formally summoned, and put on his trial. Hamilton had meanwhile fled to Germany, where an intimacy formed with Luther and Melanchthon deepened his convictions, and after an absence of six months he returned to Scotland. He openly preached in the neighborhood of Linlithgow, and Beaton, under pretense of a friendly conference, contrived to allure him to St. Andrews in January, 1528. The early stages of the conference were marked by a conciliatory spirit, but he was led into damaging avowals of opinion, and the result of his trial, on the last day of February, was that he was convicted of divers heresies, and delivered over for punishment to the secular power, by which he was condemned the same day. In the afternoon he was hurried to the stake in front of the gate of St. Salvador's College, his martyrdom, in the 24th year of his age, having done more to extend the principles of the Reformation in Scotland than his life could have done.

Hamilton, Schuyler, American soldier: b. New York 25 July 1822; d. there 18 March 1903. He was a son of J. C. Hamilton (q.v.) and a grandson of Alexander Hamilton (q.v.). He was graduated from West Point in 1841 and served in the Mexican War and in the Civil War also, becoming a major-general of volunteers in 1862. He was subsequently hydrographic engineer to the department of docks. In 1854 he published 'A History of the American Flag' and in 1877 'Our National Flag, the Stars and Stripes, its History in a Century,' delivered as an address before the New York Historical Society in June of that year.

Hamilton, Sir William, Scottish metaphysician; b. Glasgow 8 March 1788; d. Edinburgh 6 May 1856. Having studied with distinction at Glasgow, in 1807 he entered Balliol College, Oxford, where he gained first-class honors, and in 1813 he was admitted to the Scottish bar. His taste lay in a different direction, and while he diligently applied himself to almost every branch of literature, mental philosophy became his favorite study. In 1820 he became a candidate for the chair of moral philosophy in Edinburgh, rendered vacant by the death of Thomas Brown, but was defeated by Professor John Wilson. He was appointed professor of universal history in the University of Edinburgh in 1821, and in 1826 became a contributor to the 'Edinburgh Review,' and enriched it with a series of articles afterward published in collected form, with large additions, as 'Discussions on Philosophy and Literature, Education, and University Reform.' Of these the most celebrated was his 'Critique of Cousin's Cours de Philosophie,' in which was developed that philosopher's doctrine of the unconditioned. Many of these contributions were translated into the leading European languages, and attracted much attention from continental speculators in philosophy. In 1836 he became a candidate for an Edinburgh professorship, and succeeded in gaining the chair — which of all men living he was perhaps the best fitted to adorn — of logic and metaphysics. His zeal and ability in discharging its duties were rewarded by the number of ardent students whom he gathered around him. The fame of the Scottish school of metaphysicians, which had begun to wane, was gradually re-established; and his influence would have been felt to even a higher degree had he not been struck with paralysis in 1844, from which he never recovered so far as to undertake the full duties of his position. His mind, however, retained its vigor, and he endeavored to carry out literary designs he had previously formed. In 1846 he published an annotated edition of the works of Thomas Reid, and in 1854 the commencement of a similar edition of the works of Dugald Stewart. His lectures were published in 1859–61, under the editorship of Mansel and Veitch. His views are chiefly expounded in the 'Discussions' and in the 'Dissertations' appended to his edition of Reid, and are attacked in Mill's 'Examination.' See Veitch, 'Memoir of Hamilton' (1869); 'Hamilton: the Man and his Philosophy' (1883); Seth, 'Scottish Philosophy' (1890).

Hamilton, Sir William Rowan, Irish mathematician: b. Dublin 3 Aug. 1805; d. there 2 Sept. 1865. He knew Greek and Latin when only 6, and before he had completed his 14th year had made himself acquainted with 13 languages, among which were Arabic, Persian, Hindustani, Sanskrit, and Syriac. When 10 years old he began the study of mathematics, and at 17 presented a paper to Brinkley, the Irish astronomer-royal, which exhibited such a profound knowledge of mathematics, that the latter declared the author of it to be already the first mathematician of his age. In 1827, the chair of astronomy in Trinity College, as well as the post of astronomer-royal, becoming vacant, Hamilton obtained both appointments, though then only in his 23d year. His life henceforth was exclusively devoted to abstruse studies. He was knighted in 1835; in 1837 was elected president of the Royal Irish Academy, and was an honorary or corresponding member of the principal scientific academies of Europe and America. In 1828 his 'Theory of Systems of Rays' was published. In this his celebrated prediction, on theoretical grounds, of the existence of conical refraction of a ray of light was given to the world. Reasoning on the properties of light, he came to the conclusion that under certain circumstances a ray, instead of being refracted in the ordinary way, should split up into a cone of rays; a phenomenon afterward proved experimentally by Lloyd to take place under proper conditions. In 1834 his 'General Method in Dynamics' was published. In this work and that on 'Systems of Rays' the whole of any dynamical problem is made to depend on a single function and its differential coefficients. Another important treatise of his is 'Algebra looked on as the Science of Pure Time.' He published also 'Memoirs on Discontinuous Functions, or Equations of the Fifth Degree, etc.' But the foundation on which his fame most securely rests is the discovery or invention of the calculus of quaternions, an instrument of extraordinary power in the solution of intricate problems in mathematics and physics. His 'Lectures on Quaternions' appeared in 1853, and in 1866 a posthumous work on the same subject entitled 'Elements of Quaternions.' See Life of Sir William Rowan Hamilton,' by Graves (1883–9), with an Addendum (1892).

Hamilton, Bermuda, a seaport town, the capital of the Islands on Great Bermuda, Long, or Hamilton Island. It has a fine landlocked harbor. Founded in 1790. Pop. (1901) 2,246.

Hamilton, N. Y., a village of Madison County, 29 miles southwest of Utica, on the New York, O. & W. R.R. It is the seat of Colgate University (q.v.). It is in a good agricultural region, contains a lumber yard and canning factory, and has a stone quarry, from which the stone for the construction of most of the University has been taken. Hamilton was first settled in 1792, was separated from the township of Paris in 1795, and named in honor of Alexander Hamilton; the village was incorporated 12 April 1816; in 1895 a fire destroyed the business portion of the town, in which the village records were lost. Later in the same year, waterworks and an electric lighting plant were established, which are owned and operated by the town. In 1903 a free library was opened by the Library Association, and it is intended to make it a public library supported by the village corporation. (Pop. 1900) 1,627.

Hamilton, Ohio, city, county-seat of Butler County, on the Great Miami River, the Miami & Erie Canal, the Pittsburg C., C. & St. L., and the Cincinnati, H. & D. R.R.'s; about 15 miles north of Cincinnati, and 32 miles southwest of Dayton. Gen. Arthur Saint Clair established here a fort, in 1791, and called it Fort Hamilton, in honor of Alexander Hamilton. It was incorporated as a town in 1810. The excellent water-power has been of great advantage in the developement of the city, as manufacturing is its chief industry, although it is located in an agricultural section. The canal has also contributed to the water-power available for manufacturing purposes. Its chief manufactures are paper, flour, beer, woolen goods, agricultural implements, machinery, tools, and iron. The trade is in the manufactured articles and in tobacco, hay, grain, and vegetables. The government is vested in a mayor, who holds office three years, and a board of control composed of five members, each one of whom is the head of a department of the city's government. They are elected for five years. The city owns and operates the electric light plant, the waterworks, and the gas plant. Pop. (1900) 23,914.

Hamilton, Ont., Canada, city and capital of Wentworth County, situated on the shores of Burlington Bay at the western extremity of Lake Ontario, 40 miles from Toronto, 42 miles from Niagara Falls, and 70 miles northwest of Buffalo. It was laid out and settled in 1813 by G. Hamilton, and is built on a plateau of slightly elevated ground extending around the front of a hilly range from Niagara Falls. Hamilton is connected with a large system of Canadian and American Railways,— the Canadian Pacific, Grand Trunk, Toronto, Hamilton & Buffalo, the Michigan Central, the New York Central, and the Lehigh Valley and Wabash Railways. Hamilton's geographical position at the head of Lake Ontario affords the best shipping facilities to the Northwest Provinces and European markets by water, while her railway facilities are not excelled by any city in the Dominion. She has also become a centre of a complete electric railway system. There are 19 miles of street railway, 110 miles of streets, 60 miles of sewers, and 465 street electric lights. Hamilton is the chief manufacturing city in Canada and is in the centre of a fine fruit-growing district. It manufactures very largely, some of the chief industries being agricultural implements, air brakes, and electrical supplies, belting, boots and shoes, carriages, cigars, tobacco, clothing, drugs, elevators, emery wheels, engine packing, fertilizers, files, fireworks, furnaces, gasoline engines, harness, glue, mats, paints, pottery, soaps, spices, silverware, nails, wine, vinegar, mattresses, wringers, washing machines, and musical instruments. It has 2 cathedrals, 62 Protestant churches, 7 Roman Catholic churches, 15 banks, 18 public schools, 7 separate schools, 2 art schools, 2 convents, a public library, 26 charitable institutions, 4 hospitals, 2 incline railways, 4 theatres, a large insane asylum, 7 parks, a wireless telegraph station, 200 groceries, 5 bands, 2 sewage disposal works, 3 reservoirs, capacity (main) 11,000,000 gallons; 50 social and athletic clubs, about 200 national and secret societies, 100 hotels and 3 daily papers. Pop. (1904) 60,000.

J. Castell Hopkins,
Editor 'The Canadian Annual Review of Public Affairs.'

1. The Gore, King Street 2. View of Hamilton from Mountain

Hamilton College, an institution located at Clinton, Oneida County, N. Y.; founded by Samuel Kirkland, a Congregational missionary, in 1793, as an academy for both white and Indian children. The school was not opened until 1797, although Gen. Frederick William Steuben laid the cornerstone in 1794. Lack of funds prevented the completion sooner, and to the untiring efforts of its founder was due, in a great measure, the success of the undertaking. It was first called Hamilton Oneida Academy, so named in honor of one of its trustees, who was also a benefactor. In 1812 it was chartered by the University of the State of New York as Hamilton College. The school has grown steadily in facilities, keeping well ahreast of the times. Two courses are offered: the Latin-Scientific and the Classical. It has fine scientific collections, an astronomical observatory, and well-equipped laboratories. The college has at its disposal 1 fellowship, 55 scholarships, 4 prize scholarships (yielding $200 each), and a number of valuable prizes. The campus, nearly 100 acres, has many notable improvements, gifts from graduates. In 1906–7 there were connected with the school 20 professors and instructors, and 181 students. The library contained about 47,000 volumes.

OREN ROOT,
Late Registrar.

Hamilton Inlet, Labrador, the estuary of the Hamilton or Grand River. It is 150 miles long and has a maximum width of 30 miles. On its north shore is Rigolet, a Hudson's Bay Company trading-post.

Hamilton, Mount. See LICK OBSERVATORY.

Hamilton Series, a series of rocks, including the Hamilton and Marcellus stages and constituting the Middle Devonian. The name is from the town of Hamilton, 29 miles south of Utica, N. Y., where the series is typically developed. It consists there of shales and sandstones with a few beds of limestones, the most prominent being the topmost member of the series. The Hamilton like the other Devonian formations, was laid down along the Atlantic shores of what was then the American continent and in a great interior sea, sedimentation being heaviest in a northeast gulf of this sea. The sea extended from eastern New York to western Iowa. In the west the series is largely calcareous. The series is about 1,500 feet thick in eastern New York and reaches a maximum of 2,000 to 5,000 in Monroe County, Pa. It rapidly thins westward, and the south end of Lake Huron is only 20 to 50 feet thick. At the falls of the Ohio above Louisville, the series is represented by 20 feet of hydraulic limestone. The rocks forming the high cliffs along the Delaware River south of Port Jervis, Pa., are of Hamilton Age. Outside of the interior basin rocks of Hamilton Age have been determined in the Gaspe region of Canada, where they reach a thickness of 7,040 feet. In the Eureka district, Nevada, is a great but undetermined thickness of Hamilton limestone, and in the Mackenzie River valley in Northwest Territory is a deposit of fully 500 feet of fossiliferous limestone, partly at least of Hamilton Age. See DEVONIAN PERIOD; DEVONIAN SYSTEM and EQUISETÆ.

Hamilton Stage, the upper division of the Hamilton series of rocks, consists chiefly of shaly sandstone and fine shales with a few thin seams of limestone. In Ulster, Albany, and Green counties, N. Y., the thick-bedded shales are known as North River flagstone, and are quarried on the Hudson River near Kingston, Saugerties, and Coxsackie. Some of the thicker layers of these flagstones are known as bluestone.

Hamites, hăm'īts (descendants of Ham), the name given to several races in North Africa, who are regarded as of kindred origin and speak allied tongues. They include the ancient Egyptians and their modern descendants, the Copts, the Berbers, Tuaregs, Kabyles, the Gallas, Falashas, Somali, Dankali, etc.

Hamlet, the hero of Shakespeare's most famous tragedy, a personage who appears in history, yet is half mythological, but has been transformed by the genius of the English poet into one of the most dominating figures of literature. It is allowed that Shakespeare's Hamlet was suggested by the Hamleth, or Amleth, of Saxo Grammaticus. The latter's 'History of Denmark' had been published in Paris (1514). François de Belleforest included the tale of Hamlet in his 'Tragic Histories' (1570), an English translation of which appeared in 1608. Shakespeare's drama was written earlier than this last date and must have derived its plot either from de Belleforest's work, or a translation executed before the end of the 16th century, unless the poet, who, we know, was a great reader of histories, took the incident direct from Saxo Grammaticus. According to the Danish historian Hamleth was Prince of Jutland; his father, the King of Jutland, had been murdered by his own brother Fengo, who took the throne and queen of the dead man. Hamleth feigned madness to save his own life. He stabbed one of Fengo's courtiers sent to spy upon him, and had for this purpose concealed himself under a truss of straw. He reproached his mother with her shameful second marriage to such effect that she promised to help him in avenging his father by putting Fengo to death; a promise which she kept.

Hamlet Case, the designation of the first recorded action in 1850 under the Fugitive Slave Law (q.v.) of that year. It is named after Hamlet, a free negro with a family, who was surrendered after a cursory examination, as a fugitive slave of Mary Brown of Baltimore. He had been arrested by a deputy United States marshal in New York, and the whole circumstances of the case so aroused public opinion that Hamlet was finally redeemed.

Ham'ley, SIR **Edward Bruce**, English general: b. Bodmin, Cornwall, 27 April 1824; d. London 12 Aug. 1893. Entering the army in 1843, he served through the Crimean war, was professor of military history at Sandhurst 1858–64, and commandant there 1870–77; and division commander in the Egyptian war of 1882. His 'Operations of War' (1866) is a recognized text-book for military examinations. Among his other publications are: 'The Story of the Campaign' (1855), a narrative of the Crimean War; 'Wellington's Career' (1860); 'Voltaire' (1877); 'The War in the Crimea' (1890). He was also the author of a popular novel, 'Lady Lee's Widowhood,' and the admirable sketch entitled 'Shakespeare's Funeral.'

Ham'lin, Alfred Dwight Foster, American architect: b. Constantinople, Turkey, 5 Sept. 1855. He is a son of Cyrus Hamlin (q.v.). He was graduated from Amherst in 1875, studied architecture in the Massachusetts Institute of Technology in 1876–7 and at the Beaux Arts of Paris in 1878–81, and in 1883 became special assistant in Columbia University. In 1889 he became assistant professor of architecture at Columbia, and in 1891 adjunct professor. His published works include: 'A History of Architecture' (1896); and a 'Handbook of the History of Ornament.'

Hamlin, Augustus Choate, American surgeon: b. Columbia, Maine, 28 Aug. 1829: d. Bangor, Me., 19 Nov. 1905. He was graduated from Bowdoin in 1851, from the Harvard Medical School in 1855, was appointed assistant surgeon to the 2d Maine infantry in 1861, and from 1863 until mustered out in 1865, lieutenant-colonel and medical inspector, United States army. Subsequent to the War he practised in Bangor, of which he was twice mayor, and in 1882–6 was surgeon-general of Maine. Among his works are: 'Martyria' (1866); 'The Tourmaline' (1873); 'Leisure Hours among the Gems' (1884); and treatises on 'Transfusion' (1868); 'Tetanus' (1868); and 'The Transmission of Disease' (1870).

Hamlin, Cyrus, American missionary: b. Waterford, Maine, 5 Jan. 1811; d. 8 Aug. 1900. He was graduated from Bowdoin College in 1834 and from Bangor Theological Seminary in 1837; and was missionary of the American Board of Missions in Turkey 1837–59. From 1860 to 1876 he was president of Robert College, established after long controversy with the Turkish government. In this position he did much in molding the character of modern Bulgarian leaders, and producing autonomy for Bulgaria. Returning to the United States in 1877 he became a professor in the Theological Seminary in Bangor; and was president of Middlebury College, Vermont, 1880–5. Some of his works are in the Armenian language; those in English include 'Among the Turks' (1877); and 'My Life and Times' (1893).

Hamlin, Hannibal, American statesman: b. Paris Hill, Oxford County, Maine, 27 Aug. 1809; d. Bangor, Maine, 4 July 1891. Though prepared for college, he did not enter, but became the editor of 'The Jeffersonian,' a weekly of Paris, Maine; studied law, was admitted to the bar in 1833, and began practice at Hampden, Maine. He was active in Democratic politics, was elected to the lower branch of the State legislature in 1835, served by re-election until 1840, and was speaker in 1837, 1839, and 1840. Nominated for Congress in 1840, he was defeated by the Whig candidate, but in 1842 was elected, and in 1844 re-elected. Chosen to the Senate in 1848 to fill a vacancy, he was again elected in 1851, but in 1856 resigned his seat to accept the governorship of Maine to which he had been elected as a Republican. In less than a month, however, he re-entered the Senate for a full term. In 1860 he was elected vice-president on the ticket with Lincoln, and in 1861–5 was president of the Senate. He was thereafter successively collector of the port of Boston (1865–6), United States senator (1869–81), and minister to Spain (1881–3). Hamlin's separation from his party was due to his strong anti-slavery convictions. During the absence from the House of David Wilmot, he introduced the bill now known as the "Wilmot proviso," and obtained its passage in the House by 115 to 106. As vice-president he was a highly valued counsellor of Lincoln. Consult: C. E. Hamlin, 'Life and Times of Hannibal Hamlin' (1899).

Ham'line, Leonidas Lent, American Methodist bishop: b. Burlington, Conn., 10 May 1797; d. Mount Pleasant, Iowa, 23 March 1865. He was educated for the ministry, but afterward studied law, was admitted to the bar at Lancaster, Ohio, was licensed to preach by the Methodist Church, and was a traveling minister in the Ohio conference. When in 1844 the Methodist Church divided on the slavery question, he was one of the members of the general conference, and drafted the plan for the separation of the northern and southern branches. He was a bishop from 1844 to 1852, when he was retired at his own request. His 'Works' were edited by F. G. Hibbard (1869). Hamline University of Minnesota (q.v.) was named in his honor.

Hamline University, a coeducational institution at Hamline, Minn., between Minneapolis and Saint Paul. The school was established, under the auspices of the Methodist Episcopal Church, at Redwig, Minn., but it was closed in 1869. In 1880 it was reopened at Hamline. In 1903 there were connected with the school 21 professors and instructors in the college of liberal arts and 50 in the medical department. In the preparatory school there were about 125 students, in the college of liberal arts about 210, and in the medical department 161 students. There were 6,500 volumes in the library, and the endowment was $200,000.

Hammer, a tool for driving nails or wedges and for beating malleable materials. (See MALLET.) There are hand hammers, steam hammers and electric hammers. The ordinary hammer of to-day is essentially an American product. Exactly when the hammer came into use is not told in history, but it is certain that some rude form of the instrument must have been used in the earliest days of handicraft. Of the hammers made in America to-day there is no end. There is the little tack hammer which weighs only a few ounces, and is indispensable in house, store or factory. Then there is the twenty and thirty ton hammer, driven by steam and used for making immense forgings. The numberless effects which are due to its remarkable force of impact have made the hammer a necessity in all trades. Immense manufactories, employing thousands of men, are grinding year in and year out making hammers, while ten times as many wholesale houses are busy putting the product on the market. The industry has advanced to such a stage that many general hardware firms in the United States have thrown out the hammer, leaving it to the houses that deal in tools exclusively.

Hammers are made in a variety of shapes, the most in demand being the claw hammer. This and the shoemaker's hammer have retained their shapes for hundreds of years. One gold beating firm relies on them entirely. The sheets or leaves of gold are hammered to such exceeding thinness that two hundred and fifty thousand are required to make up the thickness of an inch.

Another odd product of the hammer factory is the butcher's hammer, used for killing cattle. It is capable when properly wielded of carrying a very heavy blow. Then there are the stone-cutter's hammer, the carpet layer's hammer, the wood carver's mallet and the plumber's odd implement. All of these have a good sale in the markets of the world, because they possess a «something» which users cannot find duplicated in the output of other countries.

The modern hammer is made to fit every requirement of a driving tool. One individual of the family, the magnet hammer, has a load-stone in its head, and every little tack jumps at it. The magnet hammer is very useful where canvas is being tacked on the walls. It saves the user the trouble of holding the tack and taking chances at smashing his fingers. The magnet hammer is much in use in tacking tin signs on trees. It is necessary to secure the advertisement at a height beyond the reach of the small boy and the magnet hammer answers the requirement. A clip on the side holds the card or sheet of tin while the tack is retained in position by the magnetized head. One firm blow drives the tack through the tin into the fence or tree trunk and secures the sign. A great variety of power hammers are used. These, for the most part, are masses of iron raised by steam or electricity, and then allowed to fall by their own gravity on the work. The «helve» or «shingling» hammer, used for compressing the mass of iron drawn from the puddling-furnace, and the «tilt» hammer, used in the manufacture of shear-steel, are important examples of such hammers. The first is a heavy bar of cast iron about 10 feet long, weighing 3 or 4 tons or more, to which is attached a head of wrought iron faced with steel, weighing nearly half a ton additional. It works on an axis at the end of the bar farthest from the head, and is raised by cams attached to a heavy wheel set in motion by steam or water power. These cams strike or «lick» a projection extending beyond the head, and thus raise it about 18 or 20 inches at the rate of 70 to 100 times per minute. The tilt hammer is similar, but much lighter, and is adapted for striking more than 300 blows per minute.

Hammer-head Sharks, sharks of the genus *Zygæna*, in which the head is produced on either side into a broad lobe, so that the whole has somewhat the appearance of a double-headed hammer; the eyes on the outer ends of the lobes. Five species are known, two of which (*Z. tiburo and Z. malleus*) occur in the warm American seas, and the latter reaches a length of 15 feet or more.

Hammer-toe, a deformity most frequently affecting the second toe, in which the first bone is sharply extended or pulled back and the other two are flexed at a right angle with the first. It is usually due to the long continued pressure of short shoes, particularly in early life. Amputation of the toe may be necessary in severe cases, as the discomfort becomes unbearable.

Hammer-Purgstall, Joseph, yō'zĕf hăm'-mĕr-poorg'stăl, Freiherr von, Austrian Orientalist: b. Gratz, Styria, 9 June 1774; d. Vienna 24 Nov. 1856. In 1799 he accompanied as interpreter to Constantinople the internuncio Freiherr von Herbert, who afterward entrusted him with a mission to Egypt, where he collected various antiquities and manuscripts for the Imperial Library. In 1810, on the occasion of the marriage of Napoleon with Maria Louisa of Austria, he accompanied the latter to Paris, where he became intimate with Sylvestre de Sacy and other Orientalists. In 1817 he was appointed imperial councillor at the court of Austria, where he also held the post of interpreter. In 1835 he received the title of Freiherr. Among his numerous literary works may be mentioned: 'Constitution and Administration of the Ottoman Empire' (1815–16); 'Constantinople and the Bosporus' (1821); 'History of the Ottoman Empire' (1835–6); 'History of the Assassins'; 'History of the Golden Horde in the Kiptshak'; 'History of the Ilkhans'; 'History of Persian Eloquence'; 'History of Turkish Poetry' (1836–8); 'History of Arabic Literature' (1850–7); besides numerous translations from Oriental authors, and contributions to various periodicals.

Hammock, from the Spanish, *hamaca*, originally used in Peru to denote a couch or bed of canvas or grass-netting, suspended from the branches of a tree. A sailor's hammock, common on ship-board, is generally made of hempen cloth or cotton canvas, six feet long and about three feet in width. It is gathered together at each end by means of a cord and a clew, and fastened to hooks in the ceiling of the cabin or deck. On a ship-of-war hammocks are hung about three feet apart and in the morning are taken down and stowed away in the hammock netting. The man-of-warsmen use the hammocks for their clothing and bedding during the day time. In former times when a warship entered battle the hammocks were taken on deck to form a barricade against musket balls. In recent times the hammock has become very popular for domestic use, especially in the United States, being hung on verandas and balconies and under the trees on the lawns of private estates during the summer months. These hammocks for home use are made of various materials, but usually of cotton card or manila hemp. They are dyed in bright colors and are made very attractive and picturesque.

Ham'mond, Edward Payson, American evangelist: b. Ellington, Conn., 1 Sept. 1831. He was graduated at Williams College in 1858; studied theology at Union Seminary, New York, and afterward at the Free Church Seminary, Scotland. He was ordained to the Presbyterian ministry in 1862, and was long prominent as an evangelist in Great Britain and the United States. He wrote: 'Children and Jesus'; 'Jesus the Way'; 'Golden Gleanings'; 'Early Conversion'; etc.

Hammond, Henry, English prelate: b. Chertsey, Surrey, England, 18 Aug. 1605; d. Westwood, Worcestershire, 25 April 1660. He was educated at Eton and Oxford, took orders in 1629, and in 1633 was rector of Penshurst in Kent, in 1643 archdeacon of Chichester. He was an adherent of Charles I., and took part in the unsuccessful rising of Tonbridge. He served as chaplain to the king 1645–7, and was in 1648 made sub-dean of Christ Church. In 1649 he removed to Westwood. Among his works are: 'A Practical Catechism' (1644); 'Paraphrase and Annotations upon the New

Testament' (1653). His 'Miscellaneous Theological Works' were published at Oxford, together with the 'Life' by Fell (1847–50, 3 vols.).

Hammond, James Henry, American politician: b. Newberry, S. C., 15 Nov. 1807; d. Beach Island, S. C., 13 Nov. 1864. He studied law, was admitted to the bar in 1828, and in 1830 became the editor of a political journal in Columbia, which maintained the doctrine of state rights and advocated nullification in respect to the tariff act of Congress. He entered zealously into the nullification contest which then divided the State, and took an active part in organizing the military force which South Carolina raised in 1833 to resist the Federal government. He was elected to Congress, and took his seat in 1835, but declined a re-election on account of ill health. In 1841 he was elected general of brigade, and in 1842 governor of South Carolina. While governor he published in 1844 a letter to the Free Church of Glasgow on slavery in the United States, and in 1845 two others in reply to an anti-slavery circular issued by Thomas Clarkson, the English abolitionist. These, in connection with other essays on the same subject, were published in 1853, in a volume entitled 'The Pro-Slavery Argument.' In November 1857 he was elected to the United States Senate, remaining there till 1860.

Hammond, John Hays, American mining engineer: b. San Francisco, 31 March 1855. He was graduated from the Sheffield Scientific School of Yale in 1876, studied at the Royal School of Mines, Freiburg, Saxony, and became an expert on the United States Geological Survey and mineral census, with the duty of examining gold mines in California. In 1882 he was appointed superintendent of silver mines in Sonora, Mexico, but later was again in California as consulting engineer at mines in Grass Valley, and as consulting engineer to the Union Iron Works at San Francisco, and to the Southern and Central Pacific railway companies. In the capacity of consulting engineer he visited many portions of North and South America and Mexico. In 1893 he went to South Africa as consulting engineer to the mining companies operated there by Barnato Bros. of London. He was associated with Cecil Rhodes in the latter's numerous mining interests, and consulting engineer to the Randsfontein Estates Gold Mining Co., the British South African Co. (chartered), and the Consolidated Gold Fields Co. He was one of the four leaders in the reform movement in the Transvaal and for his connection with the well-known Jameson raid, with which, however, he did not sympathize, was sentenced to death by the Boers. This sentence was later commuted to 15 years' imprisonment, and then to the payment of a fine of $125,000. He resides in New York, with offices there and in London, and is general manager and consulting engineer of the Guggenheim Exploration Co., one of the largest mining companies in the world. His reputation as a mining expert is world wide.

Hammond, Samuel, American soldier: b. Richmond County, Va., 21 Sept. 1757; d. Horse Creek, near Augusta, Ga., 11 Sept. 1842. His impulses led him, while a mere boy, to volunteer in the wars of the Virginia frontier with the Indians, where he is said to have greatly distinguished himself, and to have acquired that skill in stratagem which marked his subsequent military performances. In 1775 he raised a company, and took part in the battle of Longbridge; and in 1779 he was at the battle of Stono Ferry, S. C. After the fall of Charleston he kept the field with a small cavalry force, pursuing the active partisan warfare which alone maintained the revolutionary cause in South Carolina. He subsequently settled in Georgia; in 1802 was elected to Congress from Georgia; in 1805 was appointed by Jefferson to the civil and military command of upper Louisiana; and in 1824 removed to South Carolina, where he became surveyor-general of the State in 1827, and secretary of state in 1831.

Hammond, William Alexander, American surgeon: b. Annapolis, Md., 28 Aug. 1828; d. Washington, D. C., 5 Jan. 1900. He was graduated from the University of the City of New York in 1848; and entering the United States army in 1849 as assistant surgeon, became surgeon-general in April 1862. After the Civil War he practised his profession in New York for some years and in his later life took to writing fiction. Among his publications are included: 'Military Hygiene' (1863); 'Sleep and Its Nervous Derangements' (1869); 'Diseases of the Nervous System' (1871); 'Neurological Contributions'; etc., and the novels, 'Robert Severne'; 'A Strong-Minded Woman'; 'A Son of Perdition'; 'Doctor Grattan' (1884); 'Mr. Oldmixon'; etc.

Hammond, Ind., city in Lake County; on the Grand Calumet River, on the Baltimore & O., the Erie and the Michigan Central, and other R.R.'s; about 19 miles southeast of Chicago. It was settled in 1869 and incorporated in 1883. It is situated in an agricultural region, and its railroad facilities make it of considerable commercial importance. It has a number of manufactories, the principal of which are chemical works, steel-spring, starch, glue, carriage, nail, and flour-mills. It has a large distillery, a slaughtering and meat-packing plant, brick-yards, tanneries, and foundries. The city owns and operates the waterworks. The government is under the charter of 1883. The officers are a mayor, who holds office for four years, a city council, and administrative officials elected by the city council. The industrial growth of Hammond has been rapid, and the population has more than doubled in the last decade. Pop. (1890) 5,428; (1900) 12,376.

Ham'mondsport, N. Y., town in Steuben County, on the Erie, and the New York, O. & W. R.R.'s; about 55 miles southeast of Rochester and 50 miles southwest of Auburn. The town is in a fertile agricultural section, noted especially for the large number of vineyards. The chief manufactures are wine, fruit-boxes, flour, cigars, barrels, wire hoods, and baskets. Hammondsport has a large trade in wine, and in grapes and other fruits. It contains a high school, and several other good public buildings. Pop. 1,230.

Ham'monton, N. J., town in Atlantic County; on the Philadelphia & R. and the Camden & A. R.R.'s; about 27 miles southeast of Camden and 28 miles northwest of Atlantic City. It is situated in a region noted for its rich farms and abundance of fruit. The chief manufactures are shoes and cigars; but it is the trade centre for the northeastern part of the county, and from Hammonton a large amount of small fruits are shipped to New York and other cities. Pop. (1900) 3,481.

Hammurabi, hăm-moo-rā'bē, **The Code of**, a recently discovered code, instituted by Hammurabi, king of Babylon, about 2200 B.C. The code is a thousand years older than the Mosaic age; older than the laws of either Manu, or Moses. It is engraved on a pillar of black diorite, eight feet high, which was finally unearthed, January 1902, in the acropolis mound at Susa. The obverse of the column is surmounted by a bas-relief which represents the god Bel, the lawgiver, before whom the king stands to receive the law. The inscription which covers this stately monolith is the longest Babylonian record ever discovered. It contained originally about three thousand lines of writing, divided into forty-nine columns; but five columns on the front have been erased by some Elamite king, probably Sutruk Naknunti, who served the stele of Naram-Sin in a similar manner. The writing is a very beautiful type of the best archaic script, a kind of black-letter cuneiform, long used by kings for royal inscriptions. The code is divided into about 280 clauses, and opens with the words, «Law and justice I established in the land, I made happy the human race in those days.»

Character of the Code.— The code shows a most careful and systematic order, beginning with witchcraft, which connects it with a religious code: it passes through all grades of social and domestic life, ending with a scale of official wages for all classes of workmen, even the lowest in the scale. Hammurabi's laws of witchcraft preserve the «ordeal of water.»

«If a man has placed an enchantment upon a man, and has not justified himself, he upon whom the enchantment is placed to the Holy River (Euphrates) shall go; into the Holy River he shall plunge. If the Holy River holds (drowns) him he who enchanted him shall take his house. If on the contrary, the man is safe and thus is innocent, the wizard loses his life and his house.»

The same ordeal was applied to a wife for unfaithfulness or extravagance, or to a wine-seller who sold drink too cheap.

The three essential features of the code may be clearly defined. First it is based on personal responsibility and the *jus talionis*. Thus: «If any one destroys another's eye, his own eye shall be destroyed. If any one breaks another's bone, his own bone shall be broken. If any one knocks out the tooth of his equal, his own tooth shall be knocked out.» Next the belief in the sanctity of the oath before God, as in the Hebrew code, and also the absolute necessity of written evidence in all legal matters, as became a nation of scribes. Judgments in the law courts required a «sealed» document; an agent must take and give receipts for all money or goods entrusted to him; bonded goods required a deposit note. One of the most interesting series of clauses relates to officers or constables employed on active service; the estate of such a person could be entrusted to management, must not be sold or mortgaged, but he must depute a representative, or three years' absence and neglect forfeited fief. Substituted service was not allowed. As might be expected in a land so rich in cultivation, the agricultural laws are most explicit. Land must be cultivated, and if neglected the owner had to pay the same as neighboring land. Damage to crop by storm excused the payment of interest on loan. There are very stringent laws as to the tending of the irrigation canals and ditches, and any damage to adjacent land by neglect had to be made good. The commercial laws are extremely important, as showing a highly developed system. Noticeable are the clauses relating to agents or peddlers, commercial travelers of the period.

«If on the road on his business, the enemy have caused him to lose the property he bore, the agent by the name of God shall swear and he shall be quit. If a merchant gives goods to an agent to trade with, the agent shall write down the money, and to the merchant he shall render; the agent a sealed (receipt) for the money he gave to the merchant shall take.»

Monetary Transactions.— Money for which no receipt was taken was not to be included in the accounts. In case of dispute all witnesses and documents must be produced. Among the commercial laws are some of much interest at the present time relating to licensed premises. It is curious to note that all wine merchants were females.

«If riotous persons assemble in the house of a wine merchant and those riotous persons she seizes not and drives to the palace that wine merchant shall be put to death.»

Curious, too, is the following, which seems to reflect the Hebrew Nazarite law: «No votary or woman residing in the cloister may open a wine shop or enter one for drink on pain of being burned.»

In the code's domestic legislation, the most striking feature is the high position and legal protection extended to women. If a man causes a votary or the wife of a man «to have the finger (of scorn) pointed at her and has not justified himself» he is to be branded on the forehead.

To justify herself from scandal a woman could claim the ordeal of plunging in the sacred river. The mere formula of marriage «taking to wife» was not sufficient, for «if a man married a woman and executed not her deeds that woman is no wife.» Divorce law is most fully given — a childless woman could be divorced. If divorced without cause the husband must allow alimony and custody of her children, and a portion of the estate equal to a son, and the woman was free to marry. The woman could get a divorce, but must justify her right to do so. Thus we read:

«If the wife of a man who dwells in the house of that man has set her face to go forth, and has acted the fool, and wasted his house, and impoverished his house, they shall call her to account. If the husband shall say, I put her away, he shall put her away. She shall go her way; for her divorce he shall give her nothing.»

If the husband insisted, such a wife could be drowned. There is, however, a kindlier tone in the law as to a sick wife. «If a man has married a wife, and sickness has seized her, he may take a second wife, but the sick wife he shall not put away; in the home she shall dwell; as long as she lives he shall sustain her.»

Laws of Property.— The laws of property are most full and based on a most equitable system, one clause relates to the remarriage of a widow with young children, and might be present-day law:

"If a widow whose children are young has set her face to enter into the house of another, without the consent of the judge she shall not enter. When she enters into the house of another, the judge shall inquire regarding the house of her former husband. The house of her former husband to that woman and her future husband he shall entrust and cause them to deposit a deed. They shall keep the house and rear the little ones, but furniture for money they shall not sell. A purchaser that has bought any furniture from the children of the widow shall forfeit his money and return the property to its owner."

Here we have all the essential features of the modern ward in chancery. In the conclusion of this code Hammurabi repeatedly calls himself "King of Righteousness," as did his contemporary Melchisedek of Jerusalem, and enjoins upon all of his successors upon the throne to observe this code and its laws.

Hamon, Jean Louis, zhŏn loo-ē ā-mŏn, French genre artist: b. Plouha, Cotes-du-Nord, France, 8 May 1821; d. St. Raphael, Var, France, 29 May 1874. His work though not strong exhibits grace in drawing and has been popular. His most important work in the United States is 'Among the Flowers,' to be seen in the New York Metropolitan Museum.

Hamp'den, John, English statesman: b. London 1594; d. Thame, Oxfordshire, 24 June 1643. He was educated at Oxford and possessing an ample estate, led for several years the usual career of country gentlemen. He was cousin-german, by the mother's side, to Oliver Cromwell. He entered Parliament in the beginning of Charles I.'s reign as member for Grampound, and continued to sit in the House of Commons three times in succession as member for Wendover, and finally for Bucks. In 1636 his resistance to Charles' demand for ship-money made him the argument of all tongues, especially as it was after the decision of the judges in favor of the king's right to levy ship-money, that Hampden refused to pay it. Being prosecuted in the Court of Exchequer, he himself, aided by counsel, argued the case against the crown lawyers for twelve days before the twelve judges; and although it was decided against him by seven of them to five, the victory, as far as regarded public opinion, was his. From this time he received the title of the "patriot Hampden." In the following year (1637) he was one of those who meditated emigration to America, which they were prevented from carrying out by an order in council detaining them. Henceforward he took a prominent part in the great contest between the crown and the Parliament, and was one of the five members whom the king, in 1642, attempted, in person, to seize in the House of Commons. When civil war broke out Hampden acted with his usual decision, took command of a regiment in the parliamentary army, under the Earl of Essex. Prince Rupert having appeared near Thame, in Oxfordshire, Hampden joined a few cavalry that were rallied in haste, and in the skirmish that followed on Chalgrove Field, received a wound which proved fatal six days after its infliction. His death was a great subject of rejoicing to the royal party, and of grief to his own. His character and conduct, from first to last, evince his conscientiousness, and he has taken his rank by acclamation on the one side, and tacitly on the other, high in the list of English patriots. Consult: Nugent, 'Memorials of John Hampden' (1831); Forster, 'Life of Hampden' (1837); Gardiner, 'History of the Great Civil War,' Vol. I. (1880).

Hampden, Renn Dickson, English Anglican bishop: b. Barbadoes, W. I., 29 March 1793; d. London, England, 23 April 1868. Although a man of moderate abilities both as philosopher and theologian, it was his fortune to precipitate one of the most notable controversies in the English Church. As Bampton lecturer for 1832 he lectured on 'The Scholastic Philosophy Considered in its Relation to Christian Theology,' which brought upon him the charge of Arianism, and when he became regius professor of divinity at Oxford, in 1836, opposition to the appointment was very bitter and widespread. He was accused of heresy and all the leading men in the Anglican Church took sides in this theological war of words. In 1847 he was nominated by Lord John Russell for the see of Hereford and the strife of ten years previous was renewed in organized fashion, many bishops uniting in remonstrance and the dean of Hereford openly resisting. He was nevertheless consecrated in March 1848, and his episcopate of 20 years was quiet and uneventful, the echoes of the great controversy having ceased long before his death.

Hampden, Maine, town in Penobscot County; on the Penobscot River; about five miles southwest of Bangor. The chief manufactures are flour and lumber. There is an extensive river trade, chiefly in lumber and food products. The town is one of the oldest in the State, but recently it has grown steadily in industries and population. Pop. 2,484.

Hampden-Sidney College, in Hampden Sidney, a village near Farmville, in Prince Edward County, Va. The school was founded by the Presbyterian Church of Hanover, in 1776, and in 1783 was incorporated by the legislature of Virginia. The land was donated by Peter Johnston, but the acreage has been increased by gifts and purchases, and the college now owns 250 acres. Among the incorporators were Patrick Henry, James Madison, Nathaniel Venable, Paul Carrington, William Cabell, Sr., and many other famous Virginians. Rev. John Blair Smith, the first president of Union College, New York, had previously been president of Hampden-Sidney, also Rev. Archibald Alexander, a founder of Princeton Theological Seminary. It grants the degrees of bachelor of arts, bachelor of science, and bachelor of literature. In 1902 there were in attendance 107 students. The library contained 15,000 volumes.

Hampton, Wade, American general: b. South Carolina 1754; d. Columbia, S. C., 4 Feb. 1835. During the Revolutionary War he served under Sumter and Marion. He was a Democratic representative in Congress from South Carolina 1795–97, and again from 1803 to 1805. In 1809, he was promoted to be brigadier-general, subsequently was stationed in command at New Orleans, was superseded; in 1813 he was raised to the rank of major-general and appointed to command the force stationed at Norfolk, whence he was shortly afterward ordered to the northern frontier and placed in command of the army on Lake Champlain, with directions to threaten Montreal. The attack on Montreal, for which 12,000 men had been concentrated near Lake Champlain, was frustrated by Hampton's unwillingness to co-operate with his colleague General Wilkinson, with whom he had been long at enmity. Hampton resigned his commission 6 April 1814, and passed the rest of his life in agricultural pursuits. He was considered the wealthiest planter in the United States, and was reputed to be the owner of 3,000 slaves.

Hampton, Wade, American soldier: b. Columbia, S. C., 28 March 1818; d. there 11 April 1902. He was graduated from the University of South Carolina, studied law but never practised, managed extensive plantations in South Carolina and Mississippi, served in both houses of the State legislature, but, as a Union Democrat, was not popular among South Carolinians. At the beginning of the Civil War, he formed and equipped at his own expense the command of cavalry, infantry, and artillery known as 'Hampton's legion.' With this he won distinction at the first Bull Run and at Seven Pines, where half his troops were killed and himself severely wounded. Having been made brigadier-general of cavalry and assigned to J. E. B. Stuart's command, he took part in Lee's advance northward (1863), was prominent at Gettysburg, and later brilliantly opposed Sheridan's progress in the Shenandoah valley. He attained the rank of lieutenant-general in 1864, and was placed in command of Lee's entire cavalry forces. In 1865 he commanded J. E. Johnston's cavalry, and endeavored to prevent Sherman's northward advance from Savannah. After the war he was an active reconstructionist; in 1876 was nominated as the Democratic candidate for governor, and, after a contest regarding the election with D. H. Chamberlain, the Republican nominee, served until 1878, when he entered the United States Senate. He was in the Senate until 1891, and in 1893–7 was United States commissioner of railroads.

Hampton, Iowa, city, county-seat of Franklin County; on the Chicago G. W., and the Iowa C. R.R.'s; about 29 miles by rail south of Mason City and 60 miles north by west of Marshalltown. It is situated in an agricultural and stock-raising region. The chief industrial establishments are cigar factories and aluminum works; and its principal trade, in addition to the manufactured articles, is in grain, tobacco, live stock, and horses. Pop. (1900) 2,727.

Hampton (formerly HAMPTON COURT-HOUSE), S. C., village, county-seat of Hampton County; on a branch of the Atlantic C. L., and the Hampton & Branchville R.R.'s; about 67 miles southeast of Augusta. The village is in the yellow pine section, but cotton, sweet potatoes, and Indian corn are the staple products of the surrounding farm lands. Its chief manufactured article is lumber. Pop. 320.

Hampton, Va., town, county-seat of Elizabeth City County; on the north shore of Hampton Roads, on the Chesapeake & O. R.R.; about two and a half miles from Fortress Monroe and 15 miles north by west from Norfolk. In the last of the 16th and first of the 17th centuries the Indian village Kiquotan occupied the site of the present town of Hampton. John Smith and Lord Delaware mention (1608–10) the peaceful friendly Indians of Kiquotan, the hunters and fishermen; but before 1610 there were whites living along the shore and in this Indian village which retained its Indian name for some time after it became a white settlement. In the first session of the Virginia House of Burgesses or Colonial Legislature (1619), the borough of Hampton was represented. In the war of 1812 the town was attacked by the British and a large part was burned. In 1861 it was again burned by the Confederates. The Church of Saint John, Protestant Episcopal, built 1660, is still in good repair. Hampton contains a National Soldiers' Home, which has 2,000 resident veterans; a National Cemetery which contains 3,323 graves of soldiers, 600 of them of unknown dead. It is the seat of Hampton Normal and Agricultural Institute (q.v.). It has some manufactures; brick, fish-oil, and canned crabs. It has considerable trade in fish, especially oysters, and in fruits and vegetables. It has excellent bathing facilities and is a popular resort. Pop. (1890) 2,513; (1900) 3,521.

Hampton Court, England, a royal palace situated near Hampton, a village of Middlesex, 15 miles southwest of London. The palace is about one mile from the village. The original edifice consisted of five quadrangles, of which two remain; it was built by Cardinal Wolsey in 1525, and presented in 1526 to Henry VIII., by whom it was subsequently enlarged, and who formed around it a royal park or chase, which he enclosed and stocked with deer. A third quadrangle was added by Sir C. Wren for William III., who laid out the gardens and park in Dutch style. Hampton Court contains many valuable pictures by Holbein, Lely, Kneller, West, etc. The gardens comprise about 44 acres, and contain a famous "maze" and "wilderness." Hampton Court was inhabited by successive monarchs and their families until the reign of George II. Suites of apartments in Hampton Court palace are now set apart for persons of rank in reduced circumstances. The state apartments, picture gallery, gardens, and home park are open to the public. In 1886 the palace suffered considerable damage by fire.

Hampton Court Conference, a meeting at Hampton Court (q.v.), on the 14th, 15th, and 16th of January 1604, which was convened on the petition of the Puritan ministers to King James I. for moderation and tolerance on religious questions. By the composition of the conference,— on the episcopal side being the Archbishop of Canterbury, eight bishops, five deans, and two doctors, and on the Puritan side only four representatives,— the king sufficiently indicated his attitude toward the aims of the Puritans, and the proceedings consisted chiefly of adulation of James on the part of the episcopal party, and lecturing of the Puritan members by King James. A few alterations were made in the Prayer Book, and a new version of the Bible was agreed upon, the result being the authorized version of 1611.

Hampton Normal and Agricultural Institute, a school for negroes and Indians, opened in 1868, in Hampton, Va., under the auspices of the American Missionary Association. It was chartered by the State in 1870. The school is owned and controlled by a private corporation, administered by 17 trustees. The charter gives the trustees power to choose their own successors, and to hold property without taxation to the amount of $800,000. In 1875 the General Assembly of Virginia passed an act giving the Institute one third of the agricultural college land-grant of Virginia (see COLLEGES, LAND-GRANT) amounting to 100,000 acres, which was sold for $95,000 and which pays regular annual interest. The school was first opened in an old barracks (used during the Civil War), with two teachers and 15 pupils. It now (1903) owns 185 acres on Hampton River, upon which have been erected dormitories, a library, class-room buildings, a church, gymnasium, saw and planing-mill, shops, hospital, domestic-science school, trade school,— in all numbering 55 buildings. The Institute owns also a stock farm of 600 acres, about five miles from the school. The farm land, and the workshops where trades are taught, furnish occupation for the boys and young men. The girls are instructed and employed in sewing and cooking classes, in all the domestic work of the school, and wherever possible learning trades side by side with the boys. In 1896 the Armstrong and Slater Memorial Trade School was opened. (See NEGRO, EDUCATION OF THE.) In this school is taught the theory and practice of blacksmithing, carpentry, house painting, tailoring, and general repairing. The pupils are taught also, mechanical, civil, electrical, and mining engineering. On the farms they are taught how to care for stock, how to raise different crops, and the theory and practice of farming in general. The students are charged $10 a month for board, which is largely paid in labor. They are expected to provide their own books and clothing, and for the tuitions, buildings, furniture, and the implements used on the farms and in the shops, the school is dependent on the charity of the country. In 1878, 15 Indians, who had been prisoners of war at Saint Augustine, Fla., and in charge of Capt. R. H. Pratt, were admitted as students. Since then the Indian department has increased steadily, the pupils being chiefly from the Sioux tribe, of whom two thirds make a fair or good record. The young men of the school are organized into six military companies, all forming one battalion. This places the young men under military discipline. The 'Southern Workmen,' a monthly school periodical, is edited, printed, and managed by the pupils with only a general supervision by one of the teachers. The vacation is from June to October for all except the pupils in the industrial departments, which continue work all the year. During the regular long vacation a large number of the colored teachers of the South assemble here for a summer school. For the past ten years the average attendance at these summer schools has been nearly 500. The graduates number about 1,000, more than half of whom are teaching in the colored schools of the South. In 1902 the number of pupils in the Hampton Institute was 1,161, about 90 per cent of whom were in the industrial and preparatory departments, the remainder in the college department. The same year there were 82 instructors in the school. The library contains about 12,000 volumes. Many of the graduates are engaged in farming or working at trades; some are teaching. Booker T. Washington (q.v.), of the class of 1875, is the most noted graduate. Hampton's endowments amount to about $1,100,000. The annual income is about $170,000, and comes from the Government Indian Funds, the Slater and Peabody Funds, the State land-grant and agricultural funds, and from private donations.

Hampton Roads, Va., a broad deep channel which connects the estuary of the James River with Chesapeake Bay; really a part of the estuary which is at the mouths of the James, Elizabeth, and Nansemond rivers. Some of the good harbors along the shore are Norfolk and Portsmouth on the south; Hampton, on the Hampton Creek, an arm of the Hampton Roads, on the north. At the entrance are Forts Monroe and Wool. On the north side of the entrance is Thimble Shoal light, at lat. 37° 42′ N. and lon. 76° 14′ 5″ W. A large number of railroads have terminals on Hampton Roads, especially at Norfolk. This estuary, or channel, is considered of great military importance. During the Civil War its advantages as a military station were demonstrated. On Hampton Roads occurred the battle of Hampton Roads (q.v.), the first engagement between ironclads.

Hampton Roads, Battle of. Hampton Roads was the rendezvous of several important naval and military expeditions during the war, and the scene of two memorable encounters. On 8 March 1862 the Confederate ram Merrimac (or Virginia) left her anchorage at Norfolk, 12 miles from Fort Monroe, steamed down Elizabeth River and, with her consorts, five in number, attacked the Union fleet of five vessels in the roads, destroying the Congress and Cumberland, which lost over 250 men, and then retired to the mouth of Elizabeth River. Next morning the Merrimac returned to the roads to complete the destruction of the Union fleet, but was met by the Monitor, which had arrived the night before from New York, and a novel naval battle ensued, resulting in the return of the Merrimac to Norfolk and the saving of the remainder of the Union fleet. See MONITOR AND MERRIMAC.

E. A. CARMAN.

Hampton Roads Conference, an informal conference held 3 Feb. 1865, between President Lincoln and Secretary of State Seward, representing the United States government, and Vice-President Alexander H. Stephens, Senator Robert M. T. Hunter, and Assistant Secretary of War John A. Campbell, representing the Confederate States. The meeting took place on board the River Queen, near Fort Monroe, and its object was the arrangement of a peace between the North and South. The originator of this conference was Francis P. Blair (q.v.) who thought a combination of North and South against Maximilian in Mexico, in enforcement of the Monroe doctrine, would bring in peace by a diversion. President Lincoln refused to join the conference excepting with a view to the restoration of union, and on the understanding that the Emancipation Proclamation was to stand without qualification. He disapproved of a joint action against the French in Mexico. The conference lasted for four hours, but broke up without reaching any definite conclusion.

Hamstring. See ANATOMY; MUSCLES.

Han-yang, hän-yäng'. See HANKOW.

Han'aford, Phebe Ann Coffin, American Universalist minister: b. Nantucket, Mass., 6 May 1829. In 1849 she was married to J. H. Hanaford, a teacher. She was the first woman ordained to the ministry in New England and since her ordination in 1868 has held pastorates in Hingham and Waltham, Mass., New Haven, Conn., and Jersey City. She has been industrious as a writer, among her many published works being 'Life of Abraham Lincoln'; 'Life of George Peabody'; 'Lucretia the Quakeress'; 'Leonette, or Truth Sought and Found'; 'The Best of Books and its History'; 'Frank Nelson, the Runaway Boy'; 'The Soldier's Daughter'; 'Field, Gunboat, and Hospital'; 'Women of the Century'; 'From Shore to Shore, and Other Poems'; etc.

Han'cock, John, American statesman: b. Braintree, Mass., 23 Jan. 1737; d. Quincy, Mass., 8 Oct. 1793. He was graduated at Harvard College in 1754, but shortly after entered the counting house of an uncle, on whose death in 1764 he received a fortune of £80,000. After 1766 he was several times elected to the Massachusetts General Court. It was the seizure of his sloop, the Liberty, that occasioned the riot in 1768, when the royal commissioners of customs narrowly escaped with their lives. After the so-called "Boston massacre," in 1770, he was a member of the committee to demand of the royal governor the removal of the troops from the city, and at the funeral of the slain delivered an address which greatly offended the governor, who now endeavored to seize the persons of Hancock and Samuel Adams. Both were members of the Provincial Congress at Concord and later of that at Cambridge, and Hancock was president of each. This arrest is said to have been one of the objects of the expedition to Concord which led to the first battle of the revolution after which Gage offered pardon to all the rebels except these two, "whose offences," he added "are of too flagitious a nature to admit of any other consideration but that of condign punishment." In 1775 Hancock was chosen president of the Continental Congress, and in 1776 signed the Declaration of Independence. He resigned from the presidency in 1777, but was a member of the Congress until 1780, and again in 1785–6. With rank of major-general, he commanded the Massachusetts forces in the Rhode Island expedition, in 1780 was a member of the Massachusetts constitutional convention, and under that constitution was in 1780 chosen first governor. To this office, with an interval of two years (1785–7) he was annually re-elected till his death. Hancock was a man of strong common sense and great decision of character, of polished manners, easy address, affable, liberal, and charitable. His personal vanity, and his jealousy were at times conspicuous, but he was a sincere patriot, and of much ability. John Adams said of him: "He was by no means a contemptible scholar or orator. Compared with Washington, General Lincoln, or Knox, he was learned." See A. E. Brown, 'John Hancock: his Book' (1898).

Hancock, Winfield Scott, American soldier: b. Montgomery Square, Pa., 14 Feb. 1824; d. Governor's Island, New York harbor, 9 Feb. 1886. He was graduated from the United States military academy in 1844, and after frontier service in the Sixth infantry fought with credit in the Mexican war, was successively regimental adjutant and quartermaster in 1848–55, and briefly assistant adjutant-general to the Department of the West. Appointed assistant-quartermaster with rank of captain in 1855, he was stationed at Fort Myers, Fla., during the Seminole disturbances, and in 1857–8 was in Kansas, whence, after service, in the border troubles, he was ordered successively to Utah and California. In 1859–61 he was chief quartermaster of the southern district of California, with headquarters at Los Angeles. At the beginning of the Civil War, he was commissioned brigadier-general of volunteers, and assigned to the command of a brigade in Smith's division, Fourth corps, Army of the Potomac. He distinguished himself at Williamsburg and during the second day's fight at Antietam (17 Sept 1862) was placed in command of the 1st division, Second army corps. Promoted major-general, U. S. V. (November 1862), he commanded his division at Fredericksburg in the attack on Marye's Heights, on which occasion he lost 2,013 from a total of 5,006 troops. He largely saved the day at Chancellorsville (2–4 May 1863), and shortly afterward was assigned to the command of the Second corps. In July 1863, he was ordered by Meade to proceed to the field of Gettysburg, take command, and report whether battle should be given at that point. He reported Gettysburg as the suitable place for the ensuing battle, reorganized the Federal lines, on 2 July commanded the left wing, and on the next day the left centre, against which was directed a Confederate charge in the course of which the Second corps lost about 4,000 killed and wounded out of less than 10,000 troops and Hancock was shot from his horse. In 1866 he was appointed major-general, U. S. A., in 1866–8 commanded successively the departments of Missouri, and of Texas and Louisiana, in 1868–9 the military division of the Atlantic, in 1869–72 the department of Dakota. He was again assigned to the division of the Atlantic in 1872. In 1880 he was Democratic candidate for the presidency, but was defeated by Garfield by a vote of 4,454,416 to 4,444,952. He was a brilliant leader, known as "Hancock the Superb," — "the most conspicuous figure," says Grant, "of all the general officers who did not exercise a separate command." Consult the 'Life' by Walker (1894).

Hancock, Mich., village in Houghton County; on Lake Portage, and on the Duluth, S. S. & A. railroad; opposite Houghton (q.v.). Although the northern part of Michigan and this region had been explored by missionaries in the 17th century, the first permanent settlement was made in Hancock in 1859, and the village was incorporated in 1863. It is situated in a section rich in minerals, the Lake Superior copper belt. The Calumet and the Hecla copper mines are nearby, and the village has foundries, machine-shops, smelters, stamp-mills, lumber and brick yards. A ship-canal to Lake Superior brings a large portion of the lake traffic to and from Duluth and Superior through the "short cut," by way of Hancock. It is the seat of a Finnish college. The government is vested in a president, whose term of office is one year, and a village council who are elected by the people. The village owns and operates the waterworks. Pop. (1890) 1,772; (1900) 4,050.

Hancock, N. Y., village in Delaware County; at the junction of the two branches of the Delaware River, on the Erie and the New Y., O. & W. R.R.'s. Nearby are bluestone quarries, which add to the industrial wealth of the village. Hancock has flour-mills, tanneries, a wood alcohol factory, and large lumber-yards. It is a trade centre for an extensive agricultural region. Pop. (1900) 1,283.

Hancock, Mount, a peak of the Big Game Range, in the southern part of the Yellowstone National Park, on the boundary between the Park and Wyoming. It is on the western border of Two Ocean Plateau, a portion of the continental divide. The Snake River (q.v.) has its rise on the east side of Mount Hancock, flows north by west, then south by west around and almost circling the mountain. Mount Hancock is 10,235 feet in height.

Hand, Edward, American revolutionary soldier; b. Clyduff, King's County, Ireland, 31 Dec. 1744; d. Rockford, Lancaster County, Pa., 3 Sept. 1802. In 1774 he came to America as surgeon's mate in the 18th Royal Irish regiment, but he later resigned and entered medical practice in Pennsylvania. At the outbreak of the Revolutionary War, he became a lieutenant-colonel in Gen. William Thompson's brigade, participated in the siege of Boston, and in 1777 was appointed brigadier-general. In 1778 he succeeded General Stark in the command at Albany, and later took part in General Sullivan's expedition against the Iroquois. He sat in Congress in 1784–5, and signed the Pennsylvania constitution in 1790.

Hand. The human hand is composed of 27 bones, namely eight bones of the carpus or wrist arranged in two rows of four each, the row next the fore-arm containing the scaphoid, the semilunar, the cuneiform, and the pisiform, and that next the metacarpus, the trapezium, the trapezoid, the os magnum, and the unciform. The metacarpus consists of the five bones which form the palm, the first being that of the thumb, the others that of the fingers in succession. Lastly, the fingers proper contain 14 bones called phalanges, of which the thumb has but two, all the other digits having three each. These bones are jointed so as to admit of a variety of movements, the more characteristic being those by which the hand is flexed backward, forward, and sideways, and by which the thumb and fingers are moved in different ways.

The chief muscles which determine these movements are the "flexors," which pass down the fore-arm, are attached by tendons to the phalanges of the fingers, and serve to flex or bend the fingers; and the "extensors" for extending the fingers. There are two muscles which flex all the fingers except the thumb. The thumb has a separate long and short flexor. There is a common extensor for the fingers which passes down the back of the fore-arm and divides at the wrist into four tendons, one for each finger, each being attached to all three phalanges. The fore-finger and little finger have, in addition, each an extensor of its own, and the thumb has both a short and a long extensor. The tendons of the muscles of the hand are interlaced and bound together by bands and aponeurotic fibres, and from this results a more or less complete unity of action. It is sometimes difficult to make a movement with a single finger without the others taking part in it, as in executing instrumental music, for instance; but practice gives to these movements perfect independence.

Of all the movements of the hand the opposition of the thumb to the other fingers, alone or united, especially characterizes the human hand. This action of the thumb results from its length, from the first metacarpal bone not being placed on the same plane as the other four, as is the case in the monkey, and from the action of a muscle — the long flexor of the thumb — peculiar to the human hand. This muscle completes the action of the other motor of the thumb and permits man to hold a pen, a graver, or a needle; it gives to his hand the dexterity necessary in the execution of the most delicate work. Properly speaking then, the hand, with its highly specialized muscles, belongs to man alone. It cannot be considered, as in the ape, as a normal organ of locomotion. It is essentially the organ of touch and prehension. It molds itself to a body to ascertain its form; it comes to the aid of the eye in completing or rectifying its impressions. The functions of touch devolve principally on its anterior or palmar face, the nervous papillæ abounding specially at the ends of the fingers. A layer of adipose tissue very close in texture protects, without lessening its power or its delicacy, the network of muscles, vessels, and nerves with which this remarkable organ is equipped.

Hand'ball, a popular game of ball, the bare hand only being used. The game is indigenous to Ireland, but has been transplanted to America, where are the most expert players. Two or four men can play, one or two on a side. As far as is known the game of handball came to the United States about 1840, and has since become one of the sports under the regulations of the Amateur Athletic Union. The game consists of scoring the ball against a single back wall, with a lined-out space of 60 feet in front. The ball coming from the wall must fall between these two lines to be in play. The game is simply to strike the ball on the rebound with the hand.

Han'del, George Frederick, (properly Georg Friedrich Haendel), English composer; b. Halle, Saxony, 23 Feb. 1685; d. London 20 April 1759. His father, intending him for the law, discouraged the strong passion which he evinced early in life for the science of music. But although forbidden the use of musical instruments, the young musician contrived to hide a small clavichord in a garret, where he amused himself during great part of the night after the rest of the family had retired, and made such progress that, when at seven he accompanied his father to the court of Saxe-Weissenfels, he played on the church organ with such power and effect that the duke, who accidentally witnessed his performance, used his influence successfully with his father to permit him to follow his inclination. He was accordingly placed under

Zachau, organist of the cathedral, and was soon so far advanced in the practical part of the science as to officiate occasionally as deputy to his instructor. At 14 (1698) he went to Berlin, where at that time the opera under the direction of Buononcini and Attilio was in a very flourishing condition. Attilio became his teacher and friend. In 1703 he went to Hamburg, and procured an engagement in the orchestra at the opera there. On 30 Dec. 1704, he brought out his first opera, 'Almira,' in the February following succeeded by his 'Nero,' and subsequently by 'Florindo' and 'Daphne.' He then went to Italy, where he composed the operas 'Rodrigo' and 'Agrippina,' and the first form of the serenade 'Acis and Galatea.' On his return to Germany in 1710 he entered the service of the Elector of Hanover, afterward George I. of England, as chapel-master; but having received invitations to visit London, he set out for England, where he arrived in the latter end of 1710. On the occasion of his first visit to England he composed the opera 'Rinaldo.' He soon returned to Hanover, but at the end of two years again received permission to visit England. At the time of his arrival in London the negotiations for the Peace of Utrecht were just about to be concluded, and Handel was invited by Queen Anne to compose a 'Te Deum' and 'Jubilate' in celebration of the peace. But this act was so distasteful to the Elector of Hanover that Handel did not venture to return, but remained in England on an income of £200 a year allowed him by the queen. He was, in consequence, on the accession of his royal patron to the throne of Great Britain in 1714, in much disgrace, till Baron Kielmannseck restored him to favor. From 1715–18 Handel resided with the Earl of Burlington, and then quitted that nobleman for the service of the Duke of Chandos, who entertained him as chapelmaster to the splendid choir established at his seat at Cannons. For the service of this magnificent chapel Handel produced those anthems and organ fugues which alone would have been sufficient to immortalize him. When the Royal Academy of Music was instituted by some of the leading noblemen of England, Handel, whose fame had now reached its height, was placed at its head; and this, for a short period, may be considered as the most splendid era of music in England. The warmth of his own temper, however, excited by the arrogance and caprice of some of his principal Italian singers, caused many violent quarrels; and public opinion becoming enlisted in favor of his opponents, and especially of his rival, the musician Buononcini, his popularity waned somewhat and the Academy was dissolved (1728). Handel then started a new operatic company. But a rival company to his was afterward started, and the result was that much money was lost by both. The operas which he had composed up to this date (1735), from the institution of the Academy of Music, were 'Radamisto'; 'Ottone'; 'Giulio Cesare'; 'Floridante'; 'Flavio'; 'Tamerlano'; 'Rodelindo'; 'Alessandro'; 'Scipione'; 'Ricardo I.'; 'Tolomeo'; 'Siroe'; 'Lotario'; 'Parthenope'; 'Poro'; 'Orlando'; 'Sosarme'; 'Ariadne'; 'Ezio'; 'Ariodante'; and 'Alcina.' Among other works should be mentioned his first English oratorio, 'Esther', and his delightful pastoral 'Acis and Galatea.' In 1736 his famous setting of Dryden's ode, 'Alexander's Feast,' was performed with brilliant success. His last opera was performed in 1741. Handel had by this time begun to devote himself chiefly to music of a serious nature, especially the oratorio. The approval which his first works of this kind 'Esther,' 'Deborah' (1723), 'Athalia' (1733); had met with encouraged him to new efforts; and he produced in succession 'Saul,' 'Israel in Egypt,' and 'The Messiah.' The last-mentioned, his chief work, was brought out at Dublin in 1742. This sublime composition had been composed the previous year, in the incredibly short period of twenty-three days. When Handel returned to London his oratorios were received at Covent Garden Theatre with the greatest approbation by overflowing audiences — 'The Messiah' in particular increased yearly in reputation. Before it was given, however, a new oratorio, 'Samson,' was produced (1743), and there next followed 'Joseph and his Brethren' (1744), 'Belshazzar' (1745), 'Judas Maccabæus' (1747), 'Joshua' (1748), 'Solomon' (1749), and 'Jephthah' (1752). Some time before his death he was afflicted by nearly total blindness; but he continued not only to perform in public but even to compose. His own air, however, 'Total Eclipse,' from the oratorio of 'Samson,' is said always to have affected and agitated him extremely after the loss of his sight.

Handel's habits of life were regular; his appetites were coarse, his person large and ungainly, his manners rough, and his temper even violent; but his heart was humane, and his disposition liberal. His musical powers can hardly be estimated too highly. In boldness and strength of style, and in the combination of vigor, spirit, and invention in his instrumental compositions he has never been surpassed. His choruses have a grandeur and sublimity which have never been equaled. Yet a singular fact in regard to him as a musician is that in some of his works he shows himself as an unscrupulous plagiarist — a fact of which various explanations and palliations have been attempted. He was buried in Westminster Abbey, where a monument by Roubillac was erected to his memory. See 'Lives by Chrysander' (1858–67); and Rockstro (1883); Whittingham, 'Life and Works of Handel' (1882); the articles in the 'Dictionary of National Biography' and Grove's 'Dictionary of Music.'

Han'dicap, Brooklyn. See HORSE-RACING.

Handicapping, a term used in racing: The allowance of time, distance, or weight made to the inferior competitors in a race with the object of bringing all as nearly as possible to an equality; the extra weight imposed on a superior horse in order to reduce his chance of winning to an equality with that of an inferior animal. The handicap is framed in accordance with the known previous performances of the competitors, and in horse-racing also with regard to the sex and age of the animals engaged. The principle is the same in other contests, as in billiards a superior player is handicapped by having to allow his inferior competitor a start of a certain number of points.

Handies (hăn'dĭz) **Peak,** in the southeastern part of Colorado, in the San Juan Range; about 12 miles northeast of Silverton. Rich deposits of silver ore are found in all the mountains of this vicinity; the range is known as the 'Silver San Juan.' The altitude of Handies Peak is about 14,000 feet.

Handwriting, Expert Analysis of. A mental image may be made either consciously and with attention to every detail, or with varying degrees of consciousness amounting in some cases to almost complete automatism, but it must in any case be largely influenced by the machine which produces it. No matter what care may be employed to make two objects alike, a sufficiently minute inspection will always discern differences between them. It is from this fact we are able to distinguish a particular tone of a bell, a particular face, etc. All things, and notably those which owe their existence to organic life, are resultants of very complex forces acting simultaneously or in sequence, and in comparing similar resultants it is ever found that quantitative or qualitative differences of the constituent forces employed in fashioning them have occasioned differences in the objects themselves. These differences may be indiscernible to the casual view, but will never fail to reveal themselves to an examination sufficiently searching.

The factors employed in making marks may be roughly divided into: A, the model in the mind which it is the intention to reproduce; and B, the mechanism by which the act is to be accomplished. Under the latter head there is to consider not only the permanent structure of the individual, which necessarily limits his performance, but also the manner of employing this structure, which becomes a habit, and the fluctuations, due to disease, drugs, variations of mood, increasing age, etc., in the motor impulses controlling it.

The basis of any sound judgment on the authorship of designs such as pictures or handwriting, depends upon the recognition of sorts of differences; which it is essential to distinguish from each other. In general, designs by different authors differ in kind, while those of the same author differ in degree. The methods for distinguishing these two sorts of differences will be more particularly treated hereafter.

The general subject of the study of those characteristics which distinguish each handwriting from every other has been called *Grammapheny;* the study of methods for detecting frauds relating to handwriting either in imitating, altering, or suppressing a record, is called *Plassopheny;* and the general study of the records of human thought including their forms, their purport, and the tools and materials by means of which they are produced is called *Bibliotics.*

Ever since the more or less permanent records of human thought have had a value they have been the objects of falsification. It is not known to how great an extent this may have been practised in the hieroglyphic and ideographic carvings on stone, but doubtless interpolations were frequent in recording the deeds of their kings, and the sculptors imitated each other's style with a view of bettering their own; or each other's peculiarities to convey false impressions as to the narrator.

But with the introduction of writing in pigments on parchment and papyrus the greater facility with which alterations and erasures could be made immediately attracted the attention of the unscrupulous. According to historians the Greeks, Romans, Egyptians, Assyrians, and others practised garbling and forgery by erasing, resurfacing, and bleaching manuscripts to change their purport, or give false impressions of their age and authorship. These depredations, then as now, were chiefly made upon manuscripts of persons absent or, more commonly, deceased; whole compositions which they never saw being ascribed to them. As an example may be cited the interpolation in the text of Josephus with which Eusebius has been charged. A host of epistles, papal decrees, productions of the Fathers, and dogmatical treatises were in early times altered, erased in part, and falsified from the original text, sometimes by learned and reverend scholars for the greater glory of the Church, and sometimes by obscure copyists from ignorance, or trifling incentives. Erasmus declared he knew not a single important old manuscript which was not tainted by this kind of fraud. The methods of effacing the writing of a parchment multiplied in proportion to the increase of manuscripts and the cost of parchment. The practice of using such effaced parchments for other writings was common in the time of Cicero, as a letter from him to Trebatius testifies. Such writings were called palimpsests; and the custom of producing them gave dangerous experience to perpetrators of fraud in the art of effacing written characters by mechanical and chemical means. Plutarch speaks of this practice as one well known. As the price of parchment rose it began to be the habit in the early libraries to efface the letters from parchments «of little value» in order to replace them by more valuable compositions. Dangerous as was such a rule at any time it became fatal to learning when the choice was in the hands of ignorant monks inflamed against their adversaries in controversy, and against all «pagans,» in which class almost all the great authors of our classics were included, and willing to sacrifice the choicest thoughts of the Greeks and Romans in favor of the fanatical dissertations of those they were pleased to call the «faithful.»

When the Caliph Omar put an end to the manufacture and sale of papyrus he caused a wholesale destruction of the writings in the libraries throughout the world. Michelet states that «the fatal patience of the monks» accomplished more ruin than the conflagrations of Omar, of the hundred Spanish libraries, and of the Inquisition. (Consult Gustave Itasse, 'Le Faux devant l'histoire,' etc., from which much of the preceding is taken.) According to Adolphe Bertillon ('Revue Scien.' 25; 4 Ser. Vol. VIII. 18 Dec. 1897) the first recorded student of bibliotics was François Demelle in 1609, and the first writer on the subject one Raveneau (1656). In his treatise the latter deplores the lack of science of his colleagues, which however did not prevent their landing him in jail for forgery.

The methods employed in judging the authorship of handwriting by these and almost all later writers on the subject are the same as those relied upon by connoisseurs of painting. They deal exclusively with the pictorial and apparent peculiarities, and the undefined effect these produce upon the mind. The most daring of these methods is the so-called

"Graphology," described in a pamphlet of the Abbé Michon in 1880, which has many conscientious supporters and partial government recognition in Germany and France. This curious study has for its object the revelation of the character and peculiarities of a writer by his handwriting. It would lead to too long a digression should the various claims of the advocates of graphology be reviewed. It must suffice here to say that some of these not content with finding in the manuscript of an unknown writer personal peculiarities which he already possesses, have imagined they could detect the lurking tendencies to virtuous or vicious deeds such as self-sacrifice, kleptomania, murder, etc., which he has never developed. These are deduced from the pen habits which they think they detect in the writing: such as deliberation, precipitancy, economy of paper, or of effect, etc., etc. M. Bertillon thinks "To the public no proof is so decisive as that of personal identification of individuality, yet how many mistakes are made?" He believes with the exception of the advance in photography the art of handwriting judgment is just where Raveneau left it in the reign of Louis XIV. He forgets the aid he himself has rendered to the art of differentiating and identifying handwriting by the application of his anthropometrical measures for the identification of criminals. The former art without such methods is in precisely the state in which Bertillon found the latter before his demonstration that exact measurements of different parts of the body and the relation to each other of the results of such measurements entirely removed the chance of error in identification, whereas there have been many instances of mistaken identity, or denial of identity by a wife or other near relative of the person in question. The history of this minute branch of research resembles that of other and larger branches. Subjective impressions such as those supplied by the feelings, indicating supposed relative amounts or intensities of emotions or sensibility, which were the only guides to the pioneers of inductive research, gave way to exact methods by employment of instruments of precision recording facts in intelligible units, in estimating, for example, degrees of acidity, pitch of sounds, height of temperatures, intensity of lights. One after the other the old subjects of research were furnished with these unequivocal means of recording phenomena, and all the new subjects were required to find such means or forfeit recognition. Thus through mathematics astronomy, already in the van of exact sciences, was enabled to make enormous enlargements of our view of the universe in the last two centuries, and even those objects of research which seemed to defy such treatment were provided with mathematical methods. Psychology became a science admitting experimentation of which the results can be expressed in units, and chemistry is becoming as loyal a subject of that science of relation — mathematics — as its sisters, physics and mechanics.

The purpose of the investigation of a handwriting will determine the kind of examination that is made. If the object be to ascertain whether a particular signature has been legitimately placed as an authentification of a writing, it is necessary to scrutinize the paper on which it is written for evidence of scratching, erasing, or other tampering; the ink for peculiarities of constitution which may be inconsistent with its use at that time and in that place. The question of superposition of lines may show that the writing it validates was made after the signature. In numerous criminal trials each of these and of many other unmentioned demonstrable facts have at once stamped documents as fraudulent and obviated the necessity of the more particular study of the character of the writing. (Thus a water-mark in a paper on which was written a statement bearing date 1868 represented the German Eagle which was not adopted till after 1870, and this of course showed the whole instrument to be a fraud. A similar conclusion is forced in the case of traced characters purporting to have been written before Hofmann's discovery of the aniline colors yet demonstrably produced by aniline ink.) The value of a signature as authenticating a contract is forfeited if it is clear that parts of the body of the document were written after the signature was written. These and other problems in the domain of plassopheny are too numerous to treat in this place and attention will be directed exclusively to the grounds for deciding two specimens of writing to be by the same or by different hands.

The first and most obvious method is to compare their respective features; large or fine writing; perfect or imperfect shaping of the letters; slant or angle of the stems and tails of letters with the line of writing; peculiarities (of which there are always a number) in the forms of individual letters or in the manner of connecting or grouping them; alterations in pressure producing shading in certain directions, and many other similar details. These peculiarities are pictorial. In all genuine writing they arise from the limitations of the writer, first in forming a mental picture of what he wants to produce, and secondly in producing it. Any one of these peculiarities can be easily imitated by another, and indeed all the visible details together can be drawn or traced by a skilful artist, yet in the latter case not without revealing to one using a magnifying glass that the lines have been slowly and carefully drawn and not dashed off with ease. Even if words are photographed or traced from an original and afterward inked, an ordinary magnifying glass will show a difference in the pen marks from the current facility of the original writer. The careful study of such details constituted the entire basis of judgment of the expert till within recent years, and usually they will suffice; for though the forger should know all the minute peculiarities which are disclosed to the patient study of a handwriting, yet he could not reproduce many of them without betraying in the result a painstaking, labored use of the pen which would excite suspicion. Where the same word or signature occurs twice or more in a document the forger must avoid exact repetition of all the minutiæ and at the same time not make such deviations as are inconsistent with the habits of the writer. The most important of these habits for purposes of identification are not pictorial nor immediately apparent to the eye.

Proportions.— Among the most important kinds of characteristics which insensibly influence the judgment in forming a conclusion as to identity of authorship of two specimens of handwriting are the proportions between certain parts of a letter, or word, or group of these, which often occur together. Especially is this the case with a signature, which is written so frequently that the act becomes almost automatic and therefore one in which the peculiarities due to the hand and arm making it, and to the brain furnishing the pattern, are most prominent because without the interference of voluntary effort. The result in fact resembles typewriting where the defects in the levers and type-faces of a type-writing machine can be detected; but with this difference that in handwriting they are still recognizable even when from lack of space or other causes the signature is written smaller or larger than usual. In such cases there is found a greater conformity to the established relations of parts of the signature than any foreign hand could make without a pantograph or other artificial aid. These proportions of parts may be detected either individually by carefully noted measurements, or by composite photographs of genuine signatures. Each method has some advantages over the other. In employing composite photography one attains to an ideal signature because all the possible characteristics of relation in every signature have been introduced, but on the other hand by this means only a form has been evolved — a graphic average — which must then be made the standard for comparison.

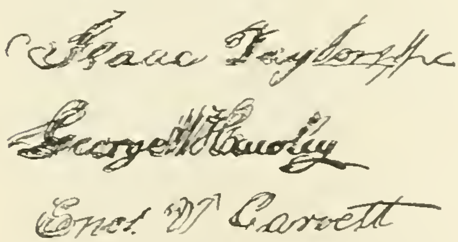


Fig. 1.— Composites of genuine signatures.

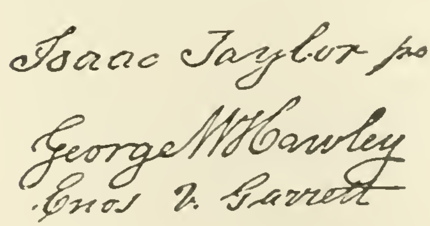


Fig. 2.— Forgeries of the above signatures.

In the case of the method by actual measurements although only a small fraction of the total number of relations is noted, yet these are in numerical form and can be averaged and the results compared directly.

The principle on which the method by investigation of proportions of parts rests is that the spaces between various distinctive points of a signature bear numerical relations to each other, and to the heights of certain letters, which are constant within comparatively narrow limits whether the signature be written small or large.

The following illustration (Fig. 3) represents a small part of a letter written with pen and ink and photographed at an enlargement of 30 diameters:

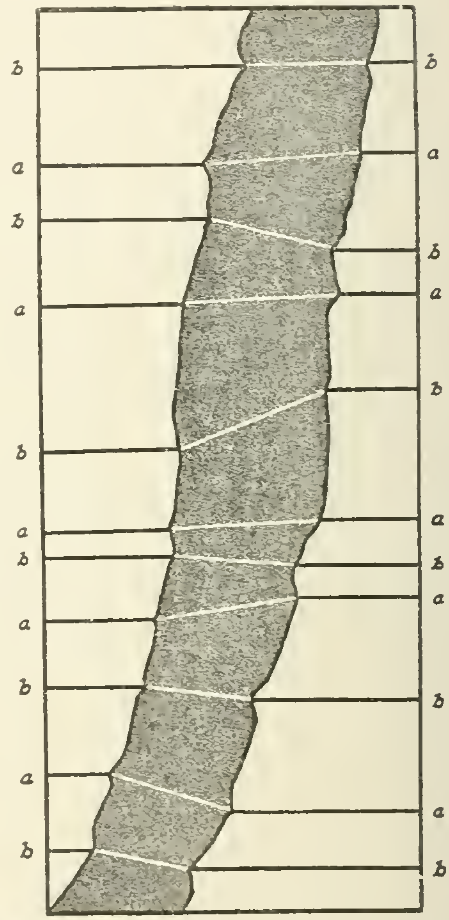


Fig. 3.— The points *a* show the widest and *b* the narrowest parts of the ink lines. It is to be noted that the maxima and minima of the two margins are not always opposite to each other, but show a tendency to oscillate about a horizontal line so that the *a*'s and *b*'s of one margin will be observed alternately above and below such line in following the ink mark downward, while those of the other margin will be found in opposite phase. This is made clearer by the white lines uniting the *a*'s and *b*'s of the opposite margins. This can be accounted for by the simultaneous operation of lateral and vertical movements which are not coincident in period.

Tremograms.— Another valuable individuality in writings executed by means of pen and ink are the irregularities observed in the margins of the lines when examined under a sufficiently high power of the microscope (about 120 diameters). How far this examination will enable one to identify an individual is not yet known, but it has been established that there are characters in the general disposition, number, arrangement, and position of these serrations, which remain comparatively constant in the writings of the same individual with different pens, ink, and paper, and under different mental and physical conditions, and which therefore cannot have other source than peculiar motions imparted to the writing instrument and writing fluid by the writer.

Inks.—Tables for the determination of the characters of inks by qualitative chemical tests have been published by Robertson, Hofmann and others. To the same end special devices have been made to solve questions relating to the composition of inks without affecting the document or writing fluid: Doremus by means of the spectroscope. Frazer through absorption of light admitted to and reflected by the ink through colored prisms. Sharples has shown that an otherwise invisible record may be made visible through shorter or longer exposure to the sensitive plate of the photographic camera, etc.

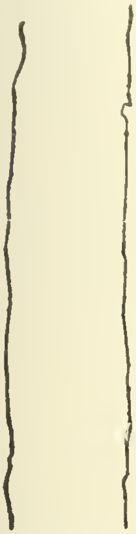


FIG. 4.—A tracing by camera lucida of the margins of an ink line drawn by a pen fixed to a ruling machine. It is enlarged 60 diameters. There is an absence of the irregularities always found in the margins of ink lines made by the human hand.

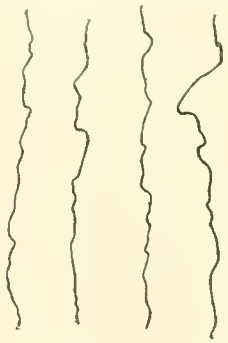


FIG. 5.—Camera lucida tracings of the margins of two ink lines by the same hand made at an interval of fifty-two days. The similarity of character of the serrations in both is noticeable.

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Handy Andy, a novel by Samuel Lover, published in 1842. It is a broadly humorous tale of life among the Irish gentry and peasantry in the first half of the 19th century, by an accomplished author who not only could illustrate his own narrative, but could write songs for it and furnish music for them as well.

Han'ford, Cal., city and county-seat of Kings County; on the Southern Pac. and Santa Fe R.R.'s, about 30 miles southeast of Fresno, and 250 miles south of San Francisco. It was first settled in 1871 and was made a city in 1891. Its chief industries are agriculture, fruits, raisins, and livestock. It has also flour and planing mills, milk condensing factory, butter and cheese factories, etc., and is a distributing centre for food products and clothing sent to mining sections in the vicinity. The city government is by a Board of Trustees, the board choosing its own chairman. The city has six banks, and a Carnegie Library. Pop. (1903) 3,000.

FRED A. DODGE,
Editor 'The Hanford Sentinel.'

Hanfstängl, Franz, fränts hänf'stengl, German lithographer: b. Rain, Germany, 1804; d. 1877. He studied art at the Munich Academy, and in 1826 went to Dresden where he began his series of lithographic copies of pictures in the Dresden Gallery, which he completed in 1852. During the latter part of his life he devoted himself to photography and kindred processes.

Hang-Chow, häng'chow, China, the capital of the province of Che-kiang, on a plain at the southern terminus of the Imperial Canal, and within two miles of the head of the estuary of the Tsien-tang River, about 40 or 50 miles from its mouth, nearly 100 miles southwest of Shanghai. It is a strongly fortified city of oblong form, surrounded with high well-built walls about eight miles in circuit, enclosing many large vacant spaces. The streets are well paved and clean, and there are numerous triumphal arches, monuments to great men, and gorgeous Buddhist temples. The stores and warehouses are noted for their size and the quantity and quality of the goods displayed. More than 100,000 persons are employed in silk manufactures, and among other industries are the weaving of cotton, manufacture of tapestries, carving in ivory, the making of lacquered ware, fans and screens, etc. The houses generally are one story high. A large portion of the inhabitants reside in the suburbs, and in boats on the waters around them. The governor-general of Che-kiang and Fe-kien resides in this city, and also the governor of the province. With their courts and troops, in addition to the great trade passing through, and its activity as a centre of literary and ecclesiastical life, Hang-Chow is one of the most important and richest cities in China. The river, opposite the city, is about four miles broad at high-water, and is crowded with vessels of all descriptions, being the channel by which vast quantities of merchandise are received from and exported to the southern provinces. The extensive Lake of Si-hou, "West Lake," close by the city, is celebrated for its natural and artificial beauties. Chapu, the seaport of Hang-Chow, is 20 miles down the river. Hang-Chow is the celebrated "Kinsai" of Marco Polo — the capital, in his time, of Southern China. It was captured by the Taiping rebels in 1861, and deserted by all its rich or respectable inhabitants. A disciplined force of Chinese, under the command of French officers, united with the Imperialist troops, recaptured the city on 31 March 1864. By the Treaty of Shimonoseki (1895) it was opened to foreign trade, and a district platted for a foreign settlement. Pop. estimated at 700,000.

Hanging, a form of capital punishment inflicted under the common law; also a mode of death sometimes lawlessly visited upon a person, or occurring from accident, or by suicide. In cases of hanging, death seldom results from pure asphyxia, but is usually in some degree owing to apoplexy and injury to the spinal cord. In attempted suicide, bleeding from the jugular vein and artificial respiration may be tried for resuscitation. In difficulty of inducing artificial respiration, laryngotomy and tracheotomy should be performed, and the lungs inflated through the opening in the neck. In judicial hanging, the noose ought to be so adjusted as to produce immediate dislocation of the spinal column, death in that case being instantaneous. In New York State electrocution as capital punishment is substituted for death by hanging, and it has to some extent been tried in other States. (See ELECTRICITY, CAUSE OF DEATH BY.) In several American States infliction of the death penalty is forbidden by law. Hanging, drawing, and quartering were once the punishment of treason in England. See CAPITAL PUNISHMENT.

Hanging Rock, Battle of, fought 6 Aug. 1780. It occurred on Hanging Rock Creek, S. C., between Col. Sumter's Americans, some 800 in number, and about as many Loyalists commanded by Maj. Carden. After driving back the Loyalists, the Americans, becoming disorganized while plundering the enemy's camp, were in turn put to flight. The American loss is unknown; that of the Loyalists, in killed, wounded, and missing, is recorded as 209. Consult Lossing, 'Field-Book of the American Revolution.'

Hankow, hän-kow' ("Mouth of the Han"), China, a town and river-port in the province of Hu-peh, at the junction of the Han with the Yang-tse-kiang, 688 miles above the mouth of the Yang-tse, which is navigable for large vessels up to the town. On the opposite bank of the Han is Hanyang, on the other side of the Yang-tse is Wuchang, the three together forming one immense city. In addition there is a large floating population, the Han being densely crowded with junks for about half a mile above its mouth. In 1857 the city was almost totally destroyed by the Taipings. The port was opened to foreign trade by the Treaty of Tientsin, ratified in 1860; and soon became the chief emporium for the tea trade of the central provinces. A concession of about 90 acres of land apart from Chinese jurisdiction is laid out like an English town. The residents of the British concession are formed into a municipality, with a council empowered to levy taxes. There are also German, French, and Russian settlements. The foreign trade of this port is one of the most important in China. The imports are brought almost exclusively from Chinese ports (about one half from Shanghai), and consist partly of foreign produce, such as cottons, woollens, and opium; partly of native produce, such as tea, silk, cotton, etc. Pop. about 850,000.

Han'na, Marcus Alonzo, American politician: b. New Lisbon, O., 24 Sept. 1837; d. 15 Feb. 1904. In 1852 his family moved to Cleveland, where he was educated in the public schools and he also took a year's course of study in Western Reserve University. He left college to enter the grocery trade with his father, and later had entire control of the business. In 1867 he became a partner with his father-in-law in the firm of Rhodes & Co., engaged in handling coal and iron; he soon mastered the details of the business, greatly extended the work of his firm, and was the first to build steel steamships for the lake trade. In 1877 he became the controlling partner of the firm, the name of which was changed to M. A. Hanna & Co., and acquired large interests in lake navigation. He also was for a time manager of a theatre, and president of the Union National Bank of Cleveland, and of the Cleveland City Railway Co. In 1880 he organized a business men's political club, and from that time was active in politics. In 1884 he was sent as a delegate to the Republican National Convention, and in the next convention (1888) was John Sherman's political manager. He first gained a national reputation, when he obtained the nomination of McKinley for President at the Convention of 1896, and as chairman of the Republican national committee, conducted the Presidential campaign, which resulted in a large plurality for McKinley. In this campaign he adopted the methods which had made him successful in business, studying the situation and its needs, and carefully attending to details. In 1897 he was appointed United States Senator to succeed Sherman, who resigned before the completion of his term of six years. In 1898 he was elected to a full term, and in 1904 re-elected, but died before taking his seat. In 1900 he again conducted the Presidential campaign. As a large employer of labor, Senator Hanna had a number of questions to settle with his own employees, and as a rule won their respect and confidence by his fairness and willingness to listen to their claims. He was a firm believer in arbitration between labor and capital, and was active in the organization, in 1901, of the National Civic Federation, a non-partisan organization formed to consider such topics as trusts, tariffs, taxation, etc., becoming its president, and a member of a permanent committee appointed to consider and settle labor disputes.

Han'nay, James, Canadian historian and journalist: b. Richibucto, N. B., 22 April 1842. After many years of editorial work upon influential Canadian journals, he was chief editorial writer on the Brooklyn, N. Y., *Daily Eagle* (1885–7), and editor of the St. John, N. B., *Daily Gazette* (1888–92), and St. John *Daily Telegraph* (1892–1900). Since 1902 he has been official reporter of the New Brunswick Provincial Parliament. Besides reports of the New Brunswick Supreme Court, he has published 'Nine Years a Captive' (1875); 'History of Acadia' (1879); 'The History of the Loyalists' (1893); 'The Story of the Queen's Rangers in the American Revolution' (1883); 'Life and Times of Sir Leonard Tilley' (q.v.) (1897); 'The History of the War of 1812'; 'New Brunswick: its Resources and Advantages' (1902).

Han'nibal, Carthaginian soldier: b. 247 B.C.; d. probably 183 B.C. He was the son of Hamilcar Barca (q.v.) and at the age of nine his father made him swear at the altar eternal hatred to the Romans. He was a witness of his father's achievements in Spain; but Hamilcar having fallen in battle in Lusitania, in 228 B.C., and his son-in-law Hasdrubal having been appointed to succeed him, Hannibal returned home. At 22 he returned to the army at the request of Hasdrubal. The soldiers perceived in him the spirit of Hamilcar, and in three campaigns his talents and his courage were so conspicuous that the army, on the murder of Hasdrubal in 221, conferred on him the chief command by acclamation. In 219 B.C. he laid siege to Saguntum, a town which had concluded an alliance with Rome. In eight months Saguntum fell. The Romans, alarmed by this, sent ambassadors to Carthage to demand that Hannibal should be delivered up. The demand being refused, they declared war. Hannibal raised a powerful force, and conceived the design of attacking the Romans in Italy. After providing for the security of Africa, and having left his brother Hasdrubal with an army in Spain, he began his march with 90,000 foot-soldiers, forty elephants, and 12,000 horsemen, traversed Gaul in the depth of winter with incredible rapidity, and reached the foot of the Alps. In nine days he crossed these mountains, probably by the pass leading over the Little St. Bernard. The conquest of the Taurinians and the capture of their chief city encouraged the people of Cisalpine Gaul to join him. These auxiliaries would have been still more numerous had not Publius Scipio approached at the head of a Roman army, which had landed at Pisa. On the banks of the Ticinus the armies engaged, and a charge of the Numidian horse left Hannibal master of the field (218 B.C.) Scipio avoided a second battle, and retreated beyond the Trebia, leaving the strong town of Clastidium in the enemy's hands. Meanwhile Sempronius arrived with a second army, but Hannibal soon provoked his impetuous adversary to an engagement, disposed an ambuscade near the Trebia, and surrounded and destroyed the Roman forces. The Romans lost their camp and 26,000 men. Hannibal now retired to winter quarters among his allies in Cisalpine Gaul; and at the opening of the next campaign (217) found two new armies awaiting his approach in the passes of the Apennines. He determined to engage them separately, and destroy Flaminius before the arrival of his colleague. He deceived him, therefore, by feigned marches, crossed the Apennines, and traversed the Clusian marsh. He then employed every means to compel Flaminius to a battle. He wasted the whole country; feigned a march to Rome; but suddenly formed an ambush in a narrow pass surrounded by almost inaccessible rocks. Flaminius, who followed him, was immediately attacked. A bloody engagement took place near the Lake Trasimenus. Assailed on every side, the Roman legions were cut in pieces. Hannibal now armed his soldiers in the Roman manner, and marched into Apulia, spreading terror wherever he approached. Rome, in consternation, entrusted her safety to Fabius Maximus, the dictator, who determined to exhaust by delay the strength of the Carthaginians. He attacked Hannibal with his own weapons, and hung upon him everywhere without attempting to overtake him, convinced that the Carthaginians could not long hold a desolated territory. Hannibal marched into the plains of Capua, with the design of separating the terrified cities from their alliance with the Romans, and drawing down Fabius from the mountains. But suddenly he found himself in the same toils in which Flaminius had perished. Shut up between the rocks of Formiæ, the sands of Liternum, and impassable marshes, he was indebted for his safety to a stratagem. Having collected a thousand oxen, and fastened burning torches to their horns, he drove the animals at midnight into the defiles guarded by the Romans. Panic-struck at the terrible sight, the Romans abandoned the heights, and Hannibal forced his way through their ranks. Minutius Felix, master of the horse, was then made colleague of Fabius in the dictatorship. Eager for combat, he fell into an ambush at Geronium, and would have perished but for the aid of Fabius. After this campaign the other Roman generals seemed unwilling to trust anything to chance, and imitated the delay of Fabius. Hannibal saw his army slowly wasting away, when the new consul Terentius Varro, an inexperienced and presumptuous man, took the command of the legions. Hannibal had occupied Cannæ, and reduced the Romans to the necessity of risking an engagement (216), Æmilius Paulus, the colleague of Varro, wished to put off the battle, but Varro chose the day of his command, and directed the attack. The Roman army was destroyed, and Hannibal now marched to Capua, which immediately opened its gates. In 215 Hannibal sustained, at the hands of Marcellus, a repulse before Nola — the first check which he had received in the open field — but in 212 B.C. made an important acquisition in the capture of Tarentum. Capua, however, was invested by two consular armies, and was on the point of surrendering. Hannibal marched to Rome, and encamped in sight of the capitol, 211 B.C.; but the Romans were not thus to be discouraged; Capua fell. This success gave the Romans a decided superiority, and nearly all the people of Italy declared in their favor. Held in check by the consul, Claudius Nero, Hannibal could not effect a union with his brother Hasdrubal, who had set out from Spain with reinforcements, but after having passed the Apennines was attacked and defeated by Nero on the Metaurus in 207. Hasdrubal himself fell, and his bloody head was thrown into the camp of Hannibal. The latter then retired to Bruttium, where, surrounded with difficulties, he yet maintained the contest with inferior forces against victorious armies. But Scipio now carried the war into Africa, and Hannibal was recalled to defend his country. He reluctantly embarked his troops, and in 203 left the country which for 16 years he had held in spite of all the efforts of Rome. He landed at Leptis, gained over a part of the Numidians, and encamped at Adrumetum. Scipio took several cities, and reduced the inhabitants to slavery. Pressed by his countrymen to come to a decisive engagement, Hannibal met Scipio at Zama, and was defeated with 20,000 loss. Peace was concluded in 201 B.C. Hannibal, accused by his enemies of stirring up Antiochus the Great to war against the Romans, went to Ephesus, to the court of Antiochus. In the ensuing struggle with Rome, Antiochus was signally defeated, and obliged to conclude a peace, one of the terms of which was that Hannibal should be delivered up. Hannibal, again obliged to flee, went to the court of Prusias, king of Bithynia. Prusias, to whom the senate had sent ambassadors to demand the person of Hannibal, was on the point of complying with the requisition, when Hannibal prevented the disgrace by swallowing poison, which he always carried about in his ring.

Hannibal, Mo., city in Marion County, on the Mississippi River, and on the Missouri, K. & T., the Chicago, B. & Q., the Wabash, and the Saint Louis, K. & N. W. R.R.'s; about 90 miles northwest of St. Louis and 15 miles south of Quincy, Ill. Hannibal was settled in 1819 and incorporated in 1839. It is situated in an agricultural region. The chief manufactures are foundry and machine-shop products, flour, lumber, cigars, lime, cement, stoves, car-wheels, shoes, and furniture. It is an important trade centre, as it has the advantages of several railroads and steamboat connection with the cities and towns on the Mississippi. A steel bridge for railroad cars and wagons crosses the river from Hannibal to East Hannibal, Ill. The trade is principally in tobacco, lumber, flour, potatoes, ready-made clothing, dairy products, and the city manufactures. It has a free circulating library, public and parish high schools, the Douglas colored high school, and a number of fine public buildings. The city charter of 1845, revised in 1873, provides for the annual election, by the people, of a mayor and a certain number of the members of the school board. The officials of the administrative departments are under the control of the mayor. The electric-light plant is owned and controlled by the city. Pop. (1900) 12,780.

Hanno, hăn'ō, or **Anno,** German mediæval prelate: b. not earlier than 1000; d. Siegberg, near Bonn, 1075. The emperor, Henry III., made him his chancellor, and presented him to the archbishopric of Cologne, to which he was consecrated in 1056. After the death of Henry III., Hanno made himself master of the person of Henry III.'s young son Henry IV., and secured for himself the administration of the empire (1062). His energetic government and his holy life, his paternal care for his see, his zealous reformation of monasteries and foundation of churches, gained him the character of a saint. The hymn in his praise is by some thought to have been written soon after his death; by others about 1183. It is one of the most important monuments of the early German national literature. The best version of it is to be found in Müllenhoff and Scherer's 'Denkmäler deutscher Poesie und Prosa' (1864).

Hanotaux, Albert Auguste Gabriel, äl-bâr ō-güst gä-brē-ĕl ä-nō-tō, French politician: b. Beaurevoir, Aisne, 18 Nov. 1853. He chose for himself the profession of the law, took a scientific course in the Ecole des Chartes, and afterward became a teacher in the Ecole des Hautes Etudes. In 1879 he received an appointment in the French foreign office; in 1881 became a member of the cabinet, and was sent to Constantinople as ambassador in 1885. From 1886 to 1889 he was republican deputy; and in May 1894 received a portfolio in the second Dupuy cabinet. He has published: 'Les Villes Retrouvées' (1880); 'Origines de l'Institution des Intendants des Provinces' (1884); 'Henri Martin, Sa Vie, Ses Œuvres, Son Temps' (1885); 'Etudes Historiques sur le XVIe. et le XVIIe. Siècle en France' (1886); 'Histoire du Cardinal de Richelieu' (1893).

Han'over, Germany, the northwesternmost province of Prussia, prior to 1866 an independent kingdom. It borders on the North Sea, and has an area of 14,870 square miles. In the south the Harz mountains attain an altitude of over 3,000 feet; the rest of the country is an alluvial plain with a gentle slope to the sea. The Elbe on the northeast boundary, the Ems, and the Weser, with its tributaries, the Leine and Aller, are the principal rivers. Coal and lignite, rock salt, iron, copper, zinc, silver, and gold, are found in the mountainous districts, and there are large peat beds in the north. Over one fourth of the area is arable land, producing large quantities of grain and flax. The keeping of bees is generally practised on the moors, and a breed of superior cattle is raised along the marshy coast land. Forests of hardwood and pine, extensively used in smelting, occupy one sixth of the surface. The manufactures are extensive, and include iron goods, machinery, woolens, linens, cottons, leather, paper, beet-root sugar, beer, spirits, and numerous domestic commodities. Hanover has over 1,500 miles of railroads, numerous canals, and an extensive traffic is carried on at its several ports, among which are Geestemünde, Emden, and Harburg, although practically its chief port is the free city and port of Bremen (q.v.). The capital is Hanover (q.v.). For administrative purposes, the province is divided into the six districts of Hanover, Hildesheim, Lüneburg, Stade, Osnabrück and Aurich. The highest court is in Celle. The province sends 36 members to the Prussian Chamber of Deputies, 10 to the Upper House, and 19 to the German Reichstag. Education is compulsory and free: chief of the higher institutions of learning is Göttingen University. The majority of the inhabitants are Lutheran Protestants. Roman Catholics inhabiting Hildesheim and Osnabrück constitute about one seventh of the population. Hanover was long connected with the Brunswick family, a scion of which, Ernest Augustus, in 1692, became the first Elector of Hanover. He married the daughter of the Elector Palatine, granddaughter of James I., and niece of Charles I. of England. He was succeeded in 1698 by his son George Louis, who in accordance with the Act of Settlement (q.v.), became George I., king of England, at the death of Queen Anne in 1714. The connection with England continued during four reigns, and in 1814 the Congress of Vienna raised Hanover to the rank of a kingdom, George IV. and William IV. thus being kings of Great Britain and of Hanover. On the accession of Queen Victoria, however, by the Salic law, the Hanoverian crown passed to the nearest male heir, Ernest Augustus, Duke of Cumberland, and at his death in 1851 to his son George V. In 1866 Hanover sided with Austria in the Austro-Prussian contest; the capital was occupied by Prussian troops; the king lost his throne, his estates were sequestrated, and Hanover was annexed to the Prussian dominions. Pop (1900) 2,590,336.

Hanover, Mass. (1) Village in the town of Hanover in Plymouth County; on a branch of the New York, N. H. & H. railroad; about

10 miles east by north from Brockton and 25 miles southeast of Boston. It is the seat of Hanover Academy. It is situated in an agricultural region, and the chief industries are connected with agricultural products. Its chief manufactures are tacks and nails. (2) The town of Hanover contains several villages, and the chief manufactures are shoes, nails, tacks, and dairy products. Pop. of the village is about 420; of the town 2,200.

Hanover, N. H., town in Grafton County; on the Connecticut River, and on the Boston & M. railroad, about 72 miles northwest of Concord. It is situated in an agricultural region and its industries are connected chiefly with farm products and lumbering. It is a summer resort, but is known principally as a college town, being the seat of Dartmouth College (q.v.). It contains also the Mary Hitchcock Memorial Hospital. Pop. (1900) 1,884.

Hanover, Pa., borough in York County; on the Western Maryland and the Pennsylvania R.R.'s; about 32 miles south of Harrisburg. It was settled about 1729 and incorporated in 1813. It is in a rich agricultural section of the State, and nearby are iron-ore mines. The chief manufactures are shoes, machine-shop products, cigars, carriages and wagons, gloves, and leather. Hanover is the commercial centre of a considerable part of York County; the trade is largely in agricultural and dairy products, the manufactures of the borough, and in live stock. The government is vested in a burgess and borough council. Pop. (1890) 3,746; (1900) 5,302.

Hanover, Prussia, the capital of a province, and formerly of the kingdom of Hanover, in an extensive plain northeast of and dominated by Mount Linden, at the confluence of the Ihme with the Leine, 44 miles by rail west by north of Brunswick. It consists of an old town, intersected by the Leine, and of various modern suburbs. The old town is unattractive, but the new quarters are regular and well built. The principal features are the Markt church, of antique appearance; the Kreuz church; Schloss church, a handsome structure, with an altar-piece by Cranach, and some curious relics collected by Henry the Lion; several handsome modern churches; the palace (1636–40, rebuilt since 1817), now a royal Prussian residence; the former palace of King Ernest Augustus (in government occupancy); the royal library; the museum of art and science; the restored town-house (1439–55); the new town-house (formerly palace of George V.); the Kestner museum of antiquities; the provincial assembly house; the Franco-German war monument; the Waterloo monument; various schools, among which is the technical high-school, a remodeled building of great extent, formerly the Welfenschloss (palace of the Guelfs), and the Schloss-Herrenhausen, formerly a royal residence. Trade and industries are important, the latter including railway works, machinery, iron castings, cotton, linen, tobacco, lacquered wares, lamps, glass, chemicals, etc.; breweries and distilleries. The city has electric street railroads.

Hanover is first mentioned in 1163. It joined the Hanseatic League in 1481, and received the Reformation in 1533. It became the residence of the Dukes of Brunswick-Lüneburg, and the capital of the principality in 1636. In 1866 the kingdom was absorbed by Prussia, and since 1890 the city has held the position of a royal residence and capital. Sir William Herschel, the two Schlegels, and Iffland were born here. Pop. (1900) 235,649, with suburbs, 302,054.

Hanover, Pa., Cavalry Action at. During the Gettysburg campaign Gen. Stuart, commanding the Confederate cavalry, was ordered by Gen. Lee to observe the movements of the Army of the Potomac and harass its rear should it attempt to follow the Confederate army and pass into Maryland. Leaving two brigades south of the Potomac, to guard the passes of the Blue Ridge, Stuart, with the rest of his command, crossed the Potomac at Seneca Creek, 20 miles north of Washington, on the night of 27 June 1863 and, learning that Hooker had crossed the river, marched north by way of Rockville, captured a train of 125 wagons and 400 prisoners between Rockville and Washington, struck the Baltimore & Ohio Railroad at Sykesville and Hood's Mills, and, ascertaining that the Union army was marching from Frederick northward, endeavored to get ahead of it, reaching Westminster at 5 P.M. of the 29th, where he struck a squadron of the First Delaware cavalry, which offered a stubborn resistance, but was finally dispersed, and Stuart, continuing his march, bivouacked at Union Mills, about midway between Westminster and Littlestown. Hearing that Union cavalry was at Littlestown, and that Early was on the Susquehanna, he marched by crossroads for Hanover, on the morning of the 30th and, at 10 o'clock, his head of column reached that place, 16 miles east of Gettysburg, and attacked the rear and flank of Kilpatrick's cavalry division, as it was passing through the town from Frederick and Littlestown, in advance of Meade's central column. His first attack threw the rear of Farnsworth's brigade into confusion, but Farnsworth rallied his men, Custer's brigade was recalled and thrown into action and, after two hours' fighting in and around the town, Stuart was driven back on the Littlestown road, having lost nearly 100 men. Kilpatrick reports his own loss as 59 killed and wounded, and 123 missing.

Stuart was now in a perilous position; he had thrust himself unwittingly between Kilpatrick's cavalry and Meade's main body; Gregg's cavalry division was moving north or his right, but he extricated himself by marching all night over a circuitous route through Jefferson to join Early at York. The latter, however, was on his way to Gettysburg, and Stuart passed almost within sight of him, without knowing it. Finding that Early was not at York, Stuart continued his march to Carlisle, hoping to find Lee's main body there, but found the place occupied by Union troops, and heard that Lee was concentrating at Gettysburg, where by marching night and day, he joined him in the afternoon of 2 July. See GETTYSBURG, CAMPAIGN AND BATTLE OF. E. A. CARMAN.

Hanover College, at Hanover, Ind.; founded in 1828, under the auspices of the Presbyterian Church, as Hanover Academy. It was chartered as a college in 1833. Women have been admitted since 1880. The regular departments are letters, arts, science, law, philosophy, and divinity; also a course for teachers. No charges are made for tuition. In 1903 the college reported 14 instructors, 160 students, and about 17,000 volumes in the library. The endowment fund is over $200,000, and the annual income is about $15,000.

Hanover Court House, Engagement Near. On 21 May 1862 Gen. McClellan had marched the Army of the Potomac up the York peninsula to the banks of the Chickahominy, 7 to 12 miles distant from Richmond. On the 26th he heard that R. H. Anderson's Confederate brigade and Stuart's cavalry were near Fredericksburg, and that another body, Branch's brigade, was in the vicinity of Hanover Court House, 17 miles north of Richmond, to his right and rear. These bodies threatened his communications, and were in position to reinforce Jackson, in the Shenandoah valley, or to oppose McDowell, whose advance was then eight miles south of Fredericksburg. Gen. Fitz-John Porter was ordered to clear the enemy from these positions and destroy the bridges over the South Anna and Pamunkey rivers. Warren's small brigade had been already detailed to destroy the bridges, had destroyed all means of communication over the Pamunkey as far as Hanover Court House, and was then posted at Old Church. On the morning of the 27th Warren moved toward the court house, on a road running parallel to the Pamunkey. Porter left New Bridge at 7 A.M. with Morell's division and Emory's cavalry brigade and, marching by way of Mechanicsville northward toward the court-house, about noon his cavalry and the Twenty-fifth New York infantry, encountered a portion of Branch's brigade, supporting two pieces of artillery, attempting to hold the road leading to the court-house. A Union battery was brought up and Butterfield's brigade deployed, which charged and drove the Confederates from the field, capturing one gun. A part of the Twenty-fifth New York was captured by the Confederates. Supposing that the Confederates had all retreated in the direction of Hanover Court House, Porter pursued, the cavalry, under Emory, and the Seventeenth New York, overtaking and capturing a large number of the Twenty-eighth North Carolina. Upon nearing the junction of the Ashland and the Court House roads, a part of Martindale's brigade was sent toward Ashland to guard that flank against an approach from Richmond and to destroy the railroad running to that city. Near Peake's station Martindale ran into Branch's brigade, was immediately attacked, and was driven back some distance. When Porter, whose advance had reached Hanover Court House, heard that Martindale had been attacked, he faced about his entire column, reached Martindale, struck Branch on his left and rear, and routed him. Branch retreated to Ashland and formed a junction with Anderson's brigade, which had fallen back from McDowell's front. After destroying the railroad in several places and opening the way for McDowell's advance from Fredericksburg, Porter returned to his old camps on the night of the 29th. The Union loss in the engagement of the 27th, was 62 killed, 223 wounded, and 70 missing. The Confederate loss was 73 killed, 102 wounded, and 730 prisoners, of whom about 150 were also wounded. Consult: 'Official Records,' Vol XI.; Webb, 'The Peninsula'; 'McClellan's Own Story'; Allan, 'The Army of Northern Virginia'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. II.

E. A. CARMAN.

Hanover, Treaty of, an alliance between England, France, and Prussia, made in September 1725, for the purpose of mutual assistance, in opposition to that between Austria and Spain.

Hansa, or **Hanse.** See HANSEATIC LEAGUE.

Hanseatic (hăn-sē-at'ĭk) **League, Hansa,** or **Hanse,** a confederacy of certain cities of northern Germany for mutual protection, especially in matters of commerce; for the extension of trade, and of rights and immunities received from sovereigns, and which had suffered curtailment. The union was formed in the 13th century, at a time when sea and land swarmed with pirates and robbers, and German trade, no longer guarded by the privileges of armed attendants, was exposed to many dangers, while government had degenerated into a power for extorting taxes without giving protection.

The first alliances known to have been concluded are those between Hamburg and Lübeck (1241 and 1255) to keep open the road across Holstein connecting the North Sea with the Baltic, and between Lübeck, Rostock, and Weimar in 1259 for defending themselves against the pirates. About the same time a similar league was concluded between the Westphalian towns, Münster, Dortmund, Soest, and Lippstadt. When a wider union came to be formed for like purposes, the name of *Hansa*, signifying a league, which was at first applied to any such confederacy, survived exclusively as the name of that influential league. During its most flourishing period it embraced 90 towns, scattered over the whole length and breadth of Germany, including Holland. Its organization was very loose, the towns of which it was made up being at first divided into three and, after the 16th century, into four provinces, each with a chief town. These divisions had, however, little more than a geographical significance. The town of Lübeck, which already held an important rank, from the fact that it was the highest court of appeal for all those towns which were governed by the Lübeck law, was recognized as the chief town of the league. Here assembled the deputies of the other Hanse towns to deliberate on the affairs of the confederacy; the decrees of the diet had no effect unless they received the sanction of the separate towns.

In the 14th century the league everywhere attained a high political importance, and gave rise to the development of that commercial policy which has since become intimately connected with all political relations, but of which the sovereigns of that time had little idea. Kings and princes were, in reality, more dependent on the league than it was on them. The extensive carrying trade of the Hanseatic League was a great source of wealth and at length there was no mart in Europe which was not gradually drawn within the circle of its influence. England, Denmark, and Flanders concluded treaties with the league for the extension of their commerce. It undertook to provide for the security of commerce on the Baltic and North seas. In the country under its immediate influence it constructed canals, and introduced a uniform system of weights and measures.

But the prosperity of the Hanse towns was naturally dependent on the continuance of the circumstances which gave rise to it, and when circumstances changed, the league was destined to decline. When the routes by land and sea were no longer insecure; when princes learned the advantages of trade to their own states, and turned their attention to the formation of a naval force of their own, and the encouragement of navigation; when the inland members of the confederation perceived that the great seaport towns had a separate interest of their own, and used them principally to promote their own ends; then the dissolution of the Hanseatic League was evidently approaching. There remained at last as active members of it only Hamburg, Lüneburg, Lübeck, and the towns in the neighborhood (Wismar, Rostock, Greifswald, Stralsund, whose interests were identified with those of Lübeck. The league existed no longer as a political power, but merely as a loose association of towns for commercial purposes.

In England, during the reign of Queen Elizabeth, the league lost its privileges by its refusal to grant complete reciprocity. About 1614 there remained only 14 towns which contributed to the support of the league, and had a voice in the management of its affairs. These were: Lübeck, Wismar, Rostock, Stralsund, Greifswald, Stettin, Danzig, Magdeburg, Brunswick, Hildesheim, Lüneburg, Hamburg, Bremen, and Cologne. The Thirty Years' war, which destroyed the prosperity of the German towns generally, gave the death-blow to the league. At the diet of 1629 it was entrusted to the cities of Lübeck, Bremen, and Hamburg to consult for its general interests, and in 1630 these towns concluded among themselves a closer union, which was renewed in 1641. After the Peace of Westphalia (1648) repeated but vain attempts were made to bring the league together again, and a last diet was held in 1669. Hamburg, Lübeck, and Bremen still retain their independence, and now form separate constituents of the German empire.

Hansen, hän'sĕn, **Gerhard Henrik Armauer,** Norwegian physician: b. Bergen, Norway, 1841. He was educated during boyhood in the cathedral schools of his native city, afterward entered upon the study of medicine, and was eventually appointed resident physician in the Rigs Hospital of Christiania. He was afterward government medical officer for the Lofoten fisheries, but did not reach the field of his fame until he was appointed in 1868 to the post of assistant physician at the Bergen Leper Hospital. From this time forth he devoted himself to the study of leprosy, and following the lines laid down by Virchow, traveled from one to another university of Europe, continuing his investigations. On his return to Norway the Medical Society of Christiania voted a sum of money to pay the expenses of his further researches. He at last was enabled to demonstrate the fact that leprosy was contagious. Continuing his investigations he discovered at last the leprosy bacillus in unstained preparations. Later it was stained and became known as Hansen's bacillus (1873). He was not successful in employing the bacillus for purposes of inoculation with a preventive object; but on the basis of his contagion theory, legislation has been enabled to check to a considerable extent the spread of the disease.

Hansom, or Hansom Cab. See CARRIAGE.

Han'son, Alexander Coutee, American journalist and politician: b. Maryland 1786; d. 1819. After being graduated at St. John's College, Annapolis, he adopted journalism as a profession, and in 1812 his office was wrecked by a mob on account of an article attacking the Madison Administration which appeared in the 'Federal Republican,' of which he was editor. He was elected to the lower house of Congress in 1813, and from 1817 until his death had a seat in the Senate.

Hanus, Paul Henry, American educator: b. Hermsdorf-unter-dem-Kynast, Prussia, 14 March 1855. He came to the United States in childhood, was educated at the University of Michigan and has been professor of the history and art of teaching at Harvard from 1891. He has published 'Elements of Determinants' (1886); 'Geometry in the Public School' (1893); 'Contemporary Educational Problems' (1899).

Hap'good, Isabella Florence, American author and translator: b. Boston, Mass., 21 Nov. 1851. She has written 'The Epic Songs of Russia'; 'Russian Rambles,' etc., and is widely known by her translations from the Russian of Tolstoy, Gogol, etc., and she has also made important translations from the French and Spanish.

Hapgood, Norman, American journalist: b. Chicago 28 March 1868. He was graduated from Harvard in 1890, and the Harvard Law School in 1893, and has since become well known as a keen, discriminating essayist and dramatic critic. He has published 'Literary Statesmen and Others' (1897); 'Daniel Webster' (1899); 'Abraham Lincoln' (1899); 'The Stage in America' (1901).

Hapsburg, hăps'bėrg (Ger. häps'boorg) (properly HABSBURG), the imperial house of Austria-Hungary, so named from the ancestral castle, in the canton of Aargau, Switzerland, on the right bank of the Aar. The castle was built in the 11th century by Bishop Werner, a descendant of Ethico I., a count of Alemannia, in the 7th century. It stands on the Wüpelsberg, a steep rocky situation, whence the name *Habichtsburg* (Hawk's Castle). The proprietors of Hapsburg became at a later period counts of Hapsburg and gradually extended their territories. Werner II., who died in 1096, is said to have been the first to assume the title. After the death, about 1232, of Rudolph II., the fourth in succession from Werner II., the family divided into two branches, the founder of one of which was Albert IV., and that of the other Rudolph III. The latter is known as the Hapsburg-Lauffenburg line, which became extinct in the direct male line in 1408. A younger son of Rudolph, called Eberhard, founded the Kyburg branch of the Hapsburg-Lauffenburg line, which did not become extinct till 1415, and Godfrey, a grandson of Rudolph, who settled in England in the 13th century, there became the founder of the Fielding family, to which the Earls of Denbigh belong, and of which the novelist Fielding was a member. The line descended from Albert IV. is that to which the historical celebrity of the house is almost entirely due. In 1273 Rudolph, the son of Albert IV., was chosen emperor of Germany or Holy Roman Emperor. He is the founder of the reigning house of Austria, which is of the line of Hapsburg-Lorraine. From Rudolph to Charles VI. the Austrian monarchs were of the Hapsburg male line. Maria Theresa, who succeeded Charles VI., married Francis Stephen of Lorraine, who in 1745 was chosen Emperor of Germany. Francis II., the third emperor of Germany of the line of Hapsburg-Lorraine, was the last who bore that title till the establishment of the new empire, the last of the so-called "Holy Roman Emperors." He changed it in 1806 for that of Emperor of Austria, and the present imperial house of Austria continues to represent that line. From the Emperor Rudolph was also descended a Spanish dynasty which began with the Emperor Charles V. (Charles I. of Spain), and terminated with Charles II. in 1700.

Haraforas, or **Alfures**, names applied in Celebes, the Moluccas, Mindinao, and the adjacent islands to certain native tribes, particularly of the interior, which differ from the Malays, and have been thought to be perhaps pre-Malayan aborigines.

Hara-kiri, hăr'a-kĭr'ē, or **Seppuku**, a mode of inflicting death upon themselves allowed in Japan to criminals of the Samurai or two-sworded class as more honorable than public execution. It consists in cutting open the body so as to disembowel it, by means of a wound made with one sword perpendicularly down the front and another with the other sword horizontally. Till recent times Japanese of the two-sworded class who had been guilty of any crime frequently resorted to this mode of killing themselves before their guilt had been proved, and it was regarded as honorable in them to do so, indicating a strong sense of shame. Sometimes they were commanded to put themselves to death in this manner. Consult: Mitford, 'Tales of Old Japan' (3d ed. 1876); and Chamberlain, 'Things Japanese' (1891).

Harald. See HAROLD.

Haran (Assyrian *Kharranu*, road), the name of a district of northern Mesopotamia and of a town situated therein, on the stream called Jullab, southeast of Edessa. The name is probably derived from the fact that at this town the trade-routes from Media, Assyria, and Babylonia met to proceed along the same highway to the coast of Cilicia. Haran is mentioned in the Old Testament in Gen. xi. 31–32, and Ezekiel xxvii. 23. To the Assyrians it was a strategic post of great importance. In the inscriptions references to it appear as early as the reign of Tiglath-pileser I. (about 1100 B.C.). An extensive commerce centred here. To the Greeks and Romans it was known as Carræ (Gk. κάρραι or Χάρα). Crassus, the Roman commander, was here defeated and slain by the Parthians during his eastern expedition (53 B.C.), and Caracalla assassinated by the soldiery of Macrinus (217 A.D.). It was of importance even in the time of Arab supremacy, but the geographer and historian Abulfeda (d. 1331) speaks of it as in ruins in his day. It was the seat of an episcopal see in the 4th century. Consult Metz, 'Geschichte der Stadt Harran' (1892).

Harar, or **Adari**, a Semitic dialect spoken in the Abyssinian province of Harar (q.v.). It includes some Hamitic words. For an account of it, consult an article by Pratorius in the 'Zeitschrift der Deutschen Morgenländischen Gesellschaft,' Vol. XXIII. (1869).

Harar, **Harrar**, or **Adari**, capital of the province of Harrar in eastern Abyssinia, south of the Gulf of Aden, about 180 miles from the coast. It is situated at an elevation of 5,500 feet above the level of the sea. The surrounding district is very fertile and produces chiefly coffee. Cotton is also a large crop, and excellent in quality. There is a brisk trade in gums, ivory, and fruits. Harar was formerly the capital of a small, independent country, ruled by an emir. In 1876 it became a dependency of Egypt, and later was under Italian protectorate. After the Italian defeat at Adowa in 1896, it passed with the province to Abyssinia. Its first European visitor was Sir Richard F. Burton, who obtained admission there as an Arab in 1855, and described it in his 'First Footsteps in East Africa, or An Exploration of Harar' (1856). Pop. (1900) 40,000. Consult further the 'Bulletin de l'Etat Major-Général de l'Armeé Egyptienne' (1876), and Paulitschke, 'Harar, Forschungsreise nach den Somal- und Galläländern' (1888).

Harar, **Harrari**, or **Harrur**, the most easterly of the Abyssinian provinces; bounded on the east and north by British and French Somaliland, and on the south and southeast by British East Africa and Italian Somaliland. The country is a table-land, with a maximum elevation of nearly 11,000 feet. Previous to the insurrection of the Mad Mullah (q.v.) it was a part of the Egyptian Sudan. It was captured by Italy in 1891, but after the severe defeat of the Italian forces by the Abyssinians at Adowa 1 March 1896 it passed to Abyssinia. The foreign trade of Abyssinia is conducted largely through Harar.

Haraucourt, **Edmond**, French poet and novelist: b. Bourmont (Haute-Marne) 1857. His first work appeared in 1883 and was entitled 'La légende des sexes, poëms hystériques.' A collection of his verses was published in 1891. He also published 'Amis' (1887); 'Shylock' (1889); 'Don Juan' (1894); 'Elizabeth' (1894). He was awarded the Academy prize for his poem 'Les Vikings' (1890).

Harbaugh, **Henry**, American clergyman of the German Reformed Church in America: b. near Waynesborough, Pa., 24 Oct. 1817; d. Mercersburg, Pa., 28 Dec. 1867. He studied at Franklin and Marshall College (Mercersburg) and at the Mercersburg Seminary, was ordained in 1843, and in 1843–64 held pastorates successively at Lewisburg, Lancaster, and Lebanon, Pa. In 1864 he was appointed professor of theology in the Mercersburg Seminary. He was one of the leading exponents of the "Mercersburg theology" (q.v.), and belonged to the high-church school of his denomination. From 1850 to 1866 he was editor of the 'Guardian,' and in 1866–7 of the Mercersburg 'Review.' Besides a collection of poems in the "Pennsylvania Dutch" dialect, he published: 'Heaven' (1843–53); a 'Life of Michael Schlatter' (1857); 'Christological Theology' (1864), and other works.

Harben, William Nathaniel, American novelist: b. Dalton, Ga., 5 July 1858. He has contributed many short stories to magazines, and his published novels include: 'White Marie' (1891); 'Almost Persuaded' (1890); 'A Mute Confessor' (1891); 'The Land of the Changing Sun' (1894); 'From Clue to Climax' (1896); 'The Caruthers Affair' (1898); 'The North Walk Mystery' (1899); 'The Woman Who Trusted' (1901); 'Westerfelt' (1901); 'Abner Daniel' (1902); 'The Substitute' (1903). He is also the author of 'Northern Georgia Sketches' (1900).

Harbin, Manchuria, a city on the Sungari River at the point where the Manchurian branch of the Trans-Siberian railway crosses that stream. The Chinese eastern branch of the railway, running to Dalny (Talienwan) (q.v.) and Port Arthur (q.v.) begins here. Prior to the Russian occupation in 1900 (see MANCHURIA), Harbin was a small Chinese village. On account of its geographical and strategical position it was chosen as a military centre, and very quickly it became also headquarters for railway and governmental affairs. Commerce and manufacture have also greatly developed, although not originally considered in the promotion of Harbin; and here more than elsewhere Russia gradually asserted its intention of becoming an active industrial force in the Orient. Every system of protection that could be devised has been employed by the government to advance its commercial prestige. Harbin consists of the old town, three miles distant from the central dépôt; Prestin, the river town, the present commercial portion; and the administration town, about the railway. Only Russians and Chinese are allowed to hold land, construct buildings, or enter any permanent enterprise. The territory for many miles surrounding has been secured so as to make it impossible for any foreign interest or influence to obtain a foothold or profit near to the city. The principal railway engineer is the chief administrative official. A census of 1903 showed a population of 60,000 exclusive of soldiery; of these all but 700 were Russians.

Harbor, a recess or inlet of the sea, a lake, or other large body of water, either landlocked or protected from winds and waves by artificial means, so as to be a secure haven for vessels in all weathers. In selecting or constructing a harbor regard is also had to convenience in loading and unloading vessels. The two chief classes are harbors of refuge and commercial harbors. Often the latter are merely tidal, only to be entered by vessels as the tide serves, and where with the tide they rise and fall. Harbors of refuge or shelter are accessible in all conditions of tide. Sometimes there is a combination of the harbor or haven with a capacious protected roadstead outside of it, as at Cherbourg, France, and other places.

Construction.—In the construction of harbors the great desiderata are sufficient depth of water and perfect security for the vessels likely to frequent them, together with the greatest possible facilities for ingress during any weather, while the chief obstacles to be surmounted are the action of the waves upon the protecting piers and breakwaters, and the formation of sand-banks and bars, which diminish the depth of water at the entrance and also within. All good harbors should possess the following characteristics: A deep, broad entrance-channel, which can be kept by ships of all kinds in all sorts of weather; an ample anchorage, free from rocks and shoals, with good holding-ground, and protected from winds and waves. Commercial harbors should also be supplied with adequate constructions and appliances for loading and discharging vessels.

Ground-plan.—In designing the ground plan of harbors, some rules should be kept in view: (1) the entrance should always be kept seawards of the works of masonry, care being taken that the direction of the piers does not throw the sea across the entrance; (2) there should be a good "loose," or point of departure free of rocks or a lee shore; (3) spending-beaches inside should be provided to allow the waves that pass in to break and spend themselves (a harbor-basin surrounded with vertical quay-walls becomes a "boiling pot"), but this is a point frequently overlooked by engineers; (4) the relation of the width of entrance to the area of a harbor should be a matter of careful study, as upon this depends the tranquillity of the interior.

Anchorage.— The anchorage of a harbor should be large enough to afford shelter to the maximum number of vessels seeking it. The space required by a vessel at anchor is, roughly, a circle whose radius is six times the depth of water plus the vessel's length. First-class harbors should have a depth of at least 40 feet, to admit and give secure anchorage to the largest ships now existing. An available depth of 25 feet is sufficient for ordinary transatlantic freight and passenger steamers. Coasting vessels rarely have a draft of more than 20 feet.

Natural Harbors.—Some of the best known natural harbors are those of Queenstown, Ireland; Rio de Janeiro, Brazil; Portland, Me.; Boston, Mass.; Narragansett Bay, R. I.; New York, N. Y.; Old Point Comfort (Norfolk), Va.; Port Royal, S. C.; Havana, Cuba; San Francisco, Cal.; Puget Sound, Wash.; King George's Sound, and Princess Royal Harbor, in southwestern Australia.

Artificial Harbors.—These are as old as naval warfare, and may almost be said to date from the birth of commerce. The Phœnicians protected their little strip of the Levant coast. Tyre and Sidon were well provided with harbors, having effectual breakwaters, mainly built of loose rubble. Carthage, Greece, and Rome, each in its own way, utilized their harbors for commercial and warlike purposes. That of Carthage was artificial, those of Greece but slightly so, nature having provided so many navigable inlets that little remained to be done by man. The great harbors of Rome, constructed in the solid and workmanlike manner of her practical race, may still be studied with profit, for the coasts of Italy yet show how well the Romans understood both the principles and the practice of this branch of marine engineering. One of their finest and most complete constructions of this nature was the port of Ostia, at the mouth of the Tiber, now more than two miles inland. The Romans were distinguished in harbor-making by the open or arched mole or enclosing work, which gave full play to the currents, preventing the deposit of sand or mud. 'The foundations of Nero's port," says Addison, 'are still to be seen. It was altogether artificial, and composed of huge moles running round it, in a kind of circular figure, except where the ships were to enter." Harbor-making came to an end with the decay of commerce and civilization consequent upon the fall of the empire, to be revived by the Italian republics of the Middle Ages. The rich traffic of Venice and Genoa soon led to the construction of suitable ports at those places, and the moles of the latter city and the works in the lagoons of Venice remain to this day. France was next in the field, embanking, protecting, and deepening the mouths of the rivers along her northwestern shores, as at Havre, Dieppe, Dunkirk, etc. In 1627, during the siege of Rochelle, Metezeau constructed jetties of loose rubble-stone, to prevent access to the city.

British Harbors.— Great Britain, whose ocean commerce is of comparatively recent date, lagged far behind her Continental rivals. With few exceptions her ports were absolutely unprotected, or rather uncreated; and this state of things continued until late in the 18th century. Two of the few exceptions were Hartlepool, where a harbor was formed about 1250, and Arbroath in 1394; in the 17th century at Whitby and Scarborough rough piers were thrown out, protecting the mouth of the port; at Yarmouth a north jetty, and subsequently a south one, were formed; an ancient mole existed at Lyme Regis; but the chief efforts of the early English engineers were directed against the shoals and waves of Dover. When, however, John Smeaton (q.v.) rose to vindicate the engineering talent of England, things took a different turn, and now few countries surpass Great Britain in the number of artificially improved commercial harbors. In Great Britain the construction and regulation of harbors is primarily under authority of the crown, but Parliament now usually names commissioners and boards with powers of ownership or management specially conferred by that body. All individual owners are required to manage harbors subject to the rights of public use, while final government control of them is practically absolute.

Harbors in the United States.— In this country all harbor-making in a public sense has been done since the beginning of the 19th century. The date of its first undertaking is 1802, when the project of building public piers in Philadelphia received government aid by an appropriation of $30,000. Twenty years later, for a harbor of refuge in Delaware Bay, $22,700 was appropriated; and in 1826 appropriations aggregating about $150,000 were made for river and harbor improvements at many places. From this time river and harbor bills have steadily increased the Congressional appropriations, which now amount in the aggregate to hundreds of millions.

Federal control over the ports of the United States, including all the important harbors, is exercised under the constitutional power of the government to regulate commerce; but in most of the details of harbor management — such as ownership and use of wharves, docks, warehouses, and the provision and disposal of facilities generally — management is left to the States. Pilot laws, the appointment of harbor-commissioners, harbor-masters, etc., and all other harbor regulations are made and enforced by the States, subject in certain things — as, for example, quarantine rules — to the jurisdiction of the Federal government. Consult: Rennie, 'Harbors'; Stevenson, 'Design and Construction of Harbors'; Moore, 'History of the Foreshore and the Law Relating Thereto'; Harcourt, 'Harbors and Docks'; Birdseye, 'Laws of the State of New York' (Navigation Law and New York Harbor); United States Revised Statutes, Secs. 5244–5255. See BREAKWATER; DOCKS AND DOCK YARDS; JETTIES; LIGHTHOUSES.

Harbor Grace, Newfoundland, a port of entry on Conception Bay, 27 miles west by north of St. John's, 84 miles by rail. It has a large but exposed harbor, with an inner secure port, a patent slip, and a lighthouse with a revolving light. It is the see of a Roman Catholic diocese with a handsome cathedral and convent. Its commerce is second to that of St. John's. Pop. (1901) 5,184.

Harbor Seal, or Hair-seal, the common small seal (*Phoca vitulina*), once common on both sides of the North Atlantic, down to Virginia in the United States, but now only occasionally seen south of Cape Cod. See SEAL.

Harbor Springs, Mich., village, county-seat of Emmet County; on Little Traverse Bay, an arm of Lake Michigan, and on the Grand Rapids & I. R.R. The landlocked harbor is much used by lumber vessels. The village is in a part of the State where the large forests make lumbering the chief industry. The chief manufactures are flour and lumber. The cool climate in summer makes Harbor Springs a favorite resort during July and August. Pop. (1900) 1,643.

Harby, Isaac, American dramatist and journalist: b. Charleston, S. C., 1788; d. New York 14 Nov. 1828. In 1822 he conducted the Charleston *City Gazette* and later the *Mercury*. His plays were 'The Gordian Knot'; 'Alexander Severus'; and 'Alberti.' He was vice-president of the Hebrew Orphan Asylum of Charleston and leader of the reformed movement among the Jews of that city — the first of its kind in the United States. In 1828 he removed to New York and engaged in journalism, until his death the same year.

Harby, Levi Charles, American naval officer: b. Georgetown, S. C., 21 Sept. 1793; d. Galveston, Tex., 3 Dec. 1870. While a midshipman in the United States navy in 1812, he was taken prisoner and confined in Dartmoor Prison, England, until the end of the war. He served under Gen. Jackson in the Creek war, and participated in the Texas struggle for independence and the conflict with Mexico. Subsequently he fought in South America under Bolivar. On the secession of South Carolina, he resigned his commission in the United States service and joined the Confederate forces as commander of the fleet at Sabine Pass.

Harcourt, här'koort, SIR **William George Granville Venables Vernon,** English statesman: b. 14 Oct. 1827; d. Malwood, Hampshire, 1 Oct. 1904. He began his education in a private school at Salisbury, and then studied at Trinity College, Cambridge, whence he was graduated with high honors in 1851, receiving the degree of M.A. He then studied law, being called to the bar in 1854, and in 1866 he became queen's counsel. In 1858 he made an attempt to enter Parliament as an Independent Liberal, but was defeated. During these years he wrote largely for the 'Saturday Review' and other journals, and in 1860 attracted considerable attention by a series of letters on international law and kindred subjects contributed to *The Times* over the signature of "Historicus," and which he continued throughout the American Civil War. In 1868 he entered Parliament as Liberal member for Oxford, serving his constituents at that post till 1880, when he was defeated for re-election. He was, however, selected to represent Derby and continued in that position until 1895, when, having been defeated at the general election, he found a seat in West Monmouthshire. In 1869 he was elected Whewell professor of international law at Cambridge; at the same time he was appointed a member of the royal commissions for amending neutrality laws and for amending the naturalization laws. He was appointed solicitor-general in 1873, but held the office only three months, and in the same year was knighted by the queen. Although he had not supported Mr. Gladstone during his retirement from power, yet upon that statesman's return to the office of prime minister in 1880, he was appointed secretary of state for the home department, continuing in that capacity until the Liberal party went out of power in 1885. At that time his name became famous through his connection with the 'Ground Game Act' (1880), the 'Arms (Ireland) Act' (1881), and the 'Explosives Act' (1883), the last one being pushed through all its stages in the shortest time on record. In 1884, his bill for unifying the municipal administration of London was introduced. Upon the return of the Liberals to power in 1886, he was made chancellor of the exchequer, holding that position only a short time, as the fortunes of politics again took him from office. During the years 1880 to 1892 he was Gladstone's lieutenant in political life, and his services were of immense value, especially on account of his brilliant oratorical powers. Again in 1892 he was made chancellor of the exchequer, acting as such until 1895. It was during this term, in 1894, that he introduced and carried his famous tax budget, in which the income tax became more graduated and the "death duties" on real and personal property were equalized, thereby giving the government much aid in solving their financial problems. Upon Gladstone's retirement in 1894, Harcourt was looked upon as his successor, but his title was ignored and Lord Rosebery appointed in his stead. Sir William then became leader of the Liberals in the House of Commons, and it became evident that he and the new prime minister did not agree as to party policy, and, though their differences were from time to time patched up, it was clear in his defeat at Derby in 1895 that the party was divided on many issues, and the effect was then seen of Sir William's Local Veto Bill, not only in the utter rout of the Liberals, but in the setback given to temperance legislation. From 1895 to 1900 he represented West Monmouthshire in the House of Commons, but the task of leadership of the Liberal party became particularly onerous because of the tendency of the various sections to break away from control. In the session of 1896, against the overwhelming Unionist majority, he scored several successes, but was severely criticised by his own party for concurring in the majority report of the special committee, of which he was a member, appointed in 1897 to investigate the Jamieson Raid and the British South Africa Company. The internal dissensions in the Cabinet became more marked as time went on, and the divided counsels manifest among the leaders of the Liberals led to his decision to retire from the leadership of the party on the floor of the House of Commons, and in 1898 with John Morley he retired from active work and thereafter sat as a private member. As a private member, he no longer restrained his attacks on the government, paying not the least deference to Liberal imperialism. He actively opposed the government's policy with regard to the sinking fund, their attitude in the negotiations with the Transvaal, and the financing of the South African war, and throughout the war he lost no opportunity in criticising the South African developments. In 1898–1900 he became prominent, both on the platform and in his letters to *The Times*, in advocating active measures against ritualistic practices in the Established Church. The general election of 1900 found him full of fight, favoring the official Liberal programme as distinct from that of the imperialistic section which favored the return of Lord Rosebery to the leadership, and when the new Parliament met his attitude signified that his former claims would not be dropped. Sir William had refused twice to enter the peerage, and in a speech delivered at the National Liberal Club on 28 July, after announcing his determination to retire at the close of the session, said: "It is not because I am weary of the fight or am lukewarm in the cause that I intend to retire. It is because I do not think it for the public advantage that persons should attempt to fulfil duties that they are unable to perform." And yet after this announcement he vigorously attacked Joseph Chamberlain, whose weightiest political antagonist he was, for his fiscal proposals, in a lengthy speech, delivered in his familiar Homeric style. It has been written of him: "Sir William Vernon-Harcourt is one of the few public men whose addresses out of Parliament are printed in full by the London journals. His reputation has steadily improved while his party has been in the minority, and his caustic wit, polished satire, and brilliant epigrams have stung and irritated the conservative peers time and again. He has Lord Beaconsfield's trick of giving phrases the stamp of his own originality, so that there is no one on the Liberal side whose speeches are quoted more frequently. It has been aptly said that Sir William's distinguishing characteristic is his cleverness. His platform speeches are not only rattling and rollicking, but are generally brimful of witty and happy phrases. He has a great gift of lucid exposition and on rare occasions, when he condescends to be serious, commands a flexible and sinuous prose." Sir William Harcourt was married in 1859 to Lady Thérèse Lewis, widow of Sir George Cornwall Lewis, and daughter of T. H. Lister, and again in 1876 to Mrs. Elizabeth Ives, widow of J. P. Ives, and daughter of John Lothrop Motley, the historian, and at one time United States minister in London.

Hard Labor, in law, compulsory work, mechanical or other, sometimes judicially imposed upon criminals in addition to imprisonment or other punishment. It is a provision of statute law both in this country and Great Britain. Its first English adoption was secured through the demand for some adequate penalty in cases where penal servitude and transportation were for any reason inexpedient. In the United States the punishment of hard labor (which, however, is generally looked upon by humanitarians and sanitarians as being rather a healthful and merciful privilege) can only be imposed by a court on the authority of statute, the mode of applying the punishment being in some cases prescribed by State or Federal laws, and in others left to prison regulation.

Hardecanute, hār-dē-ka-nūt', **Harthacnut**, or **Hardacnut**, king of England and Denmark: son of Canute: b. about 1019; d. 8 June 1042. At the time of his father's death in 1035 he was in Denmark, where he was immediately recognized as king. His half-brother, Harold, however, who happened to be in England at the time, laid claim to the throne of that part of their father's dominions. For a time the mother of Hardecanute succeeded in holding Wessex in his name, while Mercia and Northumbria were held by Harold, such an allotment having been made by a witenagemote held at Oxford. Hardecanute was about to make an armed descent upon England, when Harold died (1040), and his brother peacefully succeeded him. He reigned till 1042, but his reign was not marked by any important event. He left the government almost entirely in the hands of his mother and the powerful Earl Godwin (q.v.), while he gave himself up to feasts and carousals.

Har'dee, William Joseph, military officer: b. Savannah, Ga., 10 Oct. 1815; d. Wytheville, Va., 6 Nov. 1873. He was graduated at West Point in 1838; served with distinction in the Mexican War; and in the Civil War entered the Confederate army with the rank of colonel. He commanded a corps at Shiloh; and was promoted lieutenant-general in 1862. At Perryville he commanded the left wing of the Confederate army and in December 1864 defended Savannah against General Sherman.

Harden, William, American historian: b. Savannah, Ga., 11 Nov. 1844. He left his studies in the schools of Savannah to join the Confederate army, serving throughout the Civil War in the 54th Georgia infantry and in the signal corps. After the war he studied law and was admitted to the bar in the early 70's. He was assistant librarian of the Georgia Historical Society from 1866 to 1869, when on 5 August he was appointed librarian, a position he still occupies. He has been a member of the board of managers of Telfair Academy of Arts and Sciences since 1882, and custodian since 1884; organizer and secretary of the Georgia Society of the Sons of the Revolution since 1891; and was a Democratic member of the Georgia House of Representatives from 1900–4. He has written much on historical subjects in magazines and journals.

Hardenberg, Georg Friedrich Philipp von, gā-ōrg frēd'riн fē'lēp fōn här'dĕn-bĕrg, "Novalis," German poet: b. Wiedenstadt, Prussia, 2 May 1772; d. Wessenfels, Prussia, 25 March 1801. He made himself well acquainted with law, natural philosophy, mathematics and philosophy, but was most eminent for his poetical talents. In the works of "Novalis" there is a singular mixture of imagination, sensibility, religion and mysticism. He was the gentlest and most amiable of enthusiasts. His novel, 'Heinrich von Ofterdingen', was left unfinished. His 'Hymns to Night' and the 'Geistliche Lieder' are greatly admired. With the Schlegels and Tieck he assisted in founding the romantic school in Germany. Consult: Schubart, 'Novalis Leben' (1887); Bing, 'Friedrich von Hardenberg' (1893).

Hard'hack, or **Steeple-bush**, an erect species of American *Spiræa* (*S. tomentosa*), common in pastures and low grounds, and celebrated for its astringent properties, which cause it to be used medicinally. It is distinguishable by the dense woolly tomentum, which covers its stem and the underside of its leaves; and bears in late summer "a compact, steeple-shaped panicle of peach-blow pink."

Har'die, James Allen, American soldier: b. New York 5 May 1823; d. Washington, D. C., 14 Dec. 1876. He was graduated from the United States Military Academy in 1843, entered the artillery, during the Civil War served on the staffs successively of Generals McClellan and Burnside, was judge-advocate-general of the Army of the Potomac on Hooker's staff, became brigadier-general of volunteers in 1862, and inspector-general with rank of colonel in 1864. He was brevetted major-general, United States army, in 1865. His writings are largely confined to military reports.

Hardie, James Keir, English labor leader: b. Lanarkshire 15 Aug. 1856. He worked in the coal mines until 1879, when he was blacklisted on account of his activity in organizing the miners; he was then appointed paid secretary of the miners' union. In 1886 he organized the Ayrshire miners, and in 1887 attended his first Trade Union Congress. He was one of the founders of the Independent Labor Party, and was elected member of Parliament in 1888, 1892, and 1900. He is proprietor and editor of a weekly paper, the 'Labour Leader.'

Hardie, Robert Gordon, American portrait painter: b. Brattleboro, Vt., 29 March 1854; d. Brattleboro, Vt., 9 Jan. 1904. He studied drawing at the Cooper Union Institute, the Academy of Design, and the Art Students' League, N. Y., and at Paris became a pupil of Gerôme. He exhibited at the Salon in 1880 and following years, and in 1882 studied under Cabanel. A picture of his appeared at the Exhibition of the National Academy of Design in 1888, and he exhibited a portrait of his wife at the World's Columbian Exposition in 1893.

Harding, Chester, American portrait painter: b. Conway, Mass., 1 Sept. 1792; d. Boston 1 April 1866. As an artist he was self-taught, his trade being that of a turner. He fought as a soldier in the War of 1812, and found employment on his discharge as a sign-painter in Pittsburg, Pa. Crossing the ocean he became a favorite portrait painter in London and found patronage among the royal family. His 'Portrait of Daniel Webster' is owned by the New York Bar Association, while his 'Portrait of John Randolph' is in the Corcoran Gallery, Washington.

Harding, Karl Ludwig, German astronomer: b. Lauenburg 29 Sept. 1765; d. Göttingen 31 Aug. 1834. Called to be a tutor to the son of the illustrious Schröter, he became inspector and observer in Schröter's observatory. In 1805 he was appointed professor of astronomy in the University of Göttingen, and remained in this position till his death. He discovered the asteroid Juno, the third of the planetoids, in 1804, and independently, the second comet of 1813 credited to Pons. His 'Atlas Novus Cœlestis' (1808–23; new ed. 1856) was for years the best of its sort.

Hardness, Scale of. In mineralogy, the hardness of a mineral is estimated by observing which of certain standard minerals will scratch a smooth surface of the given mineral, and which will not. On Mohs' scale (which is usually adopted), ten such standard minerals are selected for the establishment of the scale, their hardness being arbitrarily defined as 1, 2, 3, etc., up to 10. The minerals that are commonly used for this purpose are as follows:

1. Talc.	6. Feldspar.
2. Gypsum.	7. Quartz.
3. Calcite.	8. Topaz.
4. Fluorite.	9. Sapphire.
5. Apatite.	10. Diamond.

A mineral which will neither scratch apatite nor be scratched by it, for example, has a hardness of precisely 5; and the same may be said of one which will both scratch apatite and be scratched by it. A mineral which feldspar will scratch but apatite will not, has a hardness intermediate between 5 and 6. The decimal expressing the precise degree of hardness in such a case must be assigned by guess; but there is little use in attempting to determine a hardness more closely than to the nearest half-degree on the scale given above.

Hardware in America during the past century. The term "hardware," like everything else in our country, has suffered a great deal of expansion during the past hundred years, particularly as regards its application. Originally restricted to necessary articles of steel and iron, it has come to embrace in its technical and business understanding a great variety of goods which have no relation at all to the original meaning of the word.

One of the potent causes of this sweeping change has been the steady reduction in the price of hardware for a long series of years. This reduction has not been altogether continuous, but with occasional up-lifts during prosperous times or due to manipulation and control of the products — but on the average the trend has been steadily downward, particularly as compared with a period of 50 years ago. There are innumerable articles whose present cost is only from one third to one half as much now as then. It became necessary for all who were interested in hardware — manufacturers, jobbers, and retailers — to consequently largely increase the volume of their business in dollars and cents, since the mere tonnage output was so much less in value, thus recognizing one of the elementary principles of business — that the larger the output, within certain limits, necessarily the smaller the average cost of doing business.

Because of the discovery and exploitation of enormous ore bodies of iron, copper, and lead, among which may be instanced the great mines of Lake Superior — both iron and copper — the copper deposits in Montana and Arizona, and the lead and zinc ores in Missouri and the Southwest, and also because of the steady multiplication and increased efficiency of machinery, it became possible to produce the finished product at a steadily decreasing cost.

Experience soon showed that the field of legitimate hardware was not itself sufficiently comprehensive to enable the jobber and the retailer to transact a large enough volume of business commensurate with the cost of doing this; therefore, kindred fields were invaded and occupied, and have now become practically incorporated as part of the hardware business. Thus it has been that the great number of articles which are known as house-furnishing goods, and embrace such lines as refrigerators, ice cream freezers, and innumerable other items which go to make up the objects needed in every household — and that the line of tinware and sheet iron, and what also have come to be known as sporting goods — not only guns, rifles, and pistols, but athletic supplies — have become part and parcel of the hardware business in addition to the line of cutlery, and quite a number of other items in lines that were once entirely separate in themselves and had no relation to the hardware business. Thus the hardware retail dealer has practically reverted to the original type, in the sense of going back to the plan of the old general store and keeping pretty much all that his customers need outside of such lines as drygoods, groceries, and drugs.

Hardware is, to a large extent, naturally the business of a new country because of the great amount of building and the clearing of land, though it is equally true that in the modern civilized, progressive communities of this country the use of hardware is in equal proportion to the demand caused by new countries, and much more complex and complicated in its nature.

The history of hardware is naturally the history of this country, and it can be safely said that there is no other department of mercantile business that has so kept pace with the progress of the United States, nor which to-day depicts so thoroughly all the characteristics of modern American character in all its varied details. Beginning in the crudest way with the manufacture of hand-made implements, and depending almost entirely upon importation from the Old World for what was needed — even in the way of necessities of life — it has grown by giant strides, more especially since the end of the Civil War, and in many instances largely because of the protection afforded by the tariff, until to-day American hardware is practically independent of the foreigner, save in those rare instances where we have not as yet learned the mysteries of manufacture or succeeded in procuring sufficiently skilled workmen to answer the purpose. The manufacturers of hardware in America have been original in their ideas and methods and have adapted themselves absolutely to the necessities of their environments.

not slavishly following the copies of Old World tools, but being guided solely by common sense and necessity. It has followed thus, particularly in edge tools, that there has been such advancement in the way of appropriateness to purposes intended and improvement in appearance, finish, and design as can be scarcely equalled in any other line of business. The artistic sense has not been lost sight of, but has been appealed to as well as the sense of utility. Cutting tools are made just heavy enough and to avoid the clumsiness of the Old World items in this regard. Originality has been shown in the incessant improvement of existing models and the devising of entirely new conceptions. The manufacturer has not been content to follow the custom of ages — has had little respect for tradition or inheritance, but has set himself solely to the task of producing an effective tool at the lowest possible cost.

It is true that in no country in the world does merit in hardware command the price and popularity as in the United States, and the history of manufacturers who have been successful has been the history of merit, and not because of cheapness in quality or price. The only manufacturers who have been successful for any length of time have been those who have based their products primarily on quality and who have had the faith and courage to maintain this quality in the face, often, of discouraging circumstances. It may be stated as an axiom that no hardware item of the day survives for any length of time on any other basis. The temptation to deteriorate the quality after the reputation is established and built upon its quality has always met with sure and permanent disaster.

The blacksmith of the smaller town and of the country was among the earliest makers of tools and implements, and even to this day in many localities there still survives a call for his hand-made products. The hardest fight which the manufacturers of machine-made articles have had to face has been to overcome the feeling, and often prejudice, in favor of the tool that was made by hand and that seemed consequently superior — and, as a matter of fact, the reverse has usually been the case.

Appearance counts for much — probably more in America than in any other country; attractive packages, handsome labels, and beautiful finishes are as much a part of hardware to-day as the adaptability and merit of an article. There have been numerous strides in this regard, particularly when one contemplates the old-fashioned method of tying up the hardware in heavy paper with string, a package that was both clumsy and unsightly. The question of the size and nature of the package is one of great moment in the appeal to the public, and the general tendency has been to pack the goods in smaller and smaller boxes all the time, to insure their ready sale and prevent breaking the packages, which is always so detrimental to the goods themselves, and so expensive to the dealer.

The importation of hardware is almost at an end, being confined, as before stated, to some few specialties which are slowly but surely losing their hold upon the public of this country; but, on the other hand, the exportation of American hardware — and particularly American edge tools — to all parts of the world is a large and growing business, and one of great value to the home manufacturer. The foreign business has been obtained entirely by the merit of the American article; its attractiveness, its novelty, its merit, and its adaptability to the purpose intended have, after much opposition, opened the way for American hardware in all parts of the world, so that it has steadily gained ground at the expense of the foreign article.

The steady substitution of machinery for hand labor has been the most potent cause of the great success that hardware has made in the United States. The American manufacturer is never content with present conditions, but is always endeavoring to find a more efficient and more economical method of producing the finished article, and consequently endeavors to substitute machinery for hand labor. American hardware has, therefore, been placed within the reach of all, and has largely contributed to the comfort and welfare of the people.

The production and the use of hardware cannot be intelligently considered without reference to some of the leading conditions of the country — conditions of soil and climate, as well as the temperament and nature of the people. The most far-reaching and enduring change has been the substitution of what is known as mild steel for wrought iron, due to the invention of Sir Henry Bessemer. It has rendered possible the production of hardware in all brands at very much lower prices and much more numerous forms since the production of open hearth and of Bessemer steel, which thus supplanted those of cast iron and of wrought iron.

On the other hand, hardware has been very adversely affected by this change because of the consequent substitution of steel for wood, and this is most marked in the erection of the modern sky-scraper, as it is known, where there is but comparatively little hardware used, either in the erection of the building or in its subsequent finishing. These buildings having practically little or no wood in them have small use for either the carpenter or his various tools, and all that is left of hardware is a small amount of locks and trim to decorate the building and to give it security. This process has gone on in many ways until apparently it must seriously affect the continued use of hardware in all branches of life; but, on the other hand, the growth of the population has been so great that this can be safely set down as a discussion of only academic interest at present.

In a country so diversified as to soil and climate, there is a necessity of great diversity of hardware, and the goods used in the different parts of the country invariably reflect the nature and temper of the people. The South is much more conservative than the North and clings longer to old-fashioned articles of well-known reputation some time after they have been superseded in the North by more modern things. Because of the comparative poverty of the South in the past, and the fact that the negro is the principal laborer, the demand, until lately, has been rather for price than for quality. Again, in the extreme East very much the same conditions prevail, owing to the natural economy of the people and their extreme conservatism. The West — by which is also meant the Southwest and the Northwest — is a great consumer of hardware, and within its bounds are the great distributing hardware centres.

The steady and rapid destruction of the

forests has had a far-reaching effect upon the hardware business, and one that is destined to, in many cases, permanently alter the use and nature of many hardware implements. In the beginning the country had to be cleared of forests, which created an enormous demand for all edge tools and stimulated the ingenuity of the manufacturers to produce articles fitted for the different needs — not alone for the different sections of the country, but also for the various kinds of wood. Now that the white pine forests have practically been destroyed, it is necessary to have edge tools that are more and more adapted for use of the hard woods which are still fairly abundant; and the question also presents itself to the manufacturers as to how long it will be possible to keep up the present production of such items as axes and cross-cut saws, in view of the fact that the forests are steadily disappearing.

It is impossible within the limit of this article to more than briefly mention some of the leading branches of the hardware business and tell in a few words of their nature and history.

Wire Industry.— One of the most prominent to-day is that of the wire industry, because it ramifies and affects almost every part of the hardware business. It early felt the impetus of the advantages offered by the Bessemer steel process, since it was possible to produce in wire made from steel many items which could not be drawn from wrought iron. It is difficult to state with exactness — because of its largely conflicting with other branches of iron and steel manufacture — but it has probably invested in its manufacture more than $200,000,000, and its output in 1905 was something like 15,000,000 tons. Few things have been of greater interest than the story of barbed wire and its enormous growth since its introduction. It is probably the cheapest fencing ever placed upon the market, and exactly met the demands of the new country where thousands of acres had to be fenced in at a time. It is still a product of great tonnage, but its place is being slowly but surely taken by the woven-wire fencing which, though higher in price, is more effective and is better suited now for the country, which is gradually being cut up into smaller farms.

Nail Industry.— The nail industry is a conspicuous example of the chance and changes in manufacture, for in the beginning the iron cut nail, first as made by hand and afterward by machinery, had behind it the prestige of centuries, and seemed to be enduring as an article of every-day use. It was found, however, that with the growth of the Bessemer steel business, the steel cut nail could be made cheaper, although it was not in any way a better article. Its place, in turn, is being very fastly taken by the wire nail, which is much more comprehensive in its uses than the steel cut nail, though the latter style prevails in certain sections and for certain purposes, but the decline of the steel cut nail is as marked in its way as the rapid increase in the use of the wire nail.

Tacks.— The kindred industry is that of tacks, but it has been seriously hurt by the expansion of the wire nail since it is possible to make the latter in many forms and sizes that are substitutes for tacks. This industry was founded in Taunton about 75 years ago, and for a great number of years was practically confined to New England. It spread gradually westward to Pittsburg; there it almost died out, and has since taken some hold further west in Cleveland and Chicago. Owing to the encroachment of the wire nail it has declined rather than advanced, and the number of manufacturers has been greatly decreased. The product is not large — probably not more than 15,000 tons per annum.

Farming Tools.— The making of farming tools and what are known technically as "steel goods" is one of the most important industries in the hardware line, since with these tools the crops are cultivated and gathered. The steady progress of the American manufacturer has been in the direction of producing items which were light, strong, and handsome in appearance. The diversity of soil and climate mean great diversities of various items used in cultivating the ground, and the number grows each year. The business does not keep pace with the growth of the country owing to the steady increasing use of labor-saving machinery — the mower and the reaper have taken the place of the snath, the cradle, and the scythe — the corn binder of the corn knife, and the corn planter and the cultivator have gradually diminished the use of hoes. The amount of capital invested is not exactly known, but does not probably exceed $3,000,000. The absolute importance of these tools to the country is rather striking contrasted with the small annual output in dollars and cents. See AMERICAN FARM IMPLEMENTS.

Builders' Hardware.— The builders' hardware business is often considered the centre of the hardware trade, because of its great importance as related to the hardware industry as a whole. Builders' hardware is an exceedingly comprehensive term and does not admit of exact definition. It is ordinarily used in reference to locks (see LOCKS) and trim and to all the various items which find employment in the building of a house. It is a business of immense complexity and has a most interesting history. It began far back in New Haven and New Britain, Conn., as early as 1834, and the first goods were naturally crude and rough. Shortly, however, the ingenuity of the American manufacturer produced a new article in the shape of the cast-iron lock, thus departing entirely from the wrought lock, which was formerly known to England, Germany, and France. The cheapness of the cast-iron lock and its actual efficiency soon caused it to entirely displace the foreign article. Since that time the sheet steel lock has been made in this country, but in a much smaller and more condensed form than the wrought lock of Europe.

Builders' hardware has a most interesting history since it is in part the story of the development of taste in America. The Centennial Exposition of 1876 did much to educate the people of this country in the way of good taste and high artistic ideals. There gradually became a demand for things of daily use which should have beauty as well as utility, and particularly of late years this feeling has spread to locks and trim, and all forms of builders' hardware, with increasing emphasis. The leading manufacturers have innumerable designs which are suitable for the different schools of architecture, such as Gothic, Renaissance, and Colonial, or any of the variations of the standard schools. All high-grade builders' hardware is now gotten up in shape and design to match appropriately not alone the building, but each separate room where the rooms are finished and ornamented differently. It is, therefore, largely a thing of ornament as well as of use, and the ingenuity of the manufacturer and the salesman has been taxed to keep pace with the demands of the consumer for novelty and appropriateness. It is difficult to more than approximate the annual production, but it is probably something like a matter of $25,000,000 in value. The finest grades of hardware are still made largely in the East, principally in Connecticut, but the business is slowly but steadily drifting west in keeping with the general trend of hardware manufacture.

Shovels.— The first shovels in this country were produced as far back as 1776 by Captain John Ames, who made them by hand in competition with the English article. The business then established was carried on there for the succeeding 27 years, and constituted the nucleus of the present large concern of the Oliver Ames & Sons corporation, whose headquarters are in Northeaston, Mass. Mr. Oliver Ames, the son of Captain John Ames, established in 1803 a shovel plant where he soon produced shovels that were superior to those imported from England. In 1797 Thomas Rowland commenced the manufacture of shovels at Cheltenham, Pa., and this plant has been in continuous operation ever since. Business gradually crept westward and is now spread over the country as far west as the Mississippi river. By 1854 there was something like 80,000 dozen shovels produced annually, but with the growth of the country this product has been largely increased until the annual output is now about 600,000 dozen. As with all other hand tools, the demand for shovels has been seriously affected by the introduction and improvement of labor-saving machinery — such as the steam shovel, the coal and ore conveyor, and other mechanical devices for loading and unloading. It is interesting to note that the original machinery for making shovels has not been greatly improved upon so far as the actual efficiency is concerned, although the variety of shovels has been greatly increased to meet the wants and tastes of the different parts of the country. It is difficult to approximate with any reasonable degree of accuracy the amount invested in this business, but it is probably in the neighborhood of $7,000,000.

Saws.— There are few things more difficult to make than saws, and they have been the subject of study of some of the most talented and ingenious manufacturers of the country. They were manufactured as far back as 1806 in Philadelphia, though in a very small way. In 1820 a factory was established in Bristol, Conn., by Irenus and Rollin Atkins, Rollin Atkins being the father of E. C. Atkins, the founder of E. C. Atkins & Company, of Indianapolis, who now have one of the largest saw plants of the world. It was necessary to import the first saw makers from England.

In 1840 Henry Disston, an Englishman by birth, really made the great beginning of the saw-making industry in Philadelphia, and soon produced saws that had no equal in the world. It was only a short time before the Disston saws drove out the English brand entirely from this country, and to-day this firm have not only achieved a world-wide reputation for merit but send their products all over the globe. The annual output of all saws amounts to between $10,000,000 and $12,000,000, and there is about that amount of capital invested in the business. The tonnage of steel used in the manufacture of saws varies from 15,000 to 20,000 tons per annum.

American saws, particularly hand saws, are pre-eminent in America and have no equal abroad. Outside of the Disston factory there are several very large and prominent makers, among them E. C. Atkins & Company, of Indianapolis, Ind., and the Simonds Manufacturing Company, who make their headquarters at Fitchburg, Mass. The saw business has been notable because of the genius shown by the manufacturers, and in this respect Henry Disston is pre-eminent. There are probably something like between 5,000 and 6,000 people employed permanently in the business. See Saws and Sawing.

Axes.— Axes have always been among the most important items in the hardware business because of the great need of them in felling the forests with which the country was covered in the early days. They are of innumerable sizes and shapes to suit the needs of the lumbermen and the users. The production has not increased of late years, due not only to the deforestation of the country, but also to the fact that the place of axes is being largely taken by cross-cut saws. The annual output is somewhere between 350,000 and 400,000 dozen. As in other lines of business, there have been great consolidations, so that a few large concerns have taken the place of innumerable small ones. The use of natural gas has had a most important effect on the manufacture of axes, since with it a very much superior tool can be made, and it is also of great advantage in tempering. It is noticed as regarding the matter of tempering — a thing of vital necessity in all edge tools — that practically there has been no improvement in this regard for several centuries. Not alone did many of the implements of the ancients equal in temper the best that can be produced now-a-days, but in many cases they were much superior. The difficulty seems to lie in the fact that tempering is purely a thing of experiment and not of scientific development, the reason for it not being known, nor why some metals can be tempered and others cannot. In the beginning axes were originally made by hand as were all the other hardware implements, but later the tendency developed to establish small factories on available water powers throughout the country, as at Pittsburg, Pa., Lewistown, Pa., East Douglas, Mass., and Collinsville, Conn. With the enormous demand for the goods, this industry soon outgrew its "leading strings" and established itself at more available locations.

Edge Tools. — The item of edge tools is a very large one, and next to builders' hardware, probably the most important in the whole range of hardware proper. It embraces practically everything with a cutting edge such as hatchets, chisels, drawing knives, planes, and the like, and space forbids any attempt at more than generalities. It is interesting to note that on such small items as chisels, drawing knives, adzes, and hatchets, the advance within a period of 1,000 years has been rather of attractiveness of form and appearance than in actual adaptability or merit. Some tools dug up from the Roman camp of Salzburg are, so far as adaptability goes, quite equal to any that are made up now-a-days. The simplicity of the articles mentioned has largely rendered them impossible of any great improvement. In the more complicated lines such as planes and the like there have been very great changes and improvements, and the plane industry, particularly, is one of enormous proportions. The manufacturers who have attained a reputation in edge tools have done so purely on the score of merit and because of the fact that each manufacturer made only one particular line, no one thus having a complete line of edge tools of uniform excellence, design, and efficiency; and one of the great causes of the demand for American hardware abroad — particularly since the Spanish War — has been the fact of the assembling of a complete line of high grade tools under one brand, so that the foreigner realized that anything that bore that particular trade-mark could be depended upon as being uniform in quality and efficiency. Among the somewhat lesser items in the tool line have been the interesting developments in auger bits of innumerable designs and patterns, with varying adaptability for different kinds of work. See TOOLS.

Files.— There are few things of greater and more growing importance to the hardware dealer than that of files, and it is an interesting story of development and of the genius of the manufacturer. They are articles which have to be made with the greatest care and go through a great number of processes before they reach perfection and are fitted for use. The five leading operations requisite are forging, annealing, grinding, cutting, and hardening. They were formerly made entirely by hand, and even to this day, there still exists among a few, the preference for the hand-made file. The history of the business really dates from the practical use of a machine to cut files, patent for which to all intents and purposes was first issued to William Nicholson in 1816. There are records of file-cutting machines in France as far back as 1699, and several since that time up to the 19th century, but none of them apparently of any practical value. The first really important attempt to manufacture files was soon after 1850 at Ramapo, N. Y., a company being organized under the name of the American File Company, with large capital. The life of the attempt was short, however, and the business was soon discontinued. Various attempts were made shortly after that — both in this country and England — to manufacture files by machinery, and none of them had any extended experience.

About 1863, Mr. William T. Nicholson, of Providence, R. I., gave the matter of file cutting by machinery his personal thought and attention. He had long training as a mechanic and practical experience in the finest branches of machinery. At that time the great source of supply of files for this country were the hand-made files of England, and the story of attempts to cut files by machinery had been one of sunken capital, ruined hopes, and dismal failures. From this beginning grew the great present firm of the Nicholson File Company, which largely dominates the file trade in this country and has an enormous export business. They have produced better and cheaper files than it is possible to cut by hand, and have carried the business apparently to the point of perfection. The importation of files has fallen to about $75,000 per annum, while the total output of American files does not fall short of $6,000,000, and is represented by total investments of approximately $12,000,000. See FILES AND FILEMAKING.

Rasps.— Few things have been more marked than the determination of the American manufacturer to successfully produce a machine-cut horse rasp. It followed a long ways in the wake of the machine-cut file, and after many discouragements — the principal difficulty being to overcome the inveterate prejudice of the blacksmith. To-day hand-cut horse rasps are a thing of the past.

Bolts and Nuts.— The manufacture of bolts and nuts dates as far back as 1798, a patent for screw machinery at that time being issued to David Wilkinson, a celebrated mechanic of Rhode Island. There were various other patents granted and these gradually developed in later years into the present slotters, threaders, pointers, and tapers. By slow growth and by innumerable inventions and improvements this industry has attained its present enormous proportions and is represented to-day by about 15 prominent makers, who manufacture all of the various kinds and styles of bolts, the yearly product being something like 1,000,000,000 bolts.

Screws.— The manufacture of screws — or, as they are technically known, wood screws — is one of the important developments of this country, though the demand does not keep pace with the growth of the country owing to the continued substitution of steel for iron, and consequently of bolts and rivets for screws. Screw machinery is of the highest type of automatic efficiency and almost equals human intelligence in its working. Patents for various devices on screw machinery date back into the latter part of the 18th century, and innumerable patents have been issued since that time. The real beginning of successful manufacture was in 1838 when the Eagle Screw Company was incorporated in Providence, R. I., the leading spirit being Mr. William G. Angel. In 1846 Mr. Angel finally perfected the machine for making what is known as the gimlet point on a screw — up to that time it had a blunt point. From this time dates the prosperity and growth of his company, which grew into the present American Screw Company. There are now some 13 large concerns engaged in the manufacture of screws and scattered from New England to the Mississippi river. See SCREWS.

Tin Plate.— The tin plate and sheet iron industry has kept pace with the general growth of the iron industry all over the country, and has been greatly fostered by a protective tariff since the time of what has been known as the McKinley Bill. Its production in this country has grown at an enormous rate, as may be seen by the statement that in 1892 there were only about 18,000 tons of tin plate produced in this country as against about 458,000 tons in 1904. The industry is chiefly represented by what are known as black sheets, galvanized iron, and tin plates — all of which have now become integral parts of the hardware business. See TIN PLATE.

Tinware.— Among the lines which were originally independent, but which have practically become now incorporated with the hardware business, is that of the tinware industry in all its various ramifications. The retail hardware shop has practically absorbed the tinners' shop and because of the fact that hand-made tinware is fast being supplanted by the product of the stamping company, the hardware retailer has gone into the handling of tinware in all shapes and varieties.

Enameled Ware.— Coincident with this is the development of what is known as enameled ware, being a coating on the sheet steel in place of the tinning. It is of all colors and varieties and has grown to be a business of great importance. It illustrates distinctly the general desire of the people for something more tasteful and artistic in appearance than the old-fashioned tinware.

Mechanics' Tools.— The American manufacturer has shown to great advantage in the manufacture of high grade mechanics' tools for exceedingly fine measurements. In this respect the Brown & Sharpe Manufacturing Company, of Providence, R. I., occupy a commanding position and their products to-day are sought for all over the world where exceeding accuracy is necessary. As an example, the micrometer caliper will measure with absolute accuracy the 250,000th part of an inch. For an attainment of such results, the finest tools made by any other nation cannot be compared with those of America.

Cutlery.— Few things are more interesting than the history of cutlery-making in the United States, as it has suffered many "ups and downs," not alone from various foreign competition, but from the difficulty of procuring sufficiently skilled labor to produce the proper article. The manufacture of scissors and shears — which are always treated as a part of the cutlery business — has been unique in the fact that it was a Yankee genius who first solved the problem of welding a high grade steel blade to a soft casting of iron backing made to fit the hand, this being the invention of Seth Boyden in 1826. The actual manufacture of shears in this country seems to have been commenced by R. Heinisch in 1825 at Elizabethport, N. J. This was followed by others until at present the American shears have been developed and improved as to be far ahead of any in the world. Prior to 1832 table cutlery was imported very largely from England. From that year American manufacturers began in a small way to produce these goods, and by 1865 they had practically taken the business unto themselves. There is a large export trade business in table cutlery owing to the superior quality of the goods made in this country.

The making of pocket cutlery is one of the most interesting things connected with the hardware business in America. It was started at Lakeville, Conn., by the Holley Manufacturing Company about 1845. The total annual capacity was probably less than $50,000. The business was gradually extended in a small way and finally a co-operative colony was established at Walden, N. Y., and since then this line of American industry has largely centred in the two States of New York and Connecticut. Innumerable factories have been started and have failed, largely owing to the lack of foresight on the part of the manufacturers in attempting to compete with the cheap labor of Europe in producing goods both cheap in quality and finish as they were in price. The co-operative colony spoken of grew by slow degrees and economical management, having the advantage of large water power at Walden, until they finally became one of the leading makers, not alone of this country but of the world, and were enabled to show at the recent Louisiana Purchase Exposition products superior to those made abroad, for which they received the highest award. It is an interesting case of development in the way of quality and of merit by patience and skill. There are something like 10 or 12 makers now in the field and their annual product is roughly set in the neighborhood of $2,000,000.

E. C. Simmons.

Har'dy, Arthur Sherburne, American novelist: b. Andover, Mass., 13 Aug. 1847. After a single year at Amherst College he entered the West Point Military Academy, graduating in 1869. He became a second lieutenant in the 3d Artillery regiment, saw some service during 1869 and 1870, and then resigned to become a professor of civil engineering at Iowa College for a brief time. In 1874 he went to Paris to take a course in scientific bridge-building and road-constructing, returning to take a professorship in that line of instruction at the Chandler Scientific School, connected with Dartmouth College. He assumed a similar professorship in Dartmouth College in 1878. This position (in connection with which he published 'Elements of Quaternions' (1881), followed by his translation of 'Argand's Imaginary Quantities,' by his own 'Analytical Geometry'; and 'Elements of the Calculus'; 'Imaginary Quantities'; and 'Methods in Topographical Surveying') he held until 1893, when he became editor of 'The Cosmopolitan Magazine.' He was United States minister to Persia, 1897–9, and envoy extraordinary and minister plenipotentiary to Greece, Rumania and Servia, 1899–1901, to Switzerland, 1901–3, and to Spain since 30 Jan. 1903. His works include: 'But Yet a Woman' (1883); 'The Wind of Destiny' (1886); 'Passe Rose' (1889); 'Songs of Two,' poems (1900); 'His Daughter First' (1903). He also wrote the 'Life and Letters of Joseph Hardy Neesima' (1890).

Hardy, Edward John, English author and clergyman: b. Armagh, Ireland, 7 May 1849. He took orders in the English church, became an army chaplain, in 1903 was stationed at Hong Kong, and in 1905 in Egypt. He is known the world over as the author of 'How to be Happy though Married' (1884), which has been translated into many languages. Other work by him are: 'Manners Makyth Man' (1885); 'Faint yet Pursuing' (1886); 'Uncle John's Talks with his Nephews' (1886); 'The Five Talents of Women' (1888); 'The Love Affairs of Some Famous Men' (1897); 'Mr. Thomas Atkins' (1900); 'Concerning Marriage' (1901); 'Love, Courtship and Marriage' (1902); 'Pen Portraits of our Soldiers' (1902); 'Love Rules the World' (1905); 'John Chinaman at Home' (1905).

Hardy, Iza Duffus, English novelist, daughter of Sir Thomas Hardy, the English historian. Among her numerous novels are: 'Glencairn' (1877); 'Only a Love Story' (1877); 'A Broken Faith' (1878); 'The Love that He Passed By' (1884), an American novel; 'A Woman's Loyalty' (1893); 'The Lesser Evil'; 'Man, Woman, and Fate'; 'A Butterfly' (1903), etc., and two volumes of transatlantic reminiscences, 'Between Two Oceans' (1884), and 'Oranges and Alligators: Sketches of South Florida Life' (1886).

Hardy, Thomas, English novelist: b. Dorsetshire, England, 2 June 1840. He was educated as an architect and practised his profession 1862–73. He then turned to literature and is now recognized as the first of living English novelists. His published works include 'Desperate Remedies' (1871); 'Under the Greenwood Tree' (1872); 'A Pair of Blue Eyes' (1873); 'Far from the Madding Crowd,' which first established his fame (1874); 'The Hand of Ethelberta' (1876); 'The Return of the Native' (1878); 'The Trumpet-major' (1880); 'A Laodicean' (1881); 'Two on a Tower' (1882); 'The Mayor of Casterbridge' (1886); 'The Woodlanders' (1887); 'Wessex Tales' (1888); 'A Group of Noble Dames' (1891); 'Tess of the D'Urbervilles' (1891); 'The Three Wayfarers' (1893); 'Life's Little Ironies' (1894); 'Jude the Obscure' (1895); 'Wessex Poems' (1898); 'Poems of the Past and Present' (1901). Consult: Johnson, 'The Art of Thomas Hardy' (1894); Macdonnell, 'Thomas Hardy' (1894); Windle, 'The Wessex of Thomas Hardy' (1901); Sherren, 'The Wessex of Romance' (1902).

Hare, Augustus John Cuthbert, English descriptive writer: b. Rome, Italy, 13 March 1834; d. St. Leonards, Sussex, 22 Jan. 1903. He was a nephew of J. C. Hare (q.v.). His life was spent mainly in travel, on descriptions of which his fame chiefly rests. Among his many works may be cited 'A Winter at Mentone' (1861); 'Walks in Rome' (1870); 'Wanderings in Spain' (1872); 'Memorials of a Quiet Life' (1872); 'Days near Rome' (1874); 'Walks in London' (1877); 'Days near Paris' (1887); 'Sussex'; 'The Story of My Life' (1895); 'Shropshire.'

Hare, John, English actor: b. London 16 May 1844. He made his first appearance in Liverpool, then going to London played at the Prince of Wales theatre, and later was manager of the Court theatre, the Garrick theatre, and the Globe theatre. He became distinguished as a comedian, and visited the United States, playing in the chief cities. The plays he has brought out include 'A Scrap of Paper'; 'Still Waters Run Deep'; 'A Bachelor's Romance'; and 'Gay Lord Quex.'

Hare, John Innes Clarke, American jurist: b. Philadelphia 17 Oct. 1817. Graduated from the University of Pennsylvania in 1834, he was admitted to the bar in 1841, was successively associate and presiding judge of the Philadelphia district court (1851–75), and in 1875–95 presiding judge of the court of common pleas. He was also for a time professor of the institutes of law in the University of Pennsylvania, and published: 'American Leading Cases' (1847; with Wallis), 'The Law of Contracts' (1887), 'American Constitutional Law' (1889), eleven volumes of chancery reports, and other works.

Hare, Julius Charles, English Anglican clergyman and author: b. Valdagno, Italy, 13 Sept. 1795; d. Hurstmonceaux, Sussex, 23 Jan. 1855. He was vicar of Hurstmonceaux from 1832 and published 'Vindication of Luther' and other works, but is much more widely known as co-author with his brother A. W. Hare, of 'Guesses at Truth' (1827), a work which still enjoys popularity.

Hare, Robert, American scientist: b. Philadelphia 17 Jan. 1781; d. there 15 May 1858. He was professor of chemistry in the University of Pennsylvania 1818–47. He will be longest remembered for his discovery of the oxyhydrogen blowpipe to which he gave the name "hydrostatic blowpipe," but he also invented the valve-cock, the calorimeter and a process for denarcolizing laudanum. He wrote 'Brief View of the Resources of the United States' (1810); 'Chemical Apparatus and Manipulations' (1836); 'Memoir on the Explosiveness of Nitre'; etc.

Hare, William Hobart, American Protestant Episcopal bishop: b. Princeton, N. J., 17 May 1838. He studied at the University of Pennsylvania, was ordained priest in 1862, was minister of St. Luke's, St. Paul's (Chestnut Hill) and other churches of Philadelphia, and in 1873 was consecrated missionary bishop of Niobrara. In 1883 his diocese, having been enlarged so that its limits were identical with those of the territory of South Dakota, was renamed that of South Dakota. He became known as an authority on the Indian question, and wrote pamphlets on mission work in the western United States.

Harebell, or **Bluebell,** a familiar species of bell-wort (*Campanula rotundifolia*), common throughout the northerly parts of the whole northern hemisphere (see Bluebell; Campanula), growing in dry and hilly pastures, on waysides, and open lands generally. It is, however, rare in America south of Canada, although other species are to be found here. It is perennial, with a slender stem 6 to 14 inches high, bearing a loose raceme of a few drooping flowers, on very slender stalks; the flowers, generally bright blue, but sometimes white, bell-shaped, and about half an inch long, appear in summer and autumn. The juice of the flowers yields a fine blue color, and may be used as ink.

Harel, Paul, pōl ä-rĕl, French innkeeper-poet: b. Echauffour (Orne) 1854. He became landlord of the "Croix Saint-André," an inn at Echauffour, and within a modest range of subject wrote picturesque verses in an excellent lyric style. He was elected to the Caen Academy, and on the recommendation of Sully-Prudhomme received a prize from the Académie Française. Among his works are: 'Sous les Pommiers' (1879); 'Rimes de Broche et d'Epée' (1883); 'Aux Champs' (1886); and 'L'Herbager,' a three-act poetic drama (1891).

Harelip. A fish. See Cutlips.

Ha'rem, or **Hareem'** (Ar. "the prohibited"), is used by Mussulmans to signify the women's apartments in a household establishment, forbidden to every man except the husband and near relations. The women of the harem may consist simply of a wife and her attendants, or there may be several wives and an indefinite number of concubines or female slaves, with black eunuchs, etc. The greatest harem is that of the sultan of Turkey. The women of the imperial harem are all slaves, generally Circassians or Georgians. Their life is spent in bathing, dressing, walking in the gardens, witnessing the voluptuous dances performed by their slaves, etc. The women of other Turks enjoy the society of their friends at the baths or in each other's houses, and appear in public accompanied by slaves and eunuchs; but the women of the sultan's harem have none of these privileges.

It is of course only the richer Moslems who can maintain harems; the poorer classes have generally but one wife.

Hares. In the United States the names hare and rabbit are used indiscriminately for various species of rodents of the family *Leporidæ*. Hare is the generic term, while rabbit is applied properly to a single short-legged species of essentially burrowing habits whose naked, blind, and helpless young are nurtured in underground nests (see RABBIT). None of the native American species have these characteristics. The second pair of upper incisors are small, non-functional and placed directly behind the large gnawing teeth, a peculiarity which distinguishes the hares and a few allied forms from all other rodents. The ears are always large, the tail short, bushy, and upturned, the forelimbs short and five-toed, the hind ones long and four-toed, and the soles of the feet densely hairy. Hares are exclusively vegetarian. They are extremely timid, alert and have keen senses. They move with peculiar erratic leaps and with great speed for short distances, and walk with a peculiar shuffling gait by placing the entire sole of the hind foot on the ground. A favorite attitude is that of resting on the haunches with the head erect; but the forelimbs lack altogether the prehensile powers of the squirrels. None of them are arboreal or aquatic. The older catalogues enumerate from 20 to 30 species from all parts of the world except Australasia, but chiefly belonging to the northern hemisphere. With a very few exceptions all the hares are included in the single genus *Lepus*.

The gray rabbit, wood rabbit or cottontail (*L. floridanus* or *L. sylvaticus*) is very plentiful throughout eastern North America north to Ontario. It frequents thickets and brier patches on the borders of woods, multiplying excessively in the more thickly settled regions and replacing the more retiring varying hare. All kinds of succulent herbage, bark, berries, and buds, the latter especially in winter, form the rabbit's food, which it seeks to a large extent along regularly established runways, not infrequently leading to the farmer's truck-patch. Although it does not itself burrow, the cottontail frequently escapes its pursuers by retreating into the holes of woodchucks, skunks, etc., in this respect and some others resembling the true European rabbit more closely than any other American species. Several broods of four to six young are raised each year. At birth they are blind and helpless, and are protected in a nest built in a depression in the ground of dried grass or weeds lined with the rabbit's own fur.

The varying hare or white rabbit (*L. americanus*) is a larger species with longer hind legs, taking its name from the alternating brown and white color of summer and winter respectively, a change which is less complete southward. Much difference of opinion has prevailed regarding the manner in which this change occurs, the latest competent view being that the white coat is due to the growth of new white-tipped hairs among the soft short fur, the brown tint of which again appears with the loss of the white ends of the hairs in the spring. In one or other of its varieties it ranges from Virginia northward to Hudson Bay, and is common in the hemlock forests northward. This is a typical hare, which depends for its safety from foxes, lynxes, weasels, hawks, owls and numerous other enemies solely upon its quick senses and great speed. It never enters burrows, but lives by day and night with no other shelter than that afforded by thickets. Feeding chiefly by night it travels along regular runways used in common by several individuals, a fact which is sometimes taken advantage of by foxes and other enemies to compass their destruction. A favorite winter food is the bark and buds of the birch tree. Scarcely any nest is formed for the young, which are fully active a short time after birth. A somewhat similar species is the polar hare (*L. arcticus*), a pure white species of high northern latitudes.

The jack-rabbit or prairie hare (*L. campestris*) is representative of a group of large, long-legged, big-eared hares which inhabit the western plains, and whose lives are spent mostly "on the jump." For short distances they are perhaps the swiftest quadrupeds known. Their lives are spent among the bushes, upon the twigs of which they feed, and where their young are dropped and within a short time required to shift for themselves. In cultivated districts the jack-rabbits increase enormously and become great pests. As a consequence they are much hunted, not only with dog and gun and snare, as are the eastern species, but by the organization of extensive "drives" which result in the destruction of thousands, the bodies of which are shipped to the markets. Coursing them with greyhounds after the English fashion (see COURSING) is an exciting and favorite sport.

The marsh hare (*L. palustris*) and water hare (*L. aquaticus*), of the Southern Atlantic seaboard and the Mississippi valley respectively, are rather short-legged species, which differ from the others in the readiness with which they will enter water.

In Europe the common hare (*L. timidus*), the mountain hare (*L. variabilis*) and the rabbit (*L. cuniculus*), from which the domestic races have been derived, are the principal species. Consult: Coues and Allen, 'Monographs of the Rodentia' (1877); Thompson, 'Wild Animals I have Known' (1898); Stone and Cram, 'American Animals' (1902).

Hargreaves, här'gravz, **Edmund Hammond**, English discoverer of the gold-fields of Australia: b. Gosport, England, 1815; d. Sidney, N. S. W., October 1891. When 18 he settled in Australia, but attracted to California in 1849, he there tried his luck as gold-digger, and detecting a similarity in the geological formation of California and Australia, inferred that gold would be found in the latter, also on his return established the correctness of his surmise by finding gold on the west slopes of the Blue Hills in New South Wales in 1851. He was appointed commissioner of crownlands, and received from the government of New South Wales a reward of $50,000. In 1855 he published 'Australia and Its Gold-fields.'

Hargreaves, här'grēvz, **James**, English inventor: b. Stanhill, near Blackburn, Lancashire; d. Nottingham, England, April 1778. In 1760 he invented a machine consisting of a revolving cylinder with cards or combs set round it as a substitute for the hand-cards formerly in use in combing out cotton. Some years after this he invented the spinning-jenny, by which he was able to spin with several spindles at once. With his new machines he succeeded in turning out a much greater amount of yarn than his neighbors, which excited their jealousy, and they accordingly broke into his dwelling, and destroyed his machine. In consequence of repeated persecution of this kind Hargreaves removed in 1768 to Nottingham, and in 1770 obtained a patent for his invention. Here, however, he reaped scarcely any more benefit from it than before. After refusing £3,000 offered him by a private company for his patent, this was declared invalid on the ground that he had sold several of the machines before taking out the patent. For the rest of his life he carried on business as a cotton manufacturer in partnership with Mr. James. The only public recognition this invention ever obtained was in the form of a bounty of £250 granted by Sir Robert Peel, nearly 70 years after Hargreaves' death, to his last surviving daughter.

Häring, Wilhelm, vĭl'hĕlm hā'rĭng, "Alexis Wilibald," German historical novelist: b. Breslau 29 June 1798; d. Arnstadt 16 Dec. 1871. His work was suggested by the 'Waverley Novels' and in fact, his first two important works, 'Walladmor' and 'Avalon Castle,' purported to be translations from Scott. His works are historical tales of Prussia, with Frederick the Great for hero: among these may be cited 'Cabanis'; 'The False Waldemar'; 'Peace is the First Civic Duty.' He was very fertile in plot and incident, but his style is mannered; the tales are still popular, however, from their patriotic fervor.

Harivanśa, hă-rĭ-văn'sha, a Sanskrit epic poem, later than the Mahâbhârata, to which it forms a sort of sequel or epilogue. It has been translated into French by Langlois (1834).

Hark, Joseph Maximilian, Moravian clergyman: b. Philadelphia 4 June 1849. Graduated from the Moravian College and Theological Seminary in Bethlehem, Pa., he entered the Moravian ministry and was successively pastor of Moravian churches in Lebanon, Philadelphia and Lancaster, Pa. Since 1893 he has been principal of the Moravian Seminary at Bethlehem, Pa., the oldest girls' boarding school in America. He has been a frequent contributor to 'The Outlook' and other periodicals, and has published 'The Unity of the Truth in Christianity and Evolution.'

Hark'ness, Albert, American Latinist: b. Menden, Mass., 6 Oct. 1822; d. Providence, R. I., 26 May 1907. He was graduated from Brown University in 1842, and in 1855 was appointed professor of Greek in that institution. He was a founder of the American Philological Association, and its president in 1875–6. In 1884 he was elected director of the American School of Classical Studies at Athens, Greece. His best-known works were a series of Latin text-books widely used and of much influence; including a first book, readers, a manual of prose composition, editions of Cæsar, Cicero, and Sallust, and an excellent 'Latin Grammar' (1881), revised and enlarged as 'A Complete Latin Grammar' (1898).

Harkness, William, American astronomer: b. Ecclefechan, Scotland, 17 Dec. 1837; d. 1903. He was graduated from Rochester University in 1858, studied medicine, was a surgeon in the Federal army for a time, in 1862–5 was an aid in the United States naval observatory, and during the total eclipse of 7 Aug. 1869 discovered the line K. 1474 of the solar corona. He is best known for his theory of the focal curve of achromatic telescopes, and for his invention of the spherometer caliper, the most nearly accurate device for the measurement of the inequalities of pivots in astronomical instruments. In 1894–9 he was astronomical director of the Naval Observatory, and in 1899 was retired with relative rank of rear-admiral. He published 'The Solar Parallax' (1891).

Harlan, här'lan, **James,** American legislator: b. Clarke County, Ill., 25 Aug. 1820; d. Mount Pleasant, Iowa, 5 Oct. 1899. He was graduated from Indiana Asbury (now De Pauw) University in 1845, in 1853 was elected president of Iowa Wesleyan University, in 1855–65 served as United States senator, in 1865–6 was secretary of the interior, and then served a third term (1866–72) in the Senate. Subsequently he was editor of the Washington *Chronicle*, and in 1882–5 presiding judge of the court of commissioners of Alabama claims.

Harlan, John Marshall, American jurist: b. Boyle County, Ky., 1 June 1833. He was graduated from Centre College, Kentucky, studied law at Transylvania University, and entering upon the practice of his profession at Frankfort, became county judge in 1858, and was Whig candidate for Congress in 1859, but was not elected. In the Civil War he served in the Union army as colonel of a Kentucky regiment, and in 1863–6 was attorney general of his State. He was Republican nominee for governor in 1871 and 1875, but was defeated on both occasions. In the Republican National Convention of 1872 his name was presented by the Kentucky delegation for the nomination for vice-president of the United States. In 1877 he was appointed a member of the commission to investigate the troubles in Louisiana; and in November of that same year he was appointed associate justice of the United States Supreme Court, of which he is considered one of the most able and independent members. He supported the constitutionality of the income tax clause of the Wilson Tariff Bill.

Harlan, Iowa, city, county-seat of Shelby County; on the West Nishnabotna River, the Chicago, R. I. & P., the Chicago & N. R.R.'s; about 90 miles west of Des Moines. The chief manufactures are foundry products, agricultural implements, flour, bricks, gasoline engines, and furniture. Its shipping trade is in agricultural products and the manufactures of the city. Pop. (1900) 2,422.

Harland, här'land, **Henry,** pseudonym 'Sidney Luska,' Anglo-American novelist: b. St. Petersburg, Russia, 1 March 1861; d. San Remo, Italy, 21 Dec. 1905. He was educated at Harvard and after being in the surrogate's office in New York 1883–6 removed to London, where he edited the 'Yellow Book.' He published 'As It Was Written' (1885), a musician's story; 'Mrs. Peixada' (1886); 'The Land of Love' (1887); 'My Uncle Florimond' (1888); 'The Yoke of the Thorah' (1887); 'Mr. Sonnenschein's Inheritance' (1888); 'A Latin-Quarter Courtship'; 'Comedies and Errors' (1898); 'Cardinal's Snuff-box' (1900); etc., books which have been extensively circulated in both America and England.

Harland, Marion. See Terhune, Mary Virginia.

Harlech, här'leн. Wales, an ancient town, the former capital of Merionethshire, situated on the coast, 10 miles north of Barmouth. On a steep hill overlooking the sea is the castle, which held out for the Lancastrians in the wars of the Roses, and later for Charles I. The 'March of the Men of Harlech' commemorates its capture by the Yorkists in 1468.

Harlem, a part of New York city above 106th street, between the East and Harlem Rivers and Eighth Avenue. See NEW YORK CITY.

Harlem, Ill., village in Cook County; on the Illinois C. and the Chicago & N. W. R.R.'s; about seven miles from Chicago and near Oak Park. The first permanent settlement was made in 1854, and the village of Harlem was incorporated in 1883. It is a residential suburb of Chicago, and is noted for its race track (see HORSE-RACING). Waldheim and Forest Home cemeteries are in Harlem. A monument to the men executed as anarchists who were connected with the Chicago riots of 1886 is in the Waldheim cemetery. The government is vested in a president and board of trustees elected annually. Pop. (1900) 4,085.

Harlem Plains, Battle of, in the Revolutionary War, a conflict on 16 Sept. 1776, which followed Howe's occupation of New York and Manhattan Island. On the Harlem Plains or Flats an advance guard of British troops came into contact with a body of Virginian and Connecticut troops commanded respectively by Majors Leitch and Knowlton. In attempting to flank the enemy Knowlton was killed, and by Washington's orders the Americans retreated, with a loss of 60 killed and wounded.

Harlem River, the name given to the tidal channel north of the island of Manhattan, which separates the boroughs of Manhattan and the Bronx, in New York. The Harlem is connected with the Hudson River by Spuyten Duyvil Creek, and extends south by east about seven miles to East River. Randall's Island is at its entrance to East River. In 1895 a ship-canal was opened which connects the Hudson and the Harlem south of the Spuyten Duyvil channel. A number of bridges span the Harlem, the finest being High Bridge, an aqueduct bridge, and Washington Bridge which crosses the river a little north of a point opposite Fort Washington on the Hudson. Along the western shore is the excellent roadway called the Speedway, and on the same side of the river are the polo and ball grounds, the High Bridge park and a number of fine public and private buildings.

Harlequin, här'lē-kĭn or -kwĭn (French *arlequin*, Italian *arlecchino*), a word of doubtful origin, but probably from old French *Hellequin*, *Herlequin*, the name of a demon figuring in mediæval legends; this again is supposed to be of German origin, its elements corresponding to English "hell" and "kin." Riccoboni conjectures ('History of the Italian Theatre') that the dress of the harlequins is no other than the *centunculus* of the old Roman *mimi* or mimes, who were players in ridiculous pieces or farces of a loose character. The character of the ancient harlequin was a mixture of extravagant buffoonery with great bodily agility. But in the middle of the 16th century his character was essentially changed. He became a simple, ignorant servant, who tries very hard to be witty, even at the expense of being malicious. He is a chameleon, who assumes all colors, and can be made, in the hands of a skilful actor, the principal character on the stage. He must excel in extempore sallies. This account applies more particularly to the Italian harlequin. The gallant, obsequious French harlequin is an entirely national mask. In the vaudeville theatre he is silent, with a black half-mask, and reminds one throughout the representation of the grace and agility of the cat. In Great Britain, in the Christmas pantomimes, he becomes a lover and a magician; and in exchange for the gift of language, of which he has been deprived, he has been invested with a wonder-working wand. With this wand he protects his mistress, the columbine, against the clown and pantaloon, who pursue and endeavor to capture her, until the pursuit is brought to a termination by a good fairy. The harlequin wears a tight dress of bright colors, and glittering with spangles.

Harlequin Cabbage-bug. See CABBAGE-INSECTS.

Harlequin Duck. See DUCK.

Harlequin Snake. See CORAL SNAKE.

Har'ley, Robert, 1st EARL OF OXFORD, English statesman: b. London 5 Dec. 1661; d. 21 May 1724. After the accession of Anne he and his colleague St. John, afterward Lord Bolingbroke, became leaders of the Tories. The former was chosen speaker of the House of Commons in 1702, and was chief secretary of state 1704–8. After the fall of Marlborough Harley became chancellor of the exchequer in 1710 and next year was created Earl of Oxford. He and Bolingbroke secured the Treaty of Utrecht (1713), but afterward quarrelled. Early in the reign of George I. he was impeached of high treason on the ground of his alleged Jacobite intrigues, and was kept in the Tower for two years, but owing to the inability of the Peers and the Commons to agree about the mode of procedure, was acquitted. His patronage was extended to Swift, Pope, and other literary men, and he made a valuable collection of books and MSS., which latter are preserved in the British Museum, where they form the 'Bibliotheca Harleiana.' Those which have been printed constitute the 'Harleian Miscellany.'

Harlow, här'lō, **George Henry**, English painter: b. London 10 June 1787; d. there 4 Feb. 1819. After studying under other masters, he entered the studio of Sir Thomas Lawrence, who used to employ him to dead color. In 1818 he visited Rome, where he astonished the artists there by completing an effective copy of the 'Transfiguration' of Raphael in 18 days. This gained him the friendship of Canova, who procured his election as a member of the Academy of St. Luke. His best original works are two designs from Shakespeare, 'Hubert and Prince Arthur,' and the 'Trial of Queen Catharine.' The principal characters in the latter are portraits of members of the Kemble family; and the figure of Queen Catharine is a likeness of Mrs. Siddons (q.v.). He was eminent as a portrait painter, and his portrait of Fuseli is regarded as a work of great merit.

Harlowe, Clarissa, a novel published by Samuel Richardson in 1748. The story is told by means of letters, and while somewhat prolix for modern taste, is an accurate record of many of the manners and ideals of the 18th century.

Har'maline and **Harmine,** two alkaloids which occur, probably in the form of phosphates, in the seed-coatings of the harmel or Syrian rue (*Peganum harmala*), a plant growing in the Mediterranean region and in southern Asia. The seeds are extracted with dilute acetic or sulphuric acid, and the hydrochlorids of the two alkaloids are precipitated by the addition of common salt. The precipitate is washed with salt solution, and afterward with water, in which the hydrochlorids dissolve. The filtrate is clarified by animal charcoal and heated to 140° F., after which ammonia is added. Harmine is precipitated first, and by the continued addition of ammonia the harmaline is thrown down subsequently. Harmine has the formula $C_{13}H_{12}N_2O$. It is practically insoluble in ether, and is but slightly soluble in water. It dissolves in alcohol, from which it crystallizes in colorless monoclinic prisms, melting at 495° F. Harmaline is the hydrid of harmine, and has the formula $C_{13}H_{14}N_2O$. It is somewhat soluble in water, ether, and cold alcohol, and dissolves freely in hot alcohol. It crystallizes from solution in alcohol in the form of octahedra belonging to the trimetric system, and melts at about 460° F. The salts of harmine are mostly colorless, while those of harmaline are yellow; and the salts of both of these bases exhibit marked fluorescence. The name «harmaline» is also applied to the coloring matter now more commonly known as fuchsine.

Har'mar, Josiah, American soldier: b. Philadelphia 1753; d. there 20 Aug. 1813. He entered the patriot army as captain, became colonel in 1777, served with Washington (1778–80) and with Greene in the South. In 1784 he brought to France the ratification of the final treaty. In 1789 he was made brigadier-general in the United States army, and was general-in-chief of the army from 1789 to 1792. He conducted an expedition against the Miami Indians, which suffered a severe defeat, and shortly afterward resigned his commission. From 1793–9 he was adjutant-general of Pennsylvania.

Harmattan, här-măt'an, a land-wind, very dry and hot, blowing upon the coast of Africa between Cape Verde, in lat. 14° 43′ N., and Cape Lopez, lat. 0° 36′ S., during December, January, and February. It is generally attended by fog, through which the sun shines red. It hurts vegetation and injuriously affects man, drying up the eyes, the mouth, etc., even peeling off the skin. On the other hand, it tends to terminate fever and dysentery, and to mitigate cutaneous diseases. It corresponds to the sirocco of Italy and, to a certain extent, to the Indian and Australian hot wind.

Harmodius (här-mō'dĭ-ŭs) and **Aristogiton,** ā-rĭs-tō-jī't'n, two Athenian youths who in 514 B.C. killed Hipparchus, the younger brother of the tyrant Hippias, partly because of an insult offered to the sister of Harmodius, and partly with a view to the overthrow of the Pisistratidæ. Harmodius was slain by the soldiers of Hipparchus, while Aristogiton fled, but was afterward taken and executed. Subsequently they came to be regarded as patriotic martyrs, and received divine honors from the Athenians, and had statues raised to their memory. They were strongly attached to each other, and are sculptured in a group in the Museo Nazionale, Naples, copied from the bronze originals which once adorned the Acropolis at Athens.

Har'mon, Judson, American jurist: b. Hamilton County, Ohio, 3 Feb. 1846. He was graduated at Denison University, 1866, and at Cincinnati Law School, 1869. He was judge of the common pleas court (1876–8); judge of the superior court of Cincinnati, 1878–87; and attorney-general of the United States, 1896–7. He is president of the Ohio Bar Association, and a member of the faculty in the law department of the University of Cincinnati.

Harmonic Analysis, The. «The Harmonic Analysis» is the name first given by Thomson and Tait in their 'Natural Philosophy' to a method extensively and fruitfully employed in investigations in many branches of Mathematical Physics, and first used by Daniel Bernouilli and Euler in the middle of the eighteenth century in studying the musical vibrations of a stretched elastic string.

From the physical side it is described by J. Clerk Maxwell as «a method by which the solution of an actual problem may be obtained as the sum or resultant of a number of terms, each of which is a solution of a particular case of the problem.» The method is applicable to physical problems where the actual complicated state under investigation can be regarded as due to the superposition of a number of simpler states that can coexist without interfering with one another.

For example, in dealing with the small oscillations of a musical string it is known that the string is capable of sounding a variety of so-called pure notes, known as the fundamental note, the first harmonic or octave of the fundamental note, and the higher harmonics of the fundamental note, and that the forms of vibration giving these various notes may coexist, so that the string may be sounding at once its fundamental note and its various harmonics and thus be giving a note quite distinguishable from its pure fundamental note though of the same pitch. If we are dealing with the problem of the motion of a string sounding such a complicated note, the harmonic analysis enables us to obtain and to express its solution as a sum of the terms expressing the motions which separately would give the separate pure notes actually present.

From the mathematical side the problems to which the harmonic analysis is applicable are those in which it is necessary to find a solution of a homogeneous linear differential equation which shall satisfy a set of given initial or boundary conditions sufficiently numerous to make the problem determinate. It is well known that if a solution of such a differential equation has been obtained, it may be multiplied by any constant and will still be a solution; and that if several solutions have been obtained, their sum will be a solution. In using the harmonic analysis we attempt by a skilful use of these two principles to so combine simple particular solutions of the differential equation involved in the problem as to form a solution of the equation which satisfies all the given conditions. This usually makes it necessary to analyze some one of the given conditions into a sum or series of simpler so-called harmonic terms, or in other words to develop some function of one of the independent variables, or of a set of the independent variables into a series whose terms are of specified form.

For instance, suppose a harp-string of length l initially distorted into a curve whose equation referred to the position of equilibrium of the string as the X-axis and to one end of the string as origin is $y=f(x)$, and then released, and that it is required to solve the problem of the subsequent motion of the string, the initial displacement being small.

Here we have to solve the differential equation

$$\frac{\partial^2 y}{\partial t^2}=a^2\frac{\partial^2 y}{\partial x^2}, \qquad (I)$$

subject to the conditions $y=0$ when $x=0$; $y=0$ when $x=l$; $\frac{\partial y}{\partial t}=0$ when $t=0$; $y=f(x)$ when $t=0$. It is known and is easily verified that $y=\sin\beta x\cos a\beta t$ is a particular solution of (I) if β is any constant. If we take $\beta=\frac{m\pi}{l}$, where m is any whole number, $y=\sin\frac{m\pi x}{l}\cos\frac{m\pi at}{l}$ is a solution of (I) which satisfies our first three conditions; and so is

$$y=a_1\sin\frac{\pi x}{l}\cos\frac{\pi at}{l}+a_2\sin\frac{2\pi x}{l}\cos\frac{2\pi at}{l}$$
$$+a_3\sin\frac{3\pi x}{l}\cos\frac{3\pi at}{l}+\ldots, \qquad (1)$$

where a_1, a_2, a_3, ... are any constants. When $t=0$ (1) reduces to

$$y=a_1\sin\frac{\pi x}{l}+a_2\sin\frac{2\pi x}{l}+a_3\sin\frac{3\pi x}{l}+\ldots, \qquad (2)$$

and if we can choose a_1, a_2, etc., so that the series in (2) is equal to $f(x)$ for all values of x between 0 and l, (1) becomes our required solution. This calls for the development of $f(x)$ into a Trigonometric Series of somewhat peculiar form known as a Fourier's Series, and when that is accomplished our solution is complete.

Fourier's Series.—It was first shown by Fourier in his researches into the Conduction of Heat in 1812 that

$$f(x)=\frac{1}{2}b_0+b_1\cos\frac{\pi x}{c}+b_2\cos\frac{2\pi x}{c}+b_3\cos\frac{3\pi x}{c}+\ldots$$
$$+a_1\sin\frac{\pi x}{c}+a_2\sin\frac{2\pi x}{c}+a_3\sin\frac{3\pi x}{c}+\ldots, \qquad (3)$$

where $\qquad a_m=\frac{1}{c}\int_{-c}^{c}f(x)\sin\frac{m\pi x}{c}dx,$

and $\qquad b_m=\frac{1}{c}\int_{-c}^{c}f(x)\cos\frac{m\pi x}{c}dx,$

for all values of x between $-c$ and c.

If $f(-x)=-f(x)$, that is, if $f(x)$ is an odd function, (3) reduces to

$$f(x)=a_1\sin\frac{\pi x}{c}+a_2\sin\frac{2\pi x}{c}+a_3\sin\frac{3\pi x}{c}+\ldots, \qquad (4)$$

where $\qquad a_m=\frac{2}{c}\int_0^c f(x)\sin\frac{m\pi x}{c}dx.$

If $f(-x)=f(x)$, that is, if $f(x)$ is an even function, (3) reduces to

$$f(x)=\frac{1}{2}b_0+b_1\cos\frac{\pi x}{c}+b_2\cos\frac{2\pi x}{c}$$
$$+b_3\cos\frac{3\pi x}{c}+\ldots, \qquad (5)$$

where $\qquad b_m=\frac{2}{c}\int_0^c f(x)\cos\frac{m\pi x}{c}dx.$

If the development need hold good merely for values of x between 0 and c, any one of the forms given above may be employed.

Harmonic Functions.—Laplace's Equation,

$$\frac{\partial^2 V}{\partial x^2}+\frac{\partial^2 V}{\partial y^2}+\frac{\partial^2 V}{\partial z^2}=0, \qquad (II)$$

in the numerous forms it assumes in different systems of coordinates plays a larger part in the various branches of mathematical physics than any other differential equation, and the harmonic analysis is required in a large proportion of the physical problems that obey the law it expresses.

A function which together with its first space derivatives is continuous within a specified region and which satisfies Laplace's equation at every point within the region is said to be *harmonic* in the region in question.

The form to which a harmonic function reduces on one of the level surfaces of the appropriate coördinate system is called a *Surface Harmonic.*

Zonal Harmonics.—The coefficient of z^m in the development of $(1-2\mu z+z^2)^{-\frac{1}{2}}$ in ascending powers of z, where $\mu=\cos\theta$, is represented by $P_m(\mu)$ and is called a *Surface Zonal Harmonic* of the mth degree, or a *Legendre's Coefficient* or *Legendrian.*

It can be shown that $V=r^m P_m(\cos\theta)$ and $V=\frac{1}{r^{m+1}}P_m(\cos\theta)$ are particular solutions of Laplace's equation in spherical coördinates,

$$\frac{r\partial^2(rV)}{\partial r^2}+\frac{1}{\sin\theta}\frac{\partial\left(\sin\theta\frac{\partial V}{\partial\theta}\right)}{\partial\theta}+\frac{1}{\sin^2\theta}\frac{\partial^2 V}{\partial\phi^2}=0. \quad (III)$$

They are called *Solid Zonal Harmonics.* The first form is harmonic within the sphere whose centre is at the origin of coordinates and whose radius is unity, and the second form is harmonic in all space outside of that sphere. They are appropriate functions to use in solving problems where a solution of (III) is required, if it is evident from considerations of symmetry that the solution is independent of the coordinate ϕ.

$$P_m(\mu)=\frac{1\cdot3\cdot5\cdot\ldots(2m-1)}{1\cdot2\cdot3\cdot\ldots m}\left[\mu^m-\frac{m(m-1)}{2(2m-1)}\mu^{m-2}\right.$$
$$\left.+\frac{m(m-1)(m-2)(m-3)}{2\cdot4\cdot(2m-1)(2m-3)}\mu^{m-4}\ldots\right],$$

whence

$P_0(\mu)=1,\qquad P_2(\mu)=\frac{1}{2}(3\mu^2-1),$

$P_1(\mu)=\mu,\qquad P_3(\mu)=\frac{1}{2}(5\mu^3-3\mu),$

$P_4(\mu)=\frac{1}{8}(35\mu^4-30\mu^2+3),$

$P_5(\mu)=\frac{1}{8}(63\mu^5-70\mu^3+15\mu).$

. . . .

A very important property of the Surface Zonal Harmonic $P_m(\mu)$ which follows readily from its definition is $P_m(1)=1$. That is, the function reduces to unity at all points on the polar axis.

If, in a problem where V must satisfy Laplace's Equation and there is symmetry about the polar axis, the value of V on the axis is represented by a convergent series $a_0+a_1z+a_2z^2+\ldots$, z being the distance of the point from the origin, then the series formed by writing $r^mP_m(\cos\theta)$ instead of z^m in the given series gives the value of V at any point in space at which the new series is convergent. If the value of V on the axis is represented by a convergent series $\frac{a_1}{z}+\frac{a_2}{z^2}+\frac{a_3}{z^3}+\ldots$, then the series formed from the given series by replacing $\frac{1}{z^{m+1}}$ by $\frac{1}{r^{m+1}}P_m(\cos\theta)$ gives the value of V at any point in space at which the new series is convergent.

For instance, if a charge M of statical electricity be placed on a conductor in the form of a thin circular disc of radius a, it is known that the charge will so distribute itself that the surface density σ at any point of the disc at the distance s from its center will be $\sigma=\frac{M}{4a\pi\sqrt{a^2-s^2}}$.

If the axis of the disc is taken as the polar axis, the value of the Potential Function V due to the charge, at a point of the axis at the distance x from the centre is $V=\frac{M}{2a}\cos^{-1}\left(\frac{x^2-a^2}{x^2+a^2}\right)$. This can be developed into the series

$$\frac{M}{a}\left[\frac{\pi}{2}-\frac{x}{a}+\frac{x^3}{3a^3}-\frac{x^5}{5a^5}+\ldots\right] \quad\text{if}\quad x<a,$$

$$\text{or}\quad \frac{M}{a}\left[\frac{a}{x}-\frac{a^3}{3x^3}+\frac{a^5}{5x^5}-\frac{x^7}{7a^7}+\ldots\right] \quad\text{if}\quad x>a.$$

Hence

$$V=\frac{M}{a}\left[\frac{\pi}{2}-\frac{r}{a}P_1(\cos\theta)+\frac{1}{3}\frac{r^3}{a^3}P_3(\cos\theta)\right.$$
$$\left.-\frac{1}{5}\frac{r^5}{a^5}P_5(\cos\theta)+\ldots\right] \quad\text{if } r<a, \text{ and } \theta<\frac{\pi}{2};$$

and

$$V=\frac{M}{a}\left[\frac{a}{r}-\frac{1}{3}\frac{a^3}{r^3}P_2(\cos\theta)+\frac{1}{5}\frac{a^5}{r^5}P_4(\cos\theta)-\ldots\right]$$
$$\text{if}\quad r>a.$$

If, in a problem where V must satisfy Laplace's Equation and there is symmetry about an axis, the value of V on the surface of the sphere $r=a$ is given and can be expressed as a sum or as a series of Surface Zonal Harmonics, the value of V at a point not on the sphere will be obtained by replacing the Surface Zonal Harmonics by the appropriate Solid Zonal Harmonics.

To take a very simple example: If a charge of electricity is placed on a spherical conductor of radius a, it is known that it will so distribute itself that all points on the surface will be at the same potential $\frac{M}{a}$.

Now $\frac{M}{a}=\frac{M}{a}P_0(\cos\theta)$ and is a Surface Zonal Harmonic. Hence any point at the distance r from the centre of the conductor is at potential $\frac{M}{a}\frac{r^0}{a^0}P_0(\cos\theta)$ or $\frac{M}{a}$ if $r<a$, and at potential $\frac{M}{a}\frac{a}{r}P_0(\cos\theta)$ or $\frac{M}{r}$ if $r>a$.

If the value of V on the surface of the sphere had been less simple, say $V=F(\theta)=f(\cos\theta)\equiv f(\mu)$, then $f(\mu)$ would have had to be expressed in the form $a_0P_0(\mu)+a_1P_1(\mu)+a_2P_2(\mu)+\ldots$ before we could have used the simple method illustrated above. This can be done by the aid of the formula

$$f(\mu)=a_0P_0(\mu)+a_1P_1(\mu)+a_2P_2(\mu)+a_3P_3(\mu)+\ldots,$$

where $a_m=\frac{2m+1}{2}\int_{-1}^{1}f(x)P_m(x)dx$, the development in question holding good when $-1<\mu<1$.

For instance, let one half of the surface of a homogeneous sphere be kept at the temperature zero and the other half at the temperature 1; to find the stationary temperature u of any internal point. Here $f(\mu)=1$, $0<\mu<1$, and $f(\mu)=0$, $-1<\mu<0$. Consequently

$$a_m=\frac{2m+1}{2}\left[\int_{-1}^{0}0\cdot P_m(x)dx+\int_{0}^{1}P_m(x)dx\right]$$
$$=\frac{2m+1}{2}\int_0^1 P_m(x)dx.$$

Letting $m=0, 1, 2, \ldots$, successively, and using the corresponding values 1, x, $\frac{1}{2}(3x^2-1)$, etc., of $P_m(x)$, we get $a_0=\frac{1}{2}$, $a_1=\frac{3}{4}$, $a_2=0$, $a_3=-\frac{7}{8}\cdot\frac{1}{2}$, $a_4=0$, $a_5=\frac{11}{12}\cdot\frac{1}{2}\cdot\frac{3}{4}$, ... and $f(\mu)=\frac{1}{2}P_0(\mu)+\frac{3}{4}P_1(\mu)-\frac{7}{8}\cdot\frac{1}{2}P_3(\mu)+\frac{11}{12}\cdot\frac{1}{2}\cdot\frac{3}{4}P_5(\mu)-\ldots$

If a is the radius of the sphere, the required temperature

$$u=\frac{1}{2}+\frac{3}{4}\frac{r}{a}P_1(\cos\theta)-\frac{7}{8}\cdot\frac{1}{2}\frac{r^3}{a^3}P_3(\cos\theta)$$
$$+\frac{11}{12}\cdot\frac{1}{2}\cdot\frac{3}{4}\frac{r^5}{a^5}P_5(\cos\theta)\ldots$$

Tables giving the numerical values of the Surface Zonal Harmonics have been computed and are accessible, and by their aid numerical results can be obtained in such problems as those we have been considering as readily as if we were using simple trigonometric functions. The following is such a table carried only to three places.

TABLE 1.—SURFACE ZONAL HARMONICS.

θ	$P_1(\cos\theta)$	$P_2(\cos\theta)$	$P_3(\cos\theta)$	$P_4(\cos\theta)$	$P_5(\cos\theta)$
0°	1.000	1.000	1.000	1.000	1.000
10	.985	.955	.911	.853	.784
20	.940	.824	.665	.475	.272
30	.866	.625	.325	.023	−.223
40	.766	.380	−.025	−.319	.420
50	.643	.120	−.300	−.428	.254
60	.500	−.125	−.438	−.289	.000
70	.342	−.324	−.413	−.004	.328
80	.174	−.455	−.247	.266	.281
90	.000	−.500	.000	.375	.000

Legendrians were first used by Legendre in a paper published in 1785 on the attraction of solids of revolution.

Laplace's Coefficients. — $P_m(\cos\gamma)$, where $\gamma\equiv\cos\theta\cos\theta_1+\sin\theta\sin\theta_1\cos(\phi-\phi_1)$, and is the angle made by the radius vector with a fixed line through the origin whose direction is given by the angles θ_1 and ϕ_1, is called a Laplace's Coefficient or Laplacian, the fixed line being called the Axis and its intersection with the unit sphere the Pole of the Laplacian. A Surface Zonal Harmonic $P_m(\cos\theta)$ is merely a Laplacian whose axis coincides with the axis of coordinates. $r^m P_m(\cos\gamma)$ and $\frac{1}{r^{m+1}}P_m(\cos\gamma)$ are solutions of Laplace's Equation (III). The first is harmonic within and the second without the unit sphere.

Laplacians may be used in problems symmetrical about an axis if the axis does not coincide with the axis of coordinates just as Zonal Harmonics are used when the problem is symmetrical about the polar axis.

Laplacians were first used by Laplace, in one of the most remarkable memoirs ever written, in determining the attraction of a Spheroid. The paper in question was published in 1782.

Spherical Harmonics.—A Surface Spherical Harmonic of the mth degree Y_m may be most simply defined as the function obtained by dividing a rational, integral, homogeneous, algebraic polynomial of the mth degree in x, y, z which satisfies Laplace's Equation (I), by r^m, that is, by $(x^2+y^2+z^2)^{\frac{m}{2}}$. For example, $\frac{1}{r}(x+y+z)$, $\frac{1}{r^2}(x^2+xy+y^2)$, $\frac{1}{r^3}(2x^3-3xy^2-3xz^2)$ are Surface Spherical Harmonics of the first degree, of the second degree, and of the third degree, respectively.

It is clear that $r^m Y_m$ satisfies Laplace's Equation. The same thing can be shown of $\frac{1}{r^{m+1}}Y_m$. The first is harmonic within, the second without, the unit sphere. They are known as Solid Spherical Harmonics.

It is clear that if the value of V on the surface of a sphere whose centre is the origin can be expressed as a sum of terms each of which is a surface Spherical Harmonic, its value at any point not on the surface is the sum of the appropriate corresponding Solid Spherical Harmonics.

It can be shown by transforming from spherical to rectangular coördinates that the Surface Zonal Harmonic $P_m(\mu)$ or $P_m(\cos\theta)$ and the Laplacian $P_m(\cos\gamma)$ are Surface Spherical Harmonics, and by the reverse transformation that the general Surface Spherical Harmonic Y_m can be formulated as

$$Y_m = A_0 P_m(\mu)$$

$$+\sum_{n=1}^{n=m}\left[(A_n\cos n\phi + B_n\sin n\phi)\sin^n\theta\frac{d^nP_m(\mu)}{d\mu^n}\right].$$

A function given arbitrarily on the surface of the unit sphere, i.e., a function of θ and ϕ, if expressed as a function of $\cos\theta$ and ϕ can be developed into a series of Surface Spherical Harmonics by the formulas

$$f(\mu,\phi) = \sum_{m=0}^{m=\infty}\left\{A_{0,m}P_m(\mu) + \sum_{n=1}^{n=m}\left[(A_{n,m}\cos n\phi\right.\right.$$

$$\left.\left.+B_{n,m}\sin n\phi)\sin^n\theta\frac{d^nP_m(\mu)}{d\mu^n}\right]\right\},$$

$$A_{0,m} = \frac{2m+1}{4\pi}\int_0^{2\pi}d\phi\int_{-1}^{1}f(\mu,\phi)P_m(\mu)d\mu,$$

$$\frac{2\pi}{2m+1}\frac{(m+n)!}{(m-n)!}A_{n,m}$$

$$=\int_0^{2\pi}\int_{-1}^{1}f(\mu,\phi)\cos n\phi\sin^n\theta\frac{d^nP_m(\mu)}{d\mu^n}d\mu,$$

$$\frac{2\pi}{2m+1}\frac{(m+n)!}{(m-n)!}B_{n,m}$$

$$=\int_0^{2\pi}d\phi\int_{-1}^{1}f(\mu,\phi)\sin n\phi\sin^n\theta\frac{d^nP_m(\mu)}{d\mu^n}d\mu.$$

The following theorems concerning the integration of Spherical Harmonics are important. We give them without proof.

The integral of the product of two Surface Spherical Harmonics $Y_m Y_n$ of different degrees taken over the surface of the unit sphere is equal to zero.

The integral over the surface of the unit sphere, of the product of a Surface Spherical Harmonic by a Laplacian of the same degree, is $\frac{4\pi}{2m+1}$ multiplied by the value the Spherical Harmonic assumes at the Pole of the Laplacian.

These theorems enable us to solve many problems in the theory of Gravitation and the theory of Electrostatics by direct integration.

Bessel's Functions.—A Bessel's Function or Surface Cylindrical Harmonic of the nth order $J_n(x)$ may be defined as the coefficient of z^n in the development of $e^{\frac{x}{2}\left(z+\frac{1}{z}\right)}$ into an ascending Power Series in z. It can be shown that

$$V=\cosh(\mu z)(A\cos n\phi + B\sin n\phi)J_n(\mu r)$$

and

$$V=\sinh(\mu z)(A\cos n\phi + B\sin n\phi)J_n(\mu r),$$

where μ is any constant, are solutions of Laplace's Equation in Cylindrical Coördinates

$$\frac{\partial^2 V}{\partial r^2}+\frac{1}{r}\frac{\partial V}{\partial r}+\frac{1}{r^2}\frac{\partial^2 V}{\partial\phi^2}+\frac{\partial^2 V}{\partial z^2}=0. \qquad \text{(IV)}$$

The Bessel's Functions most used are $J_0(x)$ and $J_1(x)$, which are appropriate when the problem has axial symmetry about the Axis of Z.

$$J_0(x) = 1 - \frac{x^2}{2^2} + \frac{x^4}{2^2\cdot 4^2} - \frac{x^6}{2^2\cdot 4^2\cdot 6^2} + \ldots,$$

and is convergent for all values of x.

$$J_1(x) = -\frac{dJ_0(x)}{dx}.$$

Important properties are given by the formulas

$$\int_0^x xJ_0(x)dx = xJ_1(x)$$

and

$$\int_0^x x\{J_0(x)\}^2dx = \tfrac{1}{2}x^2[\{J_0(x)\}^2+\{J_1(x)\}^2],$$

and the following formulas for development in Cylindrical Harmonic Series, the development holding good for values of r between 0 and a.

$$f(r) = \Sigma A_\kappa J_0(\mu_\kappa r),$$

where μ_κ is a root of the transcendental equation in μ, $J_0(\mu a)=0$, or of $J_1(\mu a)=0$, or of

$$\mu a J_1(\mu a) - \lambda J_0(\mu a) = 0,$$

and

$$A_\kappa = \frac{2}{a^2[\{J_0(\mu_\kappa a)\}^2 + \{J_1(\mu_\kappa a)\}^2]} \int_0^a r f(r) J_0(\mu_\kappa r) dr.$$

For the important case where $f(r) = 1$,

$$A_\kappa = \frac{2}{\mu_\kappa a[\{J_0(\mu_\kappa a)\}^2 + \{J_1(\mu_\kappa a)\}^2]} J_1(\mu_\kappa a).$$

As an example in the use of Bessel's Functions let us find the stationary temperature of any point (r, z) in a homogeneous cylinder of radius a and altitude b if the convex surface and one base are kept at the temperature zero and the other base at the temperature 1.

Here we seek a solution V of equation (IV) which reduces to zero when $z = 0$, and when $r = a$, and to 1 when $r = b$. By the aid of the formulas above this is easily formed and is

$$V = \frac{2}{\mu_1 a J_1(\mu_1 a)} \frac{\sinh(\mu_1 z)}{\sinh(\mu_1 b)} J_0(\mu_1 r)$$

$$+ \frac{2}{\mu_2 a J_1(\mu_2 a)} \frac{\sinh(\mu_2 z)}{\sinh(\mu_2 b)} J_0(\mu_2 r)$$

$$+ \frac{2}{\mu_3 a J_1(\mu_3 a)} \frac{\sinh(\mu_3 z)}{\sinh(\mu_3 b)} J_0(\mu_3 r) + \ldots$$

If numerical results are desired, tables for $J_0(x)$ and $J_1(x)$ are needed. Such tables have been computed and are accessible. We give here a small three-place one.

TABLE II.—BESSEL'S FUNCTIONS.

x	$J_0(x)$	$J_1(x)$	x	$J_0(x)$	$J_1(x)$
0.0	1.000	0.000	5.0	−.178	−.328
0.5	.938	.242	5.5	−.007	−.341
1.0	.765	.440	6.0	.151	−.277
1.5	.512	.558	6.5	.260	−.154
2.0	.224	.577	7.0	.300	−.005
2.5	−.048	.497	7.5	.266	.135
3.0	−.260	.339	8.0	.172	.235
3.5	−.380	.137	8.5	.042	.273
4.0	−.397	−.066	9.0	−.090	.245
4.5	−.320	−.231	9.5	−.194	.161
5.0	−.178	−.328	10.0	−.246	.044

TABLE III.—ROOTS OF BESSEL'S FUNCTIONS.

n	x_n for $J_0(x_n) = 0$.	x_n for $J_1(x_n) = 0$.
1	2.405	3.832
2	5.520	7.016
3	8.654	10.173

Bessel's Functions of the zeroth order were first used successfully in the Harmonic Analysis by Fourier in 1812, in dealing with the flow of heat in a right circular cylinder.

Other more complicated Harmonic Functions are Lamé's Functions or Ellipsoidal Harmonics, Conal Harmonics, Toroidal Harmonics, etc. Each set is adapted to dealing with Laplace's Equation expressed in a suitable system of Curvilinear Coördinates.

Bibliography.—For general treatises on the Harmonic Analysis and on the Harmonic Functions the reader is referred to Heine, 'Handbuch der Kugelfunktionen' (second edition, 1878); Todhunter, 'The Functions of Laplace, Lamé, and Bessel' (1875); Thomson and Tait, 'Natural Philosophy' (Appendix B, 1879); Ferrers, 'Spherical Harmonics' (1881); Byerly, 'Fourier's Series, and Spherical Harmonics' (1895); Gray and Matthews, 'Bessel's Functions' (1895). An excellent account of the history of the subject with detailed references to the early papers, memoirs, and other publications, prepared by Professor M. Bôcher, will be found at the end of Byerly's above-mentioned treatise. For the contemporary literature see the recent volumes of the 'Jahrbuch uber die Fortschritte der Mathematik' under the heading Kugelfunktionen und verwandte Funktionen.

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Harmon'ica, a musical instrument invented by Benjamin Franklin in 1762. It is formed of a number of glasses of water, and is played by touching them with the dampened finger. The less the quantity of water, the lower the tone of the scale. The name is also applied to a small wind instrument, or mouth-organ, which has a series of holes to conduct the breath to free reeds, like those of an accordion.

Harmon'icon, a chemical apparatus consisting of an open glass tube, the air in which may be made to give a sound resembling a musical note, when held over burning hydrogen. The note depends upon the size of the flame and the length of the tube.

Harmon'ics, the accessory or collateral sounds accompanying the primary, fundamental, or predominant tone of any string, pipe, or other sonorous body, and constituting in varying degrees what in English is known as «quality,» in French as «timbre,» and in German as «Klangfarbe.» No purely simple sound—one whose vibrations are all in the same period—is producible. When a sound is produced by the vibration of an open string, the whole string vibrates as a unity, giving rise to a tone called the fundamental. The string, however, further divides into various sections, which vibrate separately and more rapidly, and produce sounds—the harmonics—differing from the fundamental, but bearing certain fixed proportions to it. By whatever vibrating body a musical sound is evoked harmonics also are produced; and although some of the harmonics are suppressed by modifying circumstances, some are always present. There is a regular succession of intervals in which the harmonics naturally accompany a fundamental sound, which is represented in the following scale of vibrations: 1 2 3 4 5 6 7, etc. These also are the intervals which produce the successive chords in harmony, although the natural harmonics when produced further go beyond the range of harmony which human ears can recognize or musical instruments produce at the will of the performer. (See illustration.) 1 is the interval of the octave; 2 is the fifth; 3 is the fourth; 4 is the major third; 5 the minor third; from 6 to 7 is already beyond the range of production on a keyed instrument, but is recognized by musicians as the complement of a four-part simple chord, and is represented approximately on the pianoforte, by E flat, for example, for the key of F.

A musical tone, then, is always complex, but the harmony which attends it is not always the same. The different structure of different instruments suppresses now some, now others, of the succession of harmonics, and a different body of tone is thus produced, distinguishing a note in one instrument from the same note in another. Hence the distinctive construction of the pianoforte in which dissonant harmonics are suppressed, and on the other hand, the use in the organ of mutation and mixture stops—the thirteenths and fifteenths — whereby the consonant harmonics of a given tone are much emphasized. Again, many of the higher harmonics are strongly dissonant both with the fundamental tone and with each other, whence arises the discordant quality of such instruments for instance as the cymbals. Harmonics are also called «overtones,» and all the primary and secondary tones constituting an actual tone are frequently termed «partials» or «partial tones,» the fundamental tone being the first partial, and the harmonics, the upper partials. See HARMONY.

Harmonics, Spherical. See HARMONIC ANALYSIS.

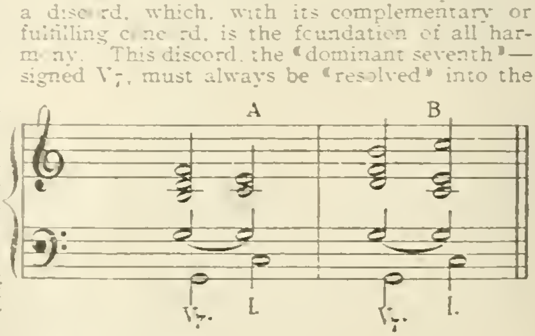
Har'monists, also called RAPPISTS and ECONOMITES, a religious-socialistic community founded in 1757 by George Rapp (1757–1847), a German of Würtemberg. The peaceable and spiritual tenets of the organization aroused antagonism and persecution, and in 1803 they emigrated to America, settling in the Connoquenessing Valley, where the Harmony Society was established on a working basis. By 1808, houses, churches, mills, and manufactories had been built, and the settlement had a population of 750 persons. In 1815 they removed to Posey County, Ind., where they founded New Harmony (q.v.); 10 years later, however, they returned to Pennsylvania, and built the township of Economy, in Beaver County, on the Ohio, 20 miles north of Pittsburg. In 1832, a German adventurer, Bernhard Muller, settling among them, caused dissensions and a split in the society; a separation and apportionment of the property was agreed upon, and 250 members retired. They held all property in common, believed in the second coming of Christ, the near advent of the millennium, and practised celibacy. As a result of the latter condition, the membership in 1902 was reduced to eight, and the valuable estate will pass finally into the hands of the last survivor. Consult Hinds, 'American Communities' (1902). Nordhoff, 'The Communistic Societies of the United States' (1874).

Harmon'ium, a modern musical instrument which produces sounds resembling those of the organ. The invention is ascribed to Alexandre Debain of Paris; but he has at the most merely the credit of perfecting an instrument previously known, called the *orgue expressif*, a kind of organ furnished with an apparatus of free vibrating reeds, intended to increase or diminish the intensity and volume of the sound, by regulating the pressure of the wind, by the aid of which the sounds were produced. The instrument has a keyboard like that of a piano, and when one of the keys is pressed down a valve is opened, which allows the wind from the bellows to rush through one of the wind-boxes and act on the vibrator. There are also several stops, like organ stops, by means of which the performer can direct the stream of wind into the wind-boxes, which produce a flute, clarinet, or any other sound, according to the number of stops which the instrument possesses. Such is the harmonium which was patented by Debain in 1840, but since that time various other improvements of more or less value have been made. The chief of these are the addition of a knee action, which either serves as an expression stop, or brings all the stops of the instrument into play at once, and what is called the percussion action, the invention of Kaufmann of Dresden, which consists in the application of a small hammer, which strikes the vibrator as soon as the key is pressed down and thus aids the action of the wind.

Harmony, (from the Greek *ἁρμόζειν*, to join or fit together), in music is the science which controls the relationship of chords, and decides that of the dissonant elements in a discord to the fundamental concord; the fundamental law being that discord is an unfinished design which requires concord for its completion.

A chord, or combination of tones, in any scale or key may be a concord or discord. The one concord in a major key consists of the keynote or tonic with its major third and fifth. This means of course the tonic triad; but in every major key there are two other major triads, absolutely equal in consonance with the tonic triad—those founded on the dominant and subdominant. In a minor key the triad on the keynote consists of the tonic with a minor third and perfect fifth. The major third and fifth are the notes which produce, naturally, a perfect sound in combination; they are called «consonances,» and any foreign element is a «dissonance.» They can be inverted, that is, any tone of a chord can be in the bass or lowest part. (See FUNDAMENTAL NOTE, TONE, OR BASS.) This, the «common chord» or «major triad» makes a starting point and a point of finality, from which the harmonies proceed, diverge and converge, and into which they resolve themselves finally.

The seventh harmonic of nature (see HARMONICS), which is one semitone less than the seventh consecutive note in an ascending major scale, constitutes a minor seventh, and produces a discord, which, with its complementary or fulfilling concord, is the foundation of all harmony. This discord, the «dominant seventh»—signed V_7, must always be «resolved» into the



chord of the tonic (1) of the key to which it belongs. (See illustration.)

A is an example of «close,» B of «open» or «extended» harmony. The discord on G instinctively demanding the chord of C as its resolution, the note G, or the similar fifth degree in any scale, is called the «dominant»—signed V, of that key, and the chords and discords built on it constitute the dominant harmonies. Position B is the most satisfactory to the ear, because of the effect of finality induced by the resolution to the first position of the triad. The two chords together form the dominant or authentic cadence — the most important of those terminal phrases which serve the same purpose in music as the marks of punctuation in literary composition. "My country, 'tis of thee" exhibits examples of two other important cadences, showing at the same time how these mark the completion of more or less final musical periods.

I. V

V_7. vi

V_7. I.

The first period is closed at A by a "half" or "imperfect" cadence — that is, the order V.—I. is reversed; the second at B by a "false" or "deceptive" cadence — that is, the dominant chord, instead of proceeding to the tonic, "deceives" the ear by proceeding to another chord; the third period is brought to a close by the authentic cadence at C.

The dominant chord can also bear the more elaborate dissonances of the 9th, 11th, and 13th, as well as the 7th, but it is impossible here to enter into the varieties of discord — "suspensions," "double-root chords," etc., into the analogous discords which may be built on the tonic as a ground-note, or the chords belonging to the minor scale. Suffice it to say the effects which can be evolved from the almost innumerable inversions and involutions of single chords and combinations of chords are subject to stringent natural laws, and the possibilities of variety are infinite.

An important branch of harmony, however, must be mentioned, that is "modulation" or change from one key (or "mode") to another. Modern scales have had the relation of their intervals so modified (see Temperament) as to be approximately alike. By the addition of a single sharp or flat any melody can proceed from the key of C to G (with F♯), F (with B♭), or A minor (with G♯). These — the dominant, subdominant (next below the dominant), and the minor of the sixth degree — are the keys of the first relation, as out of the seven notes which constitute each scale six are present in the scale of C, thus providing as it were six more or less convenient bridges by which to pass from one key to the other. The conventionality of these modulations makes them inadequate to convey the more passionate coloring of modern music, and more striking changes to remoter keys are necessary. A favorite device with modern composers is to take advantage of the "tempered" system, and by using one note in two significations (for example, F×E♯) to secure means of startling and also of very tender effects in modulation.

Harmony comparatively is of modern growth. In counterpoint (q.v.), the science which preceded harmony, attention was given altogether to the correct progression of the individual voices or parts, while the combinations made by the voices at any moment were regarded as merely accidental. But unconsciously the ear of musicians was being cultivated, and in the richness of Palestrina's simpler writings was shown the possibility of obtaining undreamt-of effects from chords as integral units in a march of harmonies, rather than accidental combinations of independent melodies. One of the fundamental rules of counterpoint was that a dissonance must either be "prepared"— that is, it must appear as a consonance in the previous chord — or else it must be approached very gradually. This rule of the old science was disregarded by Monteverde (1608), who used unprepared discords, and at one blow released the new feeling for chords from its bondage to counterpoint.

Only those who understand counterpoint and harmony can appreciate the full importance of the new departure. It meant that discords were no longer mere variations of concords, but individual creations with an individual's rights and duties. The discord most easily used was the dominant seventh, the first discord produced by nature's harmonics; and so the relation of dominant to tonic — the central idea of all harmony — developed from an increasingly general tendency into a recognized rule. During the 17th century many experiments were made by Monteverde's followers, until at the end of the century Rameau's famous treatise called attention to the fact that all chords are derived from some note which is the generator or root, and the relationships of these roots govern the progressions of the harmonies. The less known, but hardly less important, researches of Tartini formed a good supplement to Rameau's theory; and the basis of scientific harmony established by these two works was not seriously disturbed even by the thorough investigation and the astonishing discoveries of Helmholtz, who extended the foundation and built a complete superstructure thereon. In the meantime, notwithstanding that theorists fought each other with great fierceness, the science made extraordinary progress under such practical harmonists as Bach, Mozart, and Beethoven, while Wagner, who handled any number of parts as easily as did Bach himself, so enlarged the possibilities of harmony that it is difficult to conceive of any further advance. Consult the manuals by Bannister, Bowman-Weitzmann, Jadassohn, Macfarren, Ouseley, Richter, and Riemann.

Harmony of the Spheres, a hypothesis of Pythagoras and his school, according to which the motions of the heavenly bodies produced a music imperceptible by the ears of mortals. He supposed these motions to conform to certain fixed laws, which could be expressed in numbers, corresponding to the numbers which give the harmony of sounds.

Harmotome, här'mō-tōm, a mineral of the zeolite family; a hydrous silicate of aluminum and barium, invariably occurring in twin crystals of various colors from white to red-brown.

Harms'worth, Alfred Charles, English newspaper proprietor: b. Chapelizod, County Dublin, Ireland, 15 July 1865. He is the principal proprietor of the London *Daily Mail*, and *Evening News*, as well as some 30 other English journals, and equipped the arctic expedition under F. G. Jackson in 1894.

Harnack, här'näk, **Adolf**, German theologian: b. Dorpat 7 May 1851. He began his studies in his native town in 1869 and in 1874 took up his residence at Leipsic, for the purpose of pursuing a course in church history, and was made extraordinary professor there in 1876, and ordinary professor of theology, first at Giessen in 1879, and eventually at Berlin 1889. In 1890 he was made a member of the Berlin Academy. He has been a prolific writer, both in theology and church history, and some of his books have given rise to much controversy; among his works are: 'Lehrbuch der Dogmengeschichte' (1894); 'Die Ueberlieferung und der Bestand der altchristlichen Litteratur' (1893); etc.

Har'ned, Virginia, American actress: b. Boston 1868. She became a member of a traveling company about 1884, in 1895 appeared as Trilby in P. M. Potter's dramatization of Du Maurier's story, and subsequently took various roles, including Alice Rousillon in 'Alice of Old Vincennes,' and the title-part in A. W. Pinero's 'Iris.' She was married to E. H. Sothern (q.v.) in 1896.

Harness and Saddlery Trade, The. It is extremely difficult to trace the history of the harness and saddlery industry in America as far back as the days of the colonies, for in that period of our existence as a nation oxen were so generally used for purposes of plowing and carting that harnesses were in small demand. Those were the days in which roads were so poor that driving could scarcely be regarded as a pleasure, and the equipments required in saddle riding were chiefly imported from England.

The first attempt to make saddlery hardware, one of the most important accessories to the saddlery trade, was inaugurated by Seth J. and Alvin North, at New Britain, Conn. Originally engaged in the blacksmithing business, they began to extend the facilities of their shop until they were finally making bridle-bits, and other harness equipments, including shoe-buckles, and rings to be used for a variety of purposes. All these articles were originally produced from wire drawn out by hand. Later, horse-power was introduced for this purpose, but it was many years before all the finishing work on these products, the polishing, the welding, etc., ceased to be a matter of manual labor. The discovery of a more rapid method of polishing was made by a blacksmith at Middletown, Conn., to whom Alvin North paid $25 to learn the process, which simply consisted in taking an old woolen stocking, which, after all the holes had been darned, was filled with the articles to be polished. A number of small pieces of soap were added, after which the stocking was dipped in a pail of warm water and was rubbed briskly between the hands. This method of polishing was finally improved by the substitution of canvas bags for the stockings, but, with this exception, no better process was found until the tumbling-barrels were introduced.

The advent of better roads, and the corresponding increase in the popularity of driving and riding, was the means of creating a greater demand for both saddlery and harness. To meet these requirements of the trade, factories were established at Newark, N. J., Hartford, Conn., St. Louis, Mo., Wheeling, W. Va., Louisville, Ky., and Cincinnati, O., but the greater part of the harness made in those days was suitable only for the heavy stages and wagons, which were then so generally utilized both for the transportation of passengers and in business traffic. At that period in our history the movement for the betterment of roads had been confined almost exclusively to the more populous sections of the East, and as the black soil of the western prairies made the use of wagons practically impossible during certain seasons of the year there was an insistent call for heavy riding saddles. Those that were made in foreign countries had proved to be utterly unsuited, either for the rough frontier life of the West, or for the hard usage which they received in the South, and, as the result of these conditions the manufacturers of saddlery, with the characteristic inventive genius of the Yankee, devised the tree made of wood, and covered with rawhide, with long skirts and fenders to act as a protection, both from the elements and the many deep quagmires which the rider was quite certain to encounter.

It was in 1828 that the Franklin Institute presented a medal to Seth Boyden for his achievement in inventing the first buckles and bits made of annealed cast iron. The discovery had been made by putting a few pounds of cast iron into an ordinary cooking stove, in which, in the process of baking, it became annealed, a process which was largely responsible for the early success of the manufacture of saddlery hardware in this country. About the same time, Peter Hayden, then 22 years of age, began to manufacture hames and saddlery at Auburn, N. Y. His shop was a small one, and as there was little demand for such goods in his neighborhood, he extended his trade by loading his sleigh or wagon with his stock and peddling it through Central New York and Canada. By these methods his business became so well established that, in 1835, he entered into a contract with the State of Ohio, by which he agreed to furnish employment for its convict labor in the making of hames, saddle-trees, saddlery hardware, and chains. At times he employed upward of 300 convicts, to say nothing of a large force of free labor, and he was soon able to open connections for the sale of his product with the largest mercantile houses in Chicago, St. Louis, Cincinnati, Detroit, Galveston, San Francisco, and New York. Thus, from a small beginning, for Hayden's business netted but a few thousand dollars during the first years of its existence, he increased his trade until it reached millions, while it was largely due to his control of the domestic market that the importations of foreign saddlery almost entirely ceased.

The first horse-collars regularly manufactured in this country were made by Timothy Deming, in East Hartford, Conn., in 1828. Prior to this time the making of horse-collars had been the work of itinerant laborers, who traveled from place to place, hiring themselves to make collars for individuals who were in need of several, or to any local harnessmaker whose stock might need replenishing. When Deming invented and patented his short-straw collar and the block upon which it was made, the event marked the first stage in the development of collar-making in America.

Although the wax-thread, chain-stitch sewing-machine was invented by a New England concern, as early as 1853, it was three years later before it had attained such practicability that it could be used in the sewing of boots and shoes, and fully 10 years before it was applied to the making of harness Even then the prejudice against machine-stitching was so great that such products were not easily disposed of, and it was only the enormous reduction in cost that ultimately brought it into favor. Another important improvement came in 1858, when W. K. Thornton, of Niles, Mich., perfected the invention of the creasing-machine, but so slow was the trade of those days in the matter of adopting any process which necessitated a radical departure from the old-time and traditional methods that the inventor found that the only way in which he could introduce his machines was to leave them on three months' trial at such shops as would accord him this privilege. A few years later, he entered into partnership in Cincinnati, under the firm name of Thornton & Perkins. In 1865 the business was sold to Randall & Company, the concern which is now engaged in the manufacture of similar, but vastly improved machinery. In fact, the sewing-machine and the creasing-machine were such important inventions that they may be said to have practically revolutionized the industry of harness-making. Other inventions have been patented, but few of them have been of lasting benefit to the trade. The most important, perhaps, was the iron gigtree which was patented by Samuel E. Thompkins, of Newark, N. J., in 1872, the radical change which this invention heralded being indicated by the fact that all buggy saddles up to this time had been made on wooden trees imported from England, but only a few years elapsed after the introduction of the iron gigtree before the wooden tree was entirely discarded.

It was about this time that the harness industry began to enjoy a period of almost phenomenal progress. The invention of labor-saving devices enabled manufacturers to produce goods at a cost which naturally tended to increase the demand for such articles.

Among the inventions which were patented at about this time one must mention the Bosworth lock-stitching, wax-thread sewing-machine, which first appeared in 1872, as well as the Campbell lock-stitching machine, patented first in 1880. With the introduction of these inventions, hand-sewed harness largely disappeared, for these stitches, which were interlocked, made the sewing alike on both sides, which gave the appearance of hand work, a great improvement upon the product of the old harness-sewing machines which produced a sometimes unsatisfactory chain-stitch. The other kinds of harness machinery which have proved themselves such great labor-saving inventions that they are now regarded as indispensable in all well-equipped factories are the tubular riveting-machines, which entirely dispensed with the old processes of hand riveting; the box-loop sewing-machines, which now sew up all the long loops formerly sewed by hand; the quilting-machines, by means of which pads, gig and riding saddles are quilted; the power trace-trimmers, and trace-polishers; the power splitters, and the dieing-out machines. The first factory for the making of harness thread in this country was established at Paterson, N. J., by Barbour Brothers, in 1863, prior to which time such thread had been imported from Ireland, while the hard-rubber-covered harness trimmings were invented by Andrew Albright, of Newark, N. J., in 1867.

The great development in the making of horse-collars dates only from 1883, for it was in that year that William Fogelsong, of Dayton, O., invented a machine for the stuffing of collars. Some 10 years later R. Brownson, of St. Paul, Minn., perfected a metal-staple machine for sewing collars, and, with these two practically recent innovations, one set of machinery will now do the work which formerly required the labor of some 20 men. It was by means of such machinery, practically all of which is due to American push and enterprise, that the trade of saddlery and harness-making has been advanced from a position of inferiority to a commanding place among the great industries of the United States. To comprehend the extent to which this business has progressed it is only necessary to glance at the following table in which the figures prepared by the census bureau are recapitulated:

SADDLERY AND HARNESS, 1880–1900.

	1880	1890	1900
Establishments	7,999	7,9[illegible]1	12,934
Capital	$16,508,019	$35,346,620	$43,354,136
Wage earners	21,446	23,672	24,123
Wages	$ 7,997,752	$10,908,918	$10,725,647
Cost of materials	$19,968,716	$24,674,225	$32,127,926
Value of products	$38,081,643	$52,970,801	$62,630,902

The fever for the organization of combinations, "trusts," and other associations had its natural effect upon some of the saddlery manufacturers, and, in 1890, the first move was made toward the establishment of an organization for conference and mutual improvement. This initiative was taken by the Western manufacturers who called a meeting of the trade to be held at St. Louis, Mo., and it was at this time that the organization known as "The National Wholesale Saddlery Association of the United States," was formed. According to the terms of the constitution adopted at this first gathering, the objects of the association were to correct abuses, adopt uniform terms, and encourage a more fraternal feeling among competitors, but, although its annual meetings and elections have been held, and men prominent in the trade have been elected as officials, its effect upon the growth of the industry is entirely problematic. See CARRIAGE AND WAGON INDUSTRY.

Harnessed Antelopes. See BUSHBUCK.

Har'nett, Cornelius, American statesman: b. England 20 April 1723; d. North Carolina 1781. He came in early life to America, and was one of the earliest to denounce the stamp act and kindred measures. In 1770–1 he was representative of Wilmington, N. C., in the Provincial Assembly, and chairman of the most important committees of that body. In 1772 he was appointed with Robert Howe and Maurice Moore, to prepare a remonstrance against the appointment, by the royal governor Martin, of commissioners to fix the southern boundary of the province. Josiah Quincy, who visited him in 1773, called him "the Samuel Adams of North Carolina"; and, as the Revolution approached, he was its master spirit throughout the Cape Fear region. He was elected to the Provincial Congress in 1775, and drew up the instructions to the North Carolina delegates in the Continental Congress. When in 1776 Sir Henry Clinton appeared with a British fleet off Cape Fear, Harnett and Howe were excepted, as arch-rebels, from the terms of a general pardon. As member of the Continental Congress he signed the articles of confederation. When in 1780–1 the British held possession of the country around Cape Fear, Harnett was made prisoner, and died while a captive.

Har'ney, John Hopkins, American journalist: b. Bourbon County, Ky., 1806: d. 1867. He was educated at Oxford University, Ohio; became professor of mathematics at the University of Indiana and at Hanover College, and was president of a college at Louisville, Ky. He was for a number of years editor of the Louisville *Democrat*, a paper which took a radical attitude during the Civil War.

Harney, William Selby, American soldier: b. Haysboro, Tenn., 27 Aug. 1800; d. 9 May 1889. He entered the army in 1818; served as colonel in the Mexican War and was brevetted brigadier-general for gallantry at Cerro Gordo, and promoted to that rank in 1858. While commanding the department of Oregon, in 1859 he took possession of the island of San Juan, which was claimed by the English government. He was in consequence recalled. He retired in 1863 and was brevetted major-general in 1865.

Harney's Peak, the highest point of the Black Hills, South Dakota, named in honor of Gen. W. S. Harney; height 7,215 feet.

Haro Islands. See SAN JUAN ISLANDS.

Harold I., surnamed HAREFOOT, king of England: d. Oxford 17 March 1040. He succeeded his father Canute in 1035, notwithstanding a previous agreement that the sovereignty of England should descend to the sons of Canute by his second wife, the Norman princess Emma. Hardecanute, who was about to invade England at the time of Harold's death, dug up his body and beheaded it. See Freeman, 'The Norman Conquest,' Vol. I.

Harold II., king of England, second son of Godwin, earl of Kent: b. about 1022; d. Senlac, near Hastings, Sussex, 14 Oct. 1066. On his father's death in 1053 he succeeded him in the earldom of Wessex and other great offices, and upon the death of Edward the Confessor, 5 Jan. 1066, who had named him his successor, he was chosen king by the nobles, notwithstanding the claim of Edgar Atheling, or the asserted bequest of Edward in favor of William, duke of Normandy. The latter called upon him to resign the crown, and upon his refusal prepared for invasion. He also instigated Harold's brother, Tostig, to invade the northern coasts of England in conjunction with the king of Norway. The united fleet of these chiefs sailed up the Humber and landed a numerous body of men, who defeated the opposing forces of the Earls of Northumberland and Mercia; but at Stamford Bridge, on the river Derwent, in Yorkshire, were totally routed by Harold, whose brother Tostig fell in the battle. A day or two later he heard of the landing of the duke of Normandy at Pevensey, in Sussex. Hastening southward with all the troops he could muster, a general engagement ensued at Senlac, near Hastings, in which Harold was slain with an arrow, and the crown of England was passed to William. See SENLAC. Consult: Freeman, 'The Norman Conquest,' Vols. II. and III.; Tennyson, 'Harold' (1876).

Harold, or Harald I., surnamed HAARFAGER (Fair-haired), king of Norway, son of Halfdan the Black: d. Trondjhem 933. He succeeded to the throne in 860. While he reduced the lesser kings he left them with the title jarl, the administration of their territories, and the third part of their income; but many of them emigrated, and founded Norwegian colonies. Hrolf or Rollo emigrated to Neustria (France). Others, with their followers, established themselves in Iceland, the Shetland Isles, the Faroes, and the Orkneys, then uninhabited. When Harold found that the emigrants often extended their incursions into his dominions he embarked with a naval force to subdue them, conquered the Orkneys, etc., and returned.

Harold, or Harald III., surnamed HAARDRADA, king of Norway: d. Stamford Bridge, England, 25 Sept. 1066. The date of his birth is unknown. During a great part of his youth and prime he served in the imperial bodyguard at Byzantium, returning to Norway about 1045. He persuaded his nephew Magnus to divide the supreme power with him, in return for a share of his treasures, and two years later (1047) his nephew died, when he himself became sole king of Norway. In 1066 he joined Tostig, the brother of Harold II. (q.v.) of England, in an invasion of that country, having been promised half of it in case of success; but he was slain at the battle of Stamford Bridge.

Haroun-al-Rashid. See HARUN-AL-RASHID.

Harp, the oldest of stringed instruments. The Bible mentions Jubal as the inventor. It has been used by all nations in one form or another. The modern instrument is nearly triangular and the strings are extended from the upper part to one of the sides. It stands erect, and is played with both hands, the strings being struck or pulled with both fingers and thumbs. The improvements which have rendered the modern harp an efficient musical instrument are due to Sebastian Erard, who in 1794 took out a patent for a harp with seven pedals, and again in 1808 for a double-action harp with the same number of pedals, each of which effects two changes in the pitch of the strings. The harp thus constructed contains 43 strings tuned according to the diatonic scale, every eighth string being a replicate in another

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octave of the one counted from. Various improvements over Erard's harp were made during the 19th century.

Harp, or Saddleback, Seal. See SEALS.

Harp-shell, a genus (*Harpa*) of gasteropodous mollusks of the whelk family (*Buccinidæ*), having the last whorl of the shell large, and covered with numerous sharp smooth ribs, resembling the strings of a harp. The foot is large, and there is no operculum. These shells are elegantly marked, and much prized for their beauty. Nine species are known, all of them tropical, and living in deep water, on soft, sandy, or muddy bottoms.

Har'per, Charles G., English artist and author: b. 1863. He is one of the best-known of English book illustrators, and his own books, mainly lively, entertaining descriptions of pedestrian and bicycle tours in England illustrated by himself, have been popular in the United States as well as in his own country. Among them are: 'Some English Sketching Grounds'; 'From Paddington to Penzance'; 'The Brighton Road'; 'The Great North Road'; 'The Norwich Road'; 'Cycle Rides Around London.'

Harper, Ida Husted, American journalist and author: b. Fairfield, Ind. She attended the University of Indiana for two years; entered journalism when about 18, conducted a woman's department in the Terre Haute 'Saturday Evening Mail' and in the 'Firemen's Magazine,' and was a contributor to many papers, including the Cleveland *Leader*, San Francisco *Chronicle*, and Washington *Post*. She was managing editor of the Terre Haute *Daily News*, for a year, has written for the McClure syndicate, and since January 1899 has been on the editorial staff of the New York *Sun*. She was a member of the International Congress of Women in London in 1899, and was appointed chairman of the international press committee for a five years' term. She prepared the Indiana State monograph for the World's Fair at Chicago under the title 'Organized Work of Indiana Women,' and has written 'Life and Work of Susan B. Anthony' (1898) and 'History of Woman Suffrage to the Close of the Nineteenth Century' (1901).

Harper, John Murdock, Canadian educator: b. Johnstone, Renfrewshire, Scotland, 10 Feb. 1845. He was graduated from Queen's University (Kingston, Ont.), later was appointed superintendent of education for Prince Edward Island, but declined the appointment, and became successively rector of Quebec High School, and inspector of superior schools for the province of Quebec. Among his publications are text-books and various pamphlets.

Harper, Robert Goodloe, American lawyer and statesman: b. near Fredericksburg, Va., 1765; d. Baltimore, Md., 15 Jan. 1825. In his 15th year young Harper joined a troop of horse, and under Gen. Greene served during the latter part of the southern revolutionary campaign. He was graduated from Princeton College in 1785, while there acting for a time as tutor to lower classes. Sailing from Philadelphia for Charleston, with the intention of studying law, he arrived at his destination nearly penniless, but was assisted by the father of a former pupil, who obtained a position for him in a lawyer's office. In one year he was qualified to practise, and soon established a reputation, and became well known by a series of newspaper articles on the proposed change in the State constitution of South Carolina. He was soon after elected to the State legislature, and in 1794 to the national Congress. In this position he showed marked ability, supported the administrations of Washington and John Adams, and was regarded as one of the leaders of the Federal party. On the election of Thomas Jefferson as President in 1801 he retired from Congress, and resumed the practice of his profession in Baltimore. At the Maryland bar he attained great eminence, at the period too of its highest renown. He was associated with Joseph Hopkinson as counsel for Judge Chase of the United States Supreme Court, when under impeachment. In 1815 he was elected United States senator from Maryland.

Harper, William Rainey, American college president and Hebrew scholar: b. New Concord, Ohio, 26 July 1856; d. Chicago, Ill., 10 Jan. 1906. He was graduated at Muskingum College in 1870; was professor of Hebrew at the Baptist Union Theological Seminary, Chicago, in 1879–86; and of Semitic languages in the graduate faculty of Yale. From 1889 he was also professor of biblical literature. He was principal of the Chautauqua College of Liberal Arts in 1885–91, and in 1891 was appointed director of the Chautauqua system. In 1891 he was chosen first president of the new University of Chicago, where he was also head of the department of Semitic languages and literature. He was a founder and editor of 'Hebraica' and the 'Hebrew Student,' was an editor of three of the publications of the University of Chicago — the 'Biblical World,' the 'American Journal of Theology,' and the 'American Journal of Semitic Languages and Literature.' His administration was noted for its rapid development of the facilities of the university. Among his works are: 'Elements of Hebrew' (2d ed. 1890), 'Hebrew Method and Manual' (1885), and 'Elements of Hebrew Syntax' (1888), 'The T[illegible] in Higher Education' (1905); 'Th[illegible] Element in the Old Testament' (1[illegible]

Harper, William Saint John, American artist: b. Rhinebeck, N. Y., 8 Sept. 1851. He studied painting at the National Academy of Design, New York, and afterward became pupil of Munkacsy and Bonnat at Paris. He has done much successful work both as a painter and book illustrator.

Harper and Brothers, the designation of a noted firm of New York publishers. It consisted originally of James (1795–1869), John (1797–1875), Joseph Wesley (1801–70), and Fletcher (1806–77). The first two commenced to publish in 1818, as J. & J. Harper. The firm of Harper and Brothers, established in 1833, is now managed by descendants of the founders. It not only publishes books but 'Harper's Magazine' (monthly, since 1850), 'Harper's Weekly' (since 1857), 'Harper's Bazar' (fashions, social life, etc.; since 1867), and 'Harper's Round Table' (started in 1881 as 'Harper's Young People' and recently consolidated with 'St. Nicholas').

Harper's Ferry, W. Va., is situated in Jefferson County, 55 miles northwest of Washington, on the Baltimore & O. railroad. It is at the confluence of the Potomac and Shenandoah rivers, where the former breaks through the Blue Ridge, presenting one of the most picturesque scenes in America. Attracted by its fine water-power, Washington, in 1790, chose it as a site for a United States arsenal and armory, and up to 1860 $1,800,000 had been expended for land and improvements. Here 10,000 muskets were made annually, and over 75,000 small arms were usually in store. It is the seat of Storer College and of a normal school for colored pupils. Pop. (1900) 896.

Harper's Ferry came into great prominence in 1859 through the acts of John Brown (q.v.), and was the scene of noteworthy military events during the Civil War. When Virginia seceded, Harper's Ferry was held by Lieut. Roger Jones, with 45 men. On the night of 18 April 1861 a large body of Virginia militia, hastily assembled from the surrounding country, appeared before the place. Jones set fire to the arsenal, destroyed as much public property as possible, and retreated across the Potomac to Hagerstown, Md., and thence to Carlisle, Pa. The Virginia militia occupied the place, and troops were hastened to it from other States of the Confederacy. The Confederate government attached much importance to the place as a strategical point, but it was abandoned by Gen. J. E. Johnston, 15 June 1861, when he heard that Gen. Patterson, marching from Chambersburg, Pa., was threatening to cross the Potomac at Williamsport. The place was then occupied by the National forces. When Gen. Lee invaded Maryland early in September 1862, Harper's Ferry was held by Col. Dixon S. Miles with a large garrison, and there were strong outposts at Winchester and Martinsburg. Lee supposed that his presence at Frederick, Md., would cause the evacuation of Harper's Ferry and its outposts, and thus open his communications by way of Shenandoah Valley, but as it was still held by the National forces it became a necessity to dislodge them. On the morning of 10 September he set three columns in motion from Frederick to surround the place and capture its entire garrison. Gen. Jackson, with 14 brigades, marched rapidly over the South Mountain, crossed the Potomac at Williamsport on the 11th, drove the garrison from Martinsburg into Harper's Ferry, and appeared before Bolivar Heights on the 13th, thus investing the place from the west. Gen. McLaws, with 10 brigades, marched through Brownsville Gap, and, after a severe engagement with Col. Thomas H. Ford on the 12th and 13th, drove him from Maryland Heights and into Harper's Ferry. Gen. Walker, with his division, crossed the Potomac at Point of Rocks, 12 miles below Harper's Ferry, and on the 13th seized Loudoun Heights beyond the Shenandoah. Miles was now completely surrounded, the Confederates occupying high ground, commanding his position. Artillery fire was opened from all these points on the 14th, and late in the afternoon Jackson moved upon Bolivar Heights, drove in Miles' skirmish lines, and gained an advantageous position on the left of the Union line. During the night 1,500 Union cavalry crossed from Harper's Ferry to the Maryland side and escaped. During the same night Jackson crossed 10 guns to the right bank of the Shenandoah and established them on a plateau at the foot of Loudoun Heights, enfilading Miles' entire position on Bolivar Heights. Early on the 15th the Confederate guns on Maryland Heights, Loudoun Heights, and in front of Bolivar Heights opened fire, which was responded to for more than an hour, but the direct and plunging flank-fire from the Confederate batteries partially silenced the Union guns and created some disorder in the Union ranks. Jackson had advanced his lines to within 150 yards of the Union works on Bolivar Heights, and was about to assault, when Miles ordered a white flag displayed on his works and directed Gen. Julius White to arrange terms of capitulation, soon after which Miles was mortally wounded by a shell from a battery that had not seen the white flag. The Union loss during the siege was 44 killed and 173 wounded, and the number of prisoners surrendered and paroled 12,520. The Confederates captured 70 guns, 13,000 small arms, 200 wagons, and a large amount of quartermaster and commissary stores. The Confederate loss was 41 killed and 247 wounded, the greater part of whom were lost in the engagement on Maryland Heights. The Confederates abandoned Harper's Ferry on the 20th, and it was again occupied by the Union forces on the 22d. Consult: 'Official Records,' Vols. II. and XIX.; Allan, 'Army of Northern Virginia in 1862'; The Century Company's 'Battles and Leaders of the Civil War,' Vols. I. and II.

E. A. Carman.

Har'pies (Greek, *Harpuiai*, swift robbers), the goddesses of storms. Their ages, appearance, names and number are so differently given by the poets that it is difficult to say anything definite concerning them. In the Homeric poems they are represented as personified storm-winds. The later poets and artists vied with each other in depicting them under the most hideous forms. One has given them the head of a fowl, with wings and a body covered with feathers, human arms with claws, a white breast, and human legs which terminate in the feet of a fowl. Others have given them the face of a young woman with the ears of a bear. See Furies.

Harpignies, Henri Joseph, ŏn-rē zhō-zĕf är-pēn-yē, French landscapist: b. Valenciennes 28 July 1819. He studied at Paris with Achard, first exhibited at the salon of 1853, and in 1861 attracted attention by his 'Edge of a Wood beside the Allier.' His landscapes, done with equal success in oils or water-colors, evince a skilfulness of drawing and a coloristic truthfulness marred only occasionally by a harshness in matters of technique. His works number: 'View of Capri,' 'Le Saut du Loup,' 'Banks of the Rhone' (Metropolitan Museum, N. Y.), and 'Garden of the Villa Medici.'

Harp'sichord, a stringed instrument formerly in use, in appearance and construction similar to a grand pianoforte. In the front the keys were disposed, the long ones being the naturals, and the short ones the sharps and flats. This instrument, called by the Italians *clavicembalo*, by the French *clavecin*, was an improvement upon the clavichord, which was borrowed from the harp. Both are now superseded by the pianoforte. See Pianoforte.

Harps'well, Maine, a township including the post village of Harpswell Centre, and comprising a peninsula and some islands in Casco Bay, 14 miles east of Portland. It has agricul-

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tural interests and grist-mills, but is chiefly noted as a summer resort. Pop. (1900) 1,750.

Harpy-eagle. See EAGLE.

Har'raden, Beatrice, English novelist: b. Hampstead, London, 24 Jan. 1864. She took her degree at London University at 21, and subsequently traveled extensively in the United States and on the Continent. Her first novel, 'Ships that Pass in the Night' (1893), was instantly successful and was widely circulated. It has been followed by 'In Varying Moods' (1894); 'Hilda Strafford, a Californian story' (1897); 'The Fowler' (1899).

Harrier, a small mottled hound used in Europe in ancient times, and up to the end of the 18th century for chasing hares, the sportsmen following on foot. The old breed has disappeared except a few bred for show purposes by fanciers, its place being taken in sport by a small kind of foxhound followed on horseback.

Harrier. See MARSH-HAWK.

Har'rigan, Edward, American actor and playwright: b. New York 1845. He entered upon the stage as a variety performer and was a partner of Tony Hart (1871–85), when they opened in New York their first Theatre Comique (1876). Among his dramas, which are strong in character drawing, but of little value in a literary sense, are: 'Squatter Sovereignty'; 'Cordelia's Aspirations'; 'Old Lavender'; and 'Reilly and the Four Hundred.'

Harrild, Robert, English inventor: b. London 1780; d. 1853. He was the inventor and manufacturer of composition rollers for inking type, the introduction of which alone rendered cylinder presses practicable. He began the manufacture of printers' materials in London in 1809 and the printing-press with which Franklin worked in London was owned by him before it was brought to the United States in 1841 and put into the Patent Office at Washington, where it now stands.

Har'riman, Tenn., city in Roane County; on the Emery River, the Southern, the Tennessee C., and the Queen & C. R.R.'s; about 78 miles northeast of Chattanooga, and 37 miles west of Knoxville. It was founded in 1890 and received its city charter in 1891. The charter was revised in 1899. It is situated in an agricultural region which contains rich deposits of coal and of iron ore, and some timber land. Its chief manufactures are foundry and machine shop products, leather, farm implements, iron, flour, lumber, cotton goods, and furniture. It is the seat of an industrial school for colored children, and of the American University, established in 1893. Its trade in agricultural and mining products and in its own manufactured articles is rapidly increasing. The waterworks and electric-light plant are owned and operated by the city. Pop. (1900) 3,442.

Harriman Alaska Expedition, an American scientific and artistic expedition which visited the southern coast of Alaska during the summer of 1899. The party was organized by Edward H. Harriman, and consisted of the members of his own family, a few friends, and 50 gentlemen interested in science, art and literature. Among them were Messrs. Henry Gannett, W. H. Dall, C. H. Merriam, R. Ridgway, G. K. Gilbert and F. V. Calville of Washington; D. G. Elliot of Chicago; William Trelease of St. Louis; John Muir and W. E. Ritter of California, and several professors from Eastern institutions of learning. Messrs. L. A. Fuertes, R. Swain Gifford and F. S. Dellenbaugh represented the literary and artistic contingent. These gentlemen made good use of their opportunities in investigating the geography, geology, glacial phenomena, and fauna and flora of the region visited.

The results so far as announced (1904) are over 300 species and sub-species of animals and plants, records of observations of 25 "tidal" glaciers, those which discharge icebergs directly into the sea, and of 100 "land" glaciers, those whose fronts do not reach the sea. A new chart was made of the part of the coast explored. (See HARRIMAN FIORD.) Some of the new animal species found are two of foxes, five species and sub-species of shrews, five of voles, one crab, a shrimp, and 25 sea-worms. One of the sea-worms is about six feet long and of a deep vermilion color; another about the same size is blood-red with a white head. In no other part of the world have been found sea-worms of such varied and striking forms and colors. Among the plants found were a large number of new species and sub-species. Each department of science was represented by one or more experts who made critical observations and accurate reports. Consult: 'Reports of the Harriman Alaska Expedition'; 'The World's Work' (1900); 'Discoveries in our Arctic Region.'

Harriman Fiord, on the southern coast of Alaska, at about lat. 61° N. and lon. 148° W., is an arm of Prince William Sound, 15 miles in length. This fiord was discovered by the Harriman Alaska Expedition (q.v.) in 1899. The finding of this fiord is described by John Burroughs, a member of the Expedition, as follows: "Later in the afternoon we ascended an arm of Port Wells more to the westward and entered upon a voyage of discovery. We steamed up to a glacier of prodigious size that reared its front across the head of the inlet and barred further progress in that direction — the Barry Glacier. According to the United States Coast Survey map we were at the end of navigation in these waters; but we went on under a good head of steam down this new inlet where no ship had ever before passed. Glaciers hung on the steep mountain sides all about us. One of these was self-named the Serpentine by reason of its winding course down from its hidden sources in the mountains — a great white serpent with its jaws set with glittering fangs at the sea. Another was self-named the Stairway, as it came down in regular terraces or benches. As we neared the front of this glacier the mountains to the left again parted and opened another new arm of the sea, with more glaciers tumbling in mute silence from the heights, or rearing colossal palisades across our front. Another ten-mile course brought us to the head of this inlet, which was indeed the end of navigation in this direction. Subsequently this inlet was fitly named the Harriman Fiord, and the glacier at the head of it, Harriman Glacier."

Har'rington, Mark Walrod, American astronomer: b. in Sycamore, Ill., 18 Aug. 1848. He was educated at the University of Michigan, and in 1870–1 assisted in the United States Coast and Geodetic Survey of Alaska. He was professor of astronomy and director of the observatory at the University of Michigan, 1870–91. In 1884 he established the 'American Meteorological Journal' and was its managing editor until 1892. In 1891 he became chief of the Weather Bureau at Washington, D. C., which post he held till 1895, and was president of the Washington State University 1895–7.

Harriot, Thomas, English mathematician: b. Oxford 1560; d. London 2 July 1621. He entered Saint Mary's Hall, Oxford, and was graduated in 1580. In 1585 he was sent by Sir Walter Raleigh as surveyor on the Grenville expedition to Virginia, and on his return he published an account of Virginia, later printed in Hakluyt's 'Voyages.' He gained the favor of the Earl of Northumberland, who gave him an annual pension, and thereafter devoted himself entirely to mathematical and scientific research. His chief work, 'Artis Analyticæ Praxis ad Equationes Algebraicas Resolvendas,' published in 1631, embodied the most important results of his mathematical work. He practically gave to algebra its modern form, improving the notation, being the first to equate all the terms of an equation to zero, and announcing the principle that every equation has as many roots as its dimension. He also did important work in astronomy. See ALGEBRA, HISTORY OF THE ELEMENTS OF.

Harris, Amanda Bartlett, American writer: b. Warner, N. H., 15 Aug. 1824. She is a popular writer for young people and has published: 'How We Went Bird-Nesting' (1880); 'Wild Flowers, and Where They Grow' (1882); 'American Authors for Young Folks' (1887); 'The Luck of Edenhall' (1888); etc.

Harris, George, American college president: b. East Machias, Maine, 1844. He was graduated at Amherst, 1883; and at Andover Theological Seminary 1860. After taking several pastoral charges he became professor of Christian theology at Andover 1883, from which position he passed in 1899 to the presidency of Amherst, which he now holds. He was one of the editors of the 'Andover Review,' 1884–93. Among his works are 'Moral Evolution' (1896); 'Inequality and Progress' (1897).

Harris, James Rendel, English scholar. He was graduated at Cambridge University, where he was fellow and librarian of Clare College. He was professor at Johns Hopkins University and at Haverford College, and is now university lecturer in palæography at Cambridge, England. He has written many volumes on philology, palæography and kindred subjects, his latest work being 'Annotators of the Codex Bezæ' (1901).

Harris, Joel Chandler, American journalist and author: b. Eatonton, Ga., 8 Dec. 1848. He began his career as a printer's apprentice on the Forsyth (Ga.) 'Countryman' and was on the staff of the Savannah *Daily News*, 1871–6. He has been connected with the Atlanta *Constitution* from 1876 and became its editor in 1890. The series of "Uncle Remus" sketches and songs which have given him an international reputation were first printed in the *Constitution*. His published books include: 'The Folk-Lore of the Old Plantation' (1880); 'Nights With Uncle Remus' (1883); 'Mingo and Other Sketches' (1883); 'Daddy Jake, the Runaway' (1889); 'Free Joe and Other Stories' (1887); 'Balaam and his Master' (1890); 'Mr. Rabbit at Home' (1895); 'The Story of Aaron' (1896); 'Stories of Georgia History' (1897); 'Sister Jane,' a novel (1897); 'Minervy Ann' (1899); 'On the Wing of Occasion' (1900); etc.

Harris, Joseph, American agricultural writer: b. Shrewsbury, England, 1828; d. 1892. He began his scientific study of agriculture with Lawes and Gilbert at Rothamsted and in 1864 emigrated to the United States, and began to contribute to the agricultural press. His 'Walks and Talks on the Farm' was a series of articles which appeared partly in the 'Genesee Farmer,' and partly in the 'American Agriculturalist,' in which the former had become merged. Among his other writings are: 'Harris on the Pig' (1883); 'Talks on Manures' (1883); and 'Gardening for Young and Old' (1882).

Harris, Miriam Coles, American novelist: b. Dosoris, L. I., 7 July 1834. She was married to Sidney S. Harris in 1864 and has since lived in New York. She wrote: 'Rutledge' (1860); 'The Sutherlands' (1862), both widely read, and among many later and almost equally popular works of hers are: 'A Perfect Adonis' (1875); 'Missy' (1880); and 'An Utter Failure' (1891).

Harris, Samuel, American theologian: b. East Machias, Maine, 14 June 1814; d. Litchfield, Conn., 25 June 1899. He was graduated from Bowdoin College and from Andover Theological Seminary. He was a teacher for a time and held Congregationalist pastorates in Conway, Mass., 1841–51. In 1855 he was appointed professor of systematic theology in Bangor Seminary; was president of Bowdoin 1867–71; and then became professor of systematic theology in the Yale Divinity School. His writings include: 'Zaccheus or the Scriptural Plan of Benevolence'; 'Kingdom of Christ on Earth' (1874); 'Philosophical Basis of Theism' (1883); 'Self-Revelation of God' (1887); 'God, Creator and Lord of All' (1897).

Harris, Thaddeus William, American naturalist: b. Dorchester, Mass., 12 Nov. 1795; d. Cambridge, Mass., 16 Jan. 1856. He was graduated at Harvard College in 1815, studied medicine and practised his profession in Milton, Mass., until appointed librarian of Harvard in 1831. This position he occupied until his death. Early in life he exhibited a fondness for natural history, and though plodding alone, attained to a scientific eminence which secured for him the fellowship of all the principal learned societies of America, and of many abroad. For several years he gave instruction in botany and general natural history in the college, and originated the Harvard natural history society for the students. He was chiefly distinguished, however, as an entomologist, and has been surpassed as such by no one in the United States. He was one of the founders of the Massachusetts Horticultural Society. In 1837 he was appointed one of the commissioners for a zoological and botanical survey of Massachusetts, the result of which was his 'Systematic Catalogue of the Insects of Massachusetts' (1832), in which 2,350 species are enumerated. He also published: 'A Treatise on some of the Insects of New England which are Injurious to Vegetation' (1842), a work of permanent value.

DR. WILLIAM T. HARRIS,

UNITED STATES COMMISSIONER OF EDUCATION

Harris, Thomas Lake, American socialistic and religious reformer: b. Fenny Stratford, England, 15 May 1823. He accompanied his father to the United States in childhood, was for a time a Universalist pastor, and founded an 'Independent Christian Society' in 1850; but became a lecturer upon spiritualism. He lectured abroad in 1858, and on his return to the United States organized the society of the "Brotherhood of the New Life." This was established at Wassaic, Dutchess County, N. Y., 1861–7, but removed to Brocton, Chautauqua County, N. Y., in the last named year. Its nature was co-operative rather than communistic, and farming and industrial occupations were engaged in by his followers, numbering at one time about 2,000 in the United States and Great Britain, among them Lady Oliphant and her son, the well-known writer, Laurence Oliphant (q.v.). Harris removed to California in 1887, and retired to private life in 1895, residing in New York city. He published many works in prose and poetry, among which are 'Wisdom of Angels' (1856); 'Arcana of Christianity' (1857); 'Modern Spiritualism' (1860); 'God's Breath in Man' (1891).

Harris, Townsend, American merchant and diplomatist, of Welsh descent and of Revolutionary stock, the youngest of five children: b. Sandy Hill, N. Y., 4 Oct. 1804; d. New York city 25 Feb. 1878. He received his education at the village school and academy. From 1817 to 1848 he was in business in New York city, continuing his self-culture by continuous and critical reading of the best literature, learning also the French, Spanish, and Italian languages; was member of the Board of Education and in 1846–7 its president. He was the practical founder of the New York Free Academy, now the College of the City of New York, and in many ways was a typically useful citizen. He never married. In 1848 he went to California and during the following six years made trading voyages to China and the Dutch and English Indies, becoming thoroughly acquainted with the manifold Oriental varieties of human nature. He acted for a time as American vice-consul at Ningpo. He was appointed Consul General to Japan and on the U. S. S. S. San Jacinto arrived at Shimoda, his future dwelling place (and now noted for its stone quarries), where the flag of the United States was hoisted 4 Sept. 1856. From the first Mr. Harris spoke the truth as against the constant deceit and prevarication of the corrupt officials of the Yedo Shogunate, demanding the courtesies due to an accredited envoy of a civilized power and refusing to deliver the President's letter to any one but the Shogun in Yedo and to him personally. Unbacked by a single ship or man, and with his secretary only, after prolonged negotiations lasting 18 months, he made a triumphal progress to Yedo, and standing erect received personal audience of the Shogun in the palace. Then began four months' instruction of these political hermits in the methods of modern international law and procedure. He concluded the treaty and received the promise of signature by the premier, without regard to anything happening in China. Nevertheless the arrival of Commodore Tatnall with two American men-of-war, bringing news of the humiliation of the Chinese emperor and court, undoubtedly had its influence on the Japanese. Mr. Harris urged the importance of having the treaty signed without a moment's delay, and the premier Ii despatched commissioners to affix their signatures and soon after an embassy to the United States, for which reason chiefly, Ii was assassinated in Yedo, 23 March 1860. The Harris treaty secured the right of trade, residence, and of missionary operations and teachings. He was buried in Greenwood cemetery, Brooklyn, N. Y. Mr. Harris has always been very highly thought of by the Japanese, and is still the subject of much praise and appreciative writing by Japanese writers. His journals with comment and biography were published in 1896.

William Elliot Griffis,
Author of 'Townsend Harris, First American Envoy in Japan.'

Harris, William Torrey, American educator and metaphysician: b. North Killingly, Conn., 10 Sept. 1835. He studied at Yale in the class of 1858 but was not graduated, and after teaching in the St. Louis public schools, 1857–67, was superintendent of the schools of that city 1867–80. While in St. Louis he founded in 1867 the 'Journal of Speculative Philosophy,' which he still edits. He removed to Concord, Mass., in 1880 and aided in founding the Concord School of Philosophy at which he lectured on metaphysical themes. From 1889 to 1906 he was United States Commissioner of Education. He has edited Appleton's School Reader and Appleton's Educational Series and is the author of 'Hegel's Logic: a Critical Exposition' (1890); 'The Spiritual Sense of Dante's Divina Commedia' (1891); 'Introduction to the Study of Philosophy'; 'Psychologic Foundations of Education.'

Harrisburg, Pa., city, State capital; county-seat of Dauphin County, on the Susquehanna River, the Pennsylvania canal, and on the Northern Cent.; Pennsylvania; Cumberland Valley, and Philadelphia & R. R.R.'s., and is situated 105 miles northwest of Philadelphia. This is an important railroad, agricultural, industrial and commercial centre, and is the home of a system of municipal reform known as "the Harrisburg Plan" which has attracted widespread attention throughout the United States. The Susquehanna River is nearly a mile in width at this point, and is crossed by numerous bridges.

History.—The site of the future city was selected by John Harris in 1785, and the settlement was incorporated as a borough in 1791. Harris was an adventurous English trader who built the first house here in 1726, and secured a grant of 800 acres. His son established a ferry here in 1753, and the place was known for many years as Harris Ferry. The town became the capital of the state in 1812, and was chartered as a city in 1860. The Harrisburg convention (q.v.), famous in American political history was held here in 1828, and Harrison and Tyler were nominated here in 1839.

Topography.—The city has a most picturesque location on the left bank of the Susquehanna, which is spanned here by five bridges, three of them modern steel structures. The old historic "Camel-back Bridge," a part of which was burned during the middle of the 19th century, has been removed (1902). There is an extensive and beautiful park of 10 acres, well-made streets, an abundance of shade, and a fine sewage system with natural drainage.

Commerce and Industry.— The iron, steel, lumber and railroad interests of Harrisburg are of great importance. The roundhouses and repair shops of the Pennsylvania Railroad are located here and give employment to thousands of workmen. There are extensive manufactories of machinery, malt liquors, boilers, castings, brooms, cars, coaches, tanned leather, lumber, cotton goods, beds, mattresses, coffins, silk goods and a large number of rolling-mills, tin-mills, blast furnaces, nail-works, typewriter works and boot and shoe factories. The city has two morning and two evening newspapers and many weekly and monthly publications.

Public Buildings.— Prominent among the public buildings is the new State capitol, erected at a cost exceeding $4,000,000. It is built of brick and steel, with facings of marble and granite. At the main entrance is a fountain 78 feet wide, from which the water leaps down an incline in many cascades. On each side of the fountain rises a granite stairway 48 feet wide, broadening at the top into an esplanade and widening at the corners of the building to the proportions of a reviewing ground for troops. The lesser approaches to the grounds are ornamented with statues of the animals native to Pennsylvania. The State Library here, founded in 1790, contains over 100,000 volumes. In State Street stands the Dauphin County soldiers' monument, 110 feet high, in memory of the soldiers who died in the Civil War. There is also a statue here of Gen. John F. Hartranft, and a monument erected to the memory of the soldiers who fell in the Mexican War adorns the Capitol Park. Among other points of interest are the State Arsenal, the court-house, lunatic asylum, executive building, post-office, Harris Park, and Harrisburg Cemetery. The educational institutions include the high school, Harrisburg academy, St. Genevieve's academy, and the Young Ladies' Seminary. Harrisburg is the seat of a Roman Catholic bishop, and its charitable organizations include several hospitals, the Home of the Friendless, and the Children's Industrial Home.

Transportation.— Harrisburg has in operation one of the most extensive and perfect electric street railway systems in the United States. Every part of the city, and suburbs, and the neighboring towns and city are reached by electric trolley lines. The suburban railway service of the Pennsylvania and other railroads is unusually advantageous in extending the outlying residential sections of the city.

Municipal Administration.— The city government is vested in a mayor, elected every three years, with no second term, and a bicameral and select council. The highway commissioner, police officials, building inspector, fire department and sanitary officers are selected by the select council. The city solicitor, board of tax revision and appeals, water commissioners, city engineer, city clerk, 3 members of the board of public works and 5 members of the board of park commissioners, are selected by the common council. The treasurer, controller, school directors, supervisors and assessors are elected by vote of the citizens.

Banks and Finance.— Harrisburg has four national banks and a dozen other banking institutions and building and loan associations. The assessed property valuation is $26,000,000, the tax rate of course constantly changing. The municipal income amounts to $600,000 and the expenditure to $530,000. The principal items of expense are: Fire department, $15,000; waterworks, $30,000; street lighting, $30,000; police, $35,000; schools, $185,000. Public improvements involving an expenditure of $1,000,000 were begun in 1902, for the development of a new sewer system, water filtration, park development and street paving.

Municipal Reform.— Harrisburg through the progressiveness and enterprise of her citizens in the municipal improvement of the city, has been called "the model city," and the plans of 1902, for an expenditure of $1,000,000 have created an improvement system now known as "the Harrisburg plan." In May 1901, a citizen wrote a letter to a daily paper offering $100 toward a fund of $5,000 to engage expert engineers to examine the city and to report a plan of improvement. The proposal met instant approval. In a few weeks the $5,000 was pledged by 60 citizens. An organization and an executive committee soon followed, and these included the mayor, civil engineer and other officials elected by a reform element in local politics. Three noted engineers were employed, and their reports published in October 1901, included plans and estimates for the immediate improvement of the city. The subject was presented to the people at the annual election, 18 Feb. 1902. "The Harrisburg League for Municipal Improvements" carried on an aggressive campaign, proposing a million dollar expenditure. Objections were raised and to overcome these a board of public works was formed (under the laws of the State), composed of citizens who would serve without pay, and to have entire control of the improvements. An ordinance authorizing this board and providing for its appointment before the election was passed by councils immediately after an ordinance had been passed submitting to the voters the question of increasing the city's debt for the following purposes:

"The sum of $310,000 for the extension, improvement and filtration of the water supply; $305,000 for the extension and improvement of the sewerage system; $65,000 for the construction of a dam in the Susquehanna River to form part of the improved sewerage system; $250,000 for acquiring land and property for parks and for making park improvements; and $100,000 for the creation of a fund out of which the city may defray the cost of paving the intersections of streets hereafter authorized to be paved."

Upon this board three leading citizens of high character were appointed, the campaign was opened, the newspapers supported the movement, and even the women formed a civic league and aided in the work. Pamphlets, maps and diagrams were issued and a booklet, 'The Plain Truth About the Proposed Improvements for Harrisburg,' was widely circulated. The result of the election was a casting aside of party lines, and out of a total of 11,048 ballots, the "improvement" party had a majority of 3,590 votes. It was a mixed ticket selected for reform that won the election, the mayor being a Democrat (in a city naturally Republican), the treasurer, also a Democrat, while the controller was a Republican. Of the six candidates for the board of assessors, an important body, fixing the tax valuation of the city, the best three (two Republicans and one Democrat) were selected. Harrisburg in 1904 with her $1,000,000 improvements well advanced, is on the high road to remarkable prosperity. The State construction of a capitol building costing over $4,000,000, and the local railroads projecting improvements involving the expenditure of several millions, add additional strength to the movement toward municipal reform. Pop. (1900) 50,167; (1903) 52,951.

Harrisburg Convention, the assembly convened in 1828 at Harrisburg, Pa., by the protectionist faction of the New England and Middle States, consequent on the rejection of the high tariff "Woolen Bill" in the Senate, by the casting-vote of the Vice-President. The forcible presentation of the cause of protection, and the demands of the convention for an increased duty on several manufactured articles, resulted in the passage of the high tariff bill of 1828.

Har'rison, Benjamin, American statesman: b. Berkeley, Va., about 1740; d. April 1791. While a very young man he was elected to the House of Burgesses of which he was twice Speaker, and in 1773 was chosen a member of the committee which united the colonies against Great Britain. He was a member of the Continental Congress, 1774–7, and on 4 July 1776, reported, as chairman of the committee of the whole House, the Declaration of Independence, of which he was one of the signers. He was opposed to the ratification of the Federal constitution, but after its adoption, supported the national government. His brother, Charles, was a noted general in the American army during the Revolution, and his son, William Henry, became ninth President of the United States.

Harrison, Benjamin, 23d President of the United States: b. North Bend, Ohio, 20 Aug. 1833; d. Indianapolis, Ind., 13 March 1901. He was a great-grandson of Benjamin Harrison, signer of the Declaration of Independence (q.v.), and grandson of William Henry Harrison, ninth President (q.v.) He was graduated from Miami University (Oxford, Ohio) in 1852, studied law in Cincinnati, was admitted to the bar in 1853, and in 1854 began in Indianapolis the practice of his profession. In 1860 he was elected reporter of the supreme court of the State. At the time of his election to the Presidency (1888) he was one of the foremost leaders of the State bar. At the outbreak of the Civil War he assisted in recruiting the 70th regiment of Indiana Volunteers, of which he became colonel (August 1862). He was an exceedingly efficient commander. For some time he was detailed to guard railways in the West; and in the campaign from Chattanooga to Atlanta the regiment was in the 20th Army Corps, the commander of which was Gen. Joseph Hooker. Harrison commanded a brigade at Peach Tree Creek, where he served with especial distinction, and also at Nashville. He was present at Johnston's surrender at Durham Station, N. C., in 1865 was brevetted brigadier-general for his services in command of the brigade, and in June of that year was mustered out. The supreme court of Indiana had declared that Harrison by his enlistment vacated his office of reporter, and a Democrat was elected by default to fill that office for the unexpired term. At the election of 1864 Harrison, while still in the field, was rechosen. In 1867 he refused a renomination, and recommenced his legal practice, in which he was largely retained in both the Federal and State courts. In 1876 he became, on the retirement of the original candidate, the Republican candidate for the governorship, and though he ran about 2,000 votes ahead of his ticket, he was defeated by a Democratic plurality of 3,000. He was appointed a member of the Mississippi River commission in 1879, and in 1880 was chairman of the Indiana delegation in the Republican national convention. At that convention, where he cast nearly the entire vote of the State for Garfield, he was himself mentioned in connection with the Presidency. From 1881 to 1887 he was in the United States Senate, in which he took rank as a prominent debater. He opposed Cleveland's vetoes of the pension bills, urged increase in the navy and civil service reform, and as chairman of the committee on territories demanded the admission as States of North and South Dakota, Montana, Washington, and Idaho. In 1884 he was a delegate to the Republican national convention. At the convention of 1888 (Chicago, Ill.) he was presented by the solid Indiana delegation as a candidate for the nomination to the Presidency; and on the eighth ballot he received the nomination by a vote of 544. The campaign was a vigorous one, and Harrison made many excellent speeches. He was elected, receiving in the electoral college 233 ballots to 168 for Grover Cleveland. His administration was broadly characterized by a firm defence of American interests in foreign affairs and a general promotion of industry and governmental effectiveness. During this time the 55th Congress passed the tariff act known as the McKinley law; the reciprocity system was introduced; the new navy was extended; civil-service reform was promoted; and the Pan-American congress with representatives from all Central and South American countries was held at Washington in the winter of 1889–90. The Bering Sea arbitration respecting the seal fisheries was also organized between Great Britain and the United States. The Samoan difficulties were adjusted; and the Chile affair, concerned with an attack on American sailors either connived at or permitted by Chilean authorities, was promptly and satisfactorily settled by enforced reparation on the part of Chile. At the Minneapolis convention of 1892 Harrison was renominated without serious opposition. He was a second time opposed by Cleveland, and his defeat by 276 electoral votes to 145 was an occasion for some surprise. Upon his retirement from office, he returned to the practice of law, and in 1893–4 delivered a course of lectures on constitutional law at Stanford University. In 1899 he appeared as council for Venezuela in the Anglo-Venezuelan boundary arbitration commission. He was appointed a member for the United States of the Peace Conference held at The Hague in 1899, and became one of the International Board of Arbitration. He wrote 'This

Country of Ours' (1897). A complete collection of his public addresses from 1888 to 1892 was edited by Hedges (1892). A posthumous collection of articles, 'Views of an Ex-President,' was published in 1901. Consult the campaign life by Lew Wallace (1888), and Wilson (editor), 'The Presidents of the United States' (1894). GEORGE EDWIN RINES.

Editorial Staff, 'Encyclopedia Americana.'

Harrison, Burton Norville, American lawyer: b. New Orleans 1836; d. Washington, D. C., 29 March 1904. He was graduated from Yale in 1859, shortly afterward became professor of mathematics and astronomy in the University of Mississippi, and at the outbreak of the Civil War was appointed private secretary to Jefferson Davis, president of the Confederate States. Captured with Davis, he remained in imprisonment until January 1866, when his release was effected by the intervention of F. P. Blair and President Johnson. Subsequent to the war he followed the law in the north with much success.

Harrison, Mrs. Burton. See HARRISON, CONSTANCE CARY.

Harrison, Carter Henry, American politician: b. Elk Hill, Fayette County, Ky., 15 Feb. 1825; d. Chicago 28 Oct. 1893. He was graduated from Yale in 1845, from the Transylvania University law school (Lexington, Ky.), in 1855, and in the latter year was also admitted to the bar and removed to Chicago. There he invested in real estate, in 1869 was defeated as a candidate for State senator on the Democratic ticket, but in 1871 was elected county commissioner of Cook County, and in 1874 was sent to Congress from the 2d Illinois district, and in 1876 re-elected. In 1879 he was elected mayor of Chicago, and again in 1881, 1883, 1885, and 1893. He was also an unsuccessful independent candidate in 1891. In 1891 he purchased the Chicago *Times*, in the direction of which he was active until his election as mayor in 1893. In several instances his mayoralty contests assumed national interest, particularly so that of 1893 — the "World's Fair year" — when the success of the great exposition was thought to depend much upon the occupant of the mayor's chair. He was opposed by the united Citizens' and Republican forces and by nearly the entire press of Chicago, but after a vigorous campaign of public meetings was elected by more than 21,000 majority. He wrote: 'A Race with the Sun'; and 'A Summer Outing.'

Harrison, Carter Henry, American politician: b. Chicago 23 April 1860. He is son of the preceding. He graduated from St. Ignatius College, Chicago, in 1881, and from the Yale Law School in 1884. He practised law in Chicago, was later engaged in the real estate business, and in 1891 became editor of the Chicago *Times*, a position which he held for two years. He has been active in Chicago politics as a Democrat, and has been four times elected mayor of the city, in 1897, 1899, 1901, and 1903.

Harrison, Constance Cary, American novelist and miscellaneous writer: b. Vaucluse, Va., 25 April 1846. She was married in 1867 to Burton N. Harrison (q.v.) and has since lived in New York. She is one of the most popular of American authors and among her published books are: 'Woman's Handiwork in Modern Homes' (1881); 'Old-Fashioned Fairy-Book' (1884); 'Bar Harbor Days' (1887); 'The Anglomaniacs' (1887); 'Sweet Bells Out of Tune' (1893); 'An Errant Wooing' (1895); 'A Bachelor Maid' (1894); 'A Son of the Old Dominion' (1897); 'A Merry Maid of Arcady' (1897); 'Good Americans' (1898); 'A Princess of the Hills' (1901); a play, 'The Unwelcome Mrs. Hatch' (1901); etc.

Harrison, Frederic, English philosopher and historian: b. London 18 Oct. 1831. He was educated at Oxford; was called to the bar at Lincoln's Inn in 1858, and for a time practised as a conveyancing and equity lawyer. In 1877 he was appointed professor of jurisprudence and international law at the Inns of Court, a post which he held till 1889. He is the chief living representative in England of Positivism and the Religion of Humanity. He has been widely read in the United States, which he visited on a lecturing tour in 1901. He is a master of English style and his literary judgments command the fullest respect. Among his publications 'The Meaning of History' (1862); 'Science and Humanity' (1879); 'The Present and the Future' (1880); 'Byzantine History in the Early Middle Ages' (1900), his Rede Lecture. The volume entitled 'The Religious Systems of the World' (1893) includes an account by him of the Religion of Humanity.

Harrison, Gabriel, American author and artist: b. Philadelphia 25 March 1825; d. Brooklyn, N. Y., 15 Dec. 1902. He began life as a photographer and an actor and in 1845 supported Charles Keane at the Park Theatre, New York, and later taught elocution, and wrote dramatic and art criticism. Among his works are: 'Life of John Howard Payne' (1873); dramatization of 'The Scarlet Letter' (1878); etc.

Harrison, James Albert, American philologist: b. Pass Christian, Miss., 21 Aug. 1848. He was graduated at the University of Pennsylvania in 1868; and has since been professor of Latin and modern languages at Randolph-Macon College, Va., 1871–6; of English and modern languages at Washington and Lee University 1876–95, and of English and romance languages at the University of Virginia. He is a prominent member of the American Philological Association and the founder and editor of the 'Library of Anglo-Saxon Poetry.' Among his works are: 'Group of Poets and Their Haunts' (1881); 'Story of Greece' (1885); 'Dictionary of Anglo-Saxon Poetry' with Baskerville (1886); etc.

Harrison, Joseph, American engineer: b. Philadelphia 20 Sept. 1810; d. there 27 March 1874. In 1834 he began the construction of locomotives, and in 1840 designed for the Reading railway an engine which was copied and introduced into Russia with such success that he was invited to Russia, and there with two other American engineers concluded a contract with the Russian government to build the rolling-stock and locomotives of the St. Petersburg and Moscow railway. He executed also other important contracts with that government, and in 1852 returned to the United States, where he subsequently patented a safety-boiler and received both the gold and silver Rumford medals from the American Academy of Arts and Sciences. In 1860 he published a folio containing his autobiography, incidents of his Russian ex-

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perience, and his poem, 'The Ironworker and King Solomon.'

Harrison, Lowell Berge, American artist: b. Philadelphia 28 Oct. 1854. He studied with Alexander Cabanel in Paris, became known for his landscapes, especially snow-scenes, and obtained medals at the Paris Salon of 1887 and the Columbian Exposition (1893). His works include: 'Friends, or Foes?'; 'A Waif from the Sea'; 'Calling Home the Cows'; and 'November,' purchased by the French government for the Marseilles Museum.

Harrison, Mary Saint Leger («Lucas Malet»), English novelist: b. Eversley, Hampshire. She is a daughter of Charles Kingsley (q.v.) and was married to Rev. William Harrison, rector of Clovelly, who died in 1897. She inherits the talent of the Kingsleys and her novels published under the pseudonym of «Lucas Malet» have been as widely popular in America as in England. They are marked by vigorous characterization and skilful construction, and include: 'Mrs. Lorimer' (1882); 'Colonel Enderby's Wife' (1885); 'Little Peter' (1887); 'A Counsel of Perfection' (1888); 'The Wages of Sin,' a notably strong tale (1891); 'The Carissima' (1896); 'The Gateless Barner' (1900); 'Sir Richard Calmady' (1901).

Harrison, Thomas, English regicide: b. Newcastle-under-Lyne 1606; d. London 13 Oct. 1660. He was a soldier of Parliament in the civil war and commanded the guard that carried King Charles from Hurst Castle to London, sat among his judges, and signed his death warrant. He fought at Worcester, but his uncompromising attitude in religion and politics was unacceptable to Cromwell and he was deprived of his commission, and later imprisoned for his share in some of the plots devised by the extremists. At the Restoration, he was seized, tried, and condemned to death.

Harrison, Thomas Alexander, American painter: b. Philadelphia 17 Jan. 1853. He studied painting under Gérôme in the Ecole des Beaux Arts at Paris, and first exhibited in the Salon of 1881. He was awarded the gold medal by the Pennsylvania Academy of Fine Arts in 1894 and elected an associate of the National Academy in 1898. His best known works are: 'Coast of Brittany'; 'Little Slave'; 'The Sea-Shore.'

Harrison, Susan Frances Riley, Canadian author: b. Toronto 24 Feb. 1860. She was at one period literary editor of the Toronto 'Week' and has been a frequent contributor to American and English periodicals. She has written 'Crowded Out and Other Sketches' (1889); 'Pine, Rose, and Fleur-de-Lis' (1891); 'Down the River and Other Poems' (1891); and edited an anthology, 'French and English Native Writers' (1889).

Harrison, William Henry, 9th President of the United States: b. Berkeley, Charles County, Va., 9 Feb. 1773; d. Washington, D. C., 4 April 1841. He studied at Hampden and Sidney College, later pursued a course in medicine, and was about to be graduated as a practitioner, when the sudden death of his father gave him the liberty to disengage himself from a profession for which he had no natural bent nor aptitude. He received from Washington a commission in the army, and was soon on his way to Cincinnati, making the journey from Philadelphia to Pittsburg on foot, to join the regiment to which he had been assigned. He arrived at Fort Washington just after the defeat of General St. Clair's army. His first military service was to command a company of twenty men as an escort for a train of pack-horses to Fort Hamilton, a military post on the west bank of the Big Miami River from which the seat of Butler County was named. In 1793 he joined the new legion under General Anthony Wayne who made him an aide-de-camp, and in December of that year he took part in the expedition which repossessed General St. Clair's field of battle, and erected thereon Fort Recovery. He participated in all the engagements with the Indians and their British allies during this campaign, and displayed conspicuous gallantry at the Battle of Fallen Timbers. Shortly after the close of this campaign Harrison was advanced to the rank of captain and placed in command of Fort Washington. The position was largely a confidential one. The conduct of the Spaniards on the Mississippi was exasperating. French citizens and agents were engaged in exciting the people of Kentucky into a war with the Spanish of Louisiana with the object of thus embroiling our government with Spain and of forcing it into a league with France. Captain Harrison was instructed to prevent the passage down the river of boats laden with military stores belonging to the French agents. The English posts on the northern frontier, which had been held so long in violation of good faith, were now evacuated by the English in obedience to the Jay Treaty of 1794; the new garrison and supplies were sent to Fort Washington and forwarded thence through the wilderness under the supervision of the commandant of that post. In the spring of 1798 Harrison resigned his commission in the army and settled on a tract of land at North Bend about 16 miles from Cincinnati, but was immediately appointed by President John Adams as secretary of the Northwest Territory under Gen. Arthur St. Clair as governor. A year later he resigned this position to take his seat in Congress as the first delegate from the Territory. Up to this time the public lands had been sold in such vast tracts that none but men of wealth could buy them. Harrison secured the division of the land into small tracts and made it possible for the poor man to obtain a homestead. During that session of Congress a part of the Northwest Territory was formed into the Territory of Indiana. It included the present States of Indiana, Illinois, Michigan, Wisconsin, and a part of Minnesota, and contained a civilized population of nearly five thousand souls. Harrison was appointed its first governor by President Adams, and so satisfactory was his administration, he was successively reappointed by President Jefferson and President Madison. He was also made superintendent of Indian affairs. Governor Harrison organized the new government at Vincennes. Many difficult questions demanded his attention, but the most difficult and delicate was the restless and finally hostile attitude of the savages under the leadership of Tecumseh, and the preaching of Tecumseh's brother, «the Prophet.» The beginning of open warfare by the Indians was averted many times by his calmness and courage. He made in all thirteen treaties with the Indians, and secured the cession from several tribes of more than three million acres of land on the Wabash and White Rivers. Tecumseh condemned these treaties on the ground that the land belonged to all of the Indians, and that a single tribe could not give a legal title without the consent of every other tribe. Harrison invited Tecumseh to Vincennes for a conference, and directed that he should bring with him not more than thirty warriors; but he came with four hundred completely armed. There were many evidences that treachery was intended, and but for the conciliatory methods of the governor, the council would have terminated in bloodshed. Nothing was accomplished by this interview, nor by a second in the following summer. Meanwhile, frequent depredations by the Indians made it evident that conciliatory measures could no longer be employed, and on 26 Sept. 1811 Harrison set out with 900 men to punish them. On 6 November, when the army was within a short distance of Tippecanoe, it was met by messengers demanding a parley. A council was agreed upon for the next day, but at 4 o'clock on the following morning, the treacherous savages fiercely attacked the camp of Harrison in an endeavor to take it by surprise. The fighting continued till daylight when the Indians were routed with great loss. In the war of 1812 Harrison was appointed to the chief command of the Northwest, and given a major-general's commission. He urged upon the government the importance of creating a navy on the Lakes. That advice was heeded, and the splendid achievement of Commodore Perry on 10 Sept. 1813, was made possible by the military sagacity of this accomplished soldier. Six days after Perry's victory General Harrison embarked his artillery and supplies for a descent on Canada. The British general, Proctor, burned the fort and navy-yard at Malden and retreated, closely pursued by Harrison who overtook him and his Indian allies led by Tecumseh near the river Thames. Within five minutes almost the whole British force was captured, and shortly afterward the Indians were completely routed, and their leader Tecumseh was slain. The battle of the Thames and Perry's victory ended the war in Upper Canada, and gave the United States undisputed possession of the Great Lakes excepting Lake Ontario.

The years between the War of 1812 and the presidential campaign of 1840 Harrison devoted in part to the service of his country, and in part to the life of a country gentleman. He was in turn a member of Congress, state senator in the general Assembly of Ohio, presidential elector, United States senator from Ohio, and minister to the United States of Colombia. In 1820 he retired to his farm at North Bend In December 1839, he was nominated by the National Whig convention for the Presidency of the United States, with John Tyler of Virginia for vice-president. The campaign which followed was one of the most exciting in the history of the country. Political mass meetings and processions were introduced for the first time, and party watchwords and emblems were employed with telling effect. That canvass has commonly been called the 'log-cabin and hard cider campaign.' The eastern end of General Harrison's home at North Bend consisted of a log cabin covered with clapboards, and his table was reputed to be well supplied with good cider, instead of wines. Log cabins and hard cider thus became party emblems typifying republican simplicity. "Tippecanoe and Tyler too' was shouted and sung and emblazoned from one end of the country to the other. Nothing could stem the tide of wonderful popular enthusiasm for the hero of Tippecanoe and the Thames. Van Buren, the Democratic candidate, received only sixty electoral votes out of two hundred and ninety-four. The death of the President occurred only thirty-one days after his inauguration. Consult Bostwick in Wilson's 'Presidents of the United States' (1894).

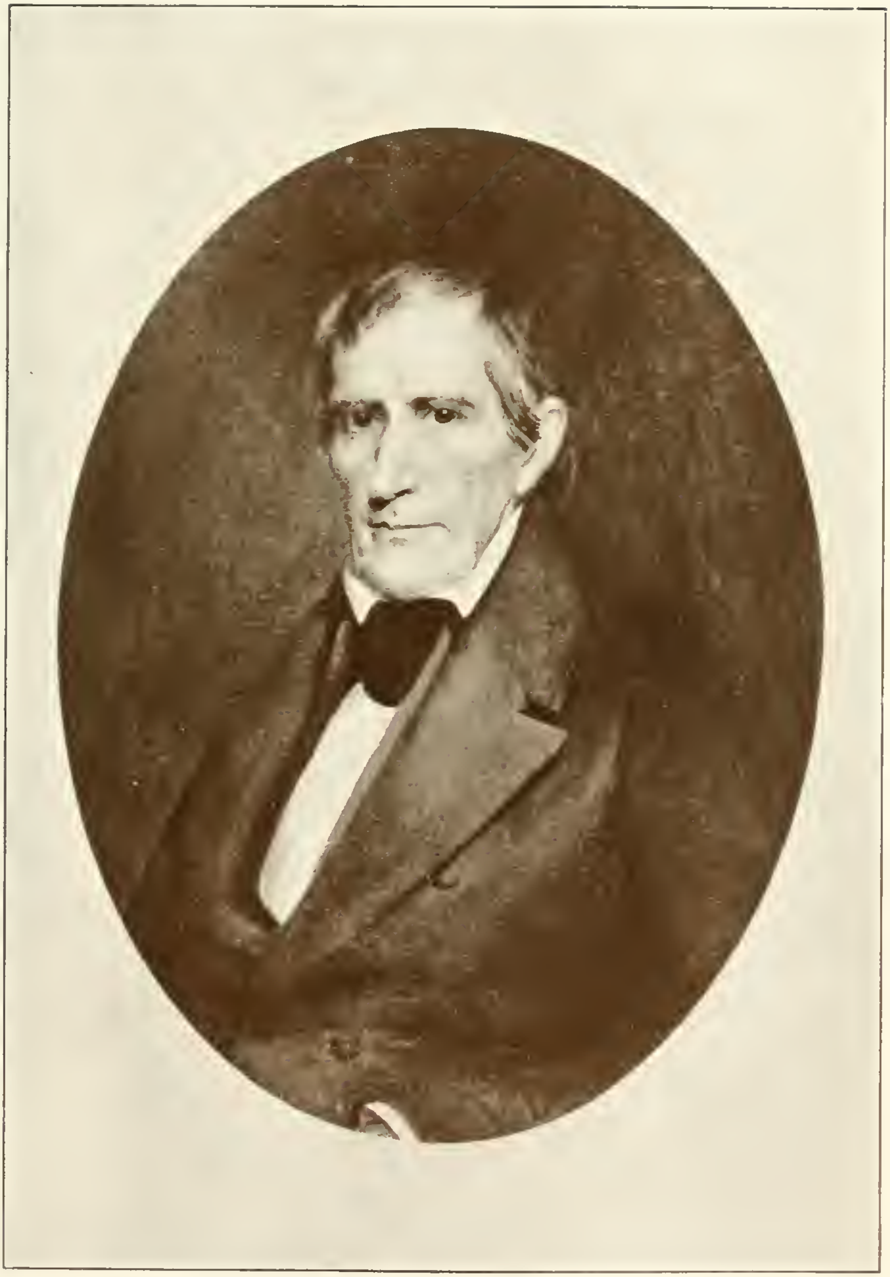
Harrison, Ark., town, county-seat of Boone County; on the St. Louis & N. A. railroad; about 120 miles northwest of Little Rock. It is in the lead and zinc section, and its industries are chiefly connected with mining. Considerable fruit is grown in the vicinity, and it has flour-milling and dairy interests. It is the seat of a collegiate and normal institute for women. The United States government building cost about $80,000. Pop. 1,603.

Harrison, N. J., city in Hudson County; on the Passaic River, the Pennsylvania and the Erie R.R.'s. It is a suburb of Newark, and a sub-station of the Newark post-office, but has an independent municipal government. It was settled in 1668 and incorporated in 1873. The charter of 1873 is still in force, and by it the government is vested in a common council elected by wards. The chief manufactures are wire-cloth, marine-engines, steel, machinery, tubes, refrigerators, ink, beer, and leather. The water-plant is owned and operated by the city. Pop. (1900) 10,596.

Harrison, Ohio, village in the township of Harrison, Hamilton County, on the boundary between Ohio and Indiana, and on the Cleveland, C., C. & St. L. railroad, 23 miles by rail west-northwest of Cincinnati. The village situated on the north bank of the Whitewater River, a tributary of the Great Miami, in a fertile farming section, has manufactures of furniture, sashes, blinds, brushes, bricks, shoes, a corn-drill factory, a cannery, and lumber, flour, and roller mills. Its public buildings include a high school and six churches. Pop. (1900) 1,456.

Har'risonburg, Va., town, county-seat of Rockingham County; on the Chesapeake & W., the Southern, and the Baltimore & O. R.R.'s; about 100 miles northwest of Richmond. It is in the Shenandoah Valley, and is surrounded by a rich agricultural country. Its chief manufactures are flour, staves, saw and planing mill products, foundry and machine shop products, and pottery. It is the trade centre for the greater part of the county. The town owns and operates the water-works. Pop. (1900) 3,521.

Harrisonburg, Engagement Near. Harrisonburg, Va., on the Great Valley Turnpike, 22 miles north of Staunton, and 122 miles northwest of Richmond, was the scene of many stirring events in the Civil War. The place was occupied by Gen. Banks late in April 1862, and abandoned when Jackson forced Banks down the valley in May. When Jackson, in turn, was forced up the valley by the combined armies of McDowell and Frémont, he abandoned the main valley, moving from Harrisonburg to Cross Keys and Port Republic, his rear-guard, two regiments of Virginia cavalry, under Gen. Turner Ashby, halting about two miles southeast of Harrisonburg. On 6 June 1862 Col. Wyndham, with the First New Jersey cavalry and a battalion of the Fourth New York, moving from Harrisonburg, attacked Ashby and



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was defeated and followed to within one mile of the town, with the loss of several men killed and wounded, and about 60 taken prisoners, including Wyndham himself. Gen. Bayard then pushed forward with cavalry and infantry and Ashby fell back and called for infantry support. Jackson sent him Stuart's brigade — First Maryland, Forty-fourth, Fifty-second, and Fifty-eighth Virginia. A few miles beyond Harrisonburg Bayard attacked with the Pennsylvania «Bucktails» under command of Lieut.-Col. T. L. Kane, and in the engagement Ashby was killed, and Kane was wounded and captured. While this was happening on the right, the Sixtieth Ohio infantry and First Pennsylvania cavalry, on the left, drove in the Confederate skirmish-line, without loss on either side. As soon as the wounded could be removed the Confederates fell back in the direction of Port Republic, and the Union forces retired to Harrisonburg. The Union loss in the engagement was 65 killed, wounded, and missing. The Confederate loss including Ashby, was 18 killed, 50 wounded, and 3 missing. Consult: 'Official Records,' Vol. XII.

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Har'risonville, Mo., city, county-seat of Cass County; on the Missouri, K. & T., and the Missouri P. R.R.'s; about 30 miles southeast of Kansas City. It is situated in an agricultural and stock-raising region and the trade and manufactures are connected chiefly with the products of the surrounding farms. The shipping consists mostly of grain, live stock, lumber, and dairy products. Pop. (1900) 1,844.

Harrisse, hăr-ēs', **Henri,** American critic, bibliographer, and historian: b. Paris 1830, of Russian-Hebrew parentage. He became a citizen of the United States, and for several years practised law in New York. He has published 'Bibliotheca Americana Vetustissima' (1866); 'Christopher Columbus' (1884–5); 'John and Sebastian Cabot' (1883); 'The Discovery of North America'; etc.

Har'rodsburg, Ky., city, county-seat of Mercer County; on a branch of the Southern railroad; about 45 miles southwest of Lexington and 58 miles southeast of Louisville. It is the oldest permanent settlement in the State, and was founded by James Harrod in 1774. Two years later Kentucky was incorporated as one of the counties of Virginia and Harrodsburg was made the county-seat. Stock-raising and farming are the principal occupations in the surrounding country. It has flour and planing mills, a distillery, brick-yard, and ice factory. The climate, scenery, and the Greenville Springs nearby make it a pleasure and health resort. It is the seat of Beaumont College, an institution for women, opened in 1894. Pop. (1900) 2,876.

Harrow School, England, an academic institution situated at Harrow-on-the-Hill, a town of Middlesex, 12 miles northwest of London. It is one of the famous public schools of England and was founded by John Lyon in 1571. The original red brick school house, now the Fourth Form School, was built 1608–15. New buildings were added in 1819 and since, the chief of these being the Vaughan Memorial Library (1863), and the semi-circular speech-room (1877). The school was primarily intended to afford free education to 30 poor boys of the parish; but provision was also made for the admission of 'so many foreigners as the place can conveniently contain.' The age of admission is 12 to 14; and there are six entrance scholarships of from $150 to $400 per annum, offered every Easter. The most valuable learning scholarships are Baring's three of $500 a year for five years to Hertford College, Oxford. Among the distinguished alumni of Harrow are Dr. Parr, Theodore Hook, Sheridan, Byron, Palmerston, Anthony Trollope, and Cardinal Manning. Under the Public Schools Act of 1868 the governing body comprises six members, elected respectively by the Lord Chancellor, the universities of Oxford, Cambridge and London, the Royal Society and the undermasters.

Hart, Albert Bushnell, American historian: b. Clarksville, Pa., 1 July 1854. He was graduated from Harvard in 1880, subsequently becoming professor of history there. He has written: 'Coercive Powers of the United States Government' (1885); 'Formation of the Union'; 'Introduction to the Study of Federal Government' (1890); 'Studies in American Education' (1895); 'Life of Salmon P. Chase' (1899); 'Practical Essays on American Government' (1893); etc. He has also edited 'American History Told by Contemporaries' (1898–1901); 'American Citizen Series' (1899); and since 1895, the 'American Historical Review.'

Hart, James McDougal, American painter: b. Kilmarnock, Ayrshire, Scotland, 10 May 1828. He came to the United States in 1831, and studied art under his brother William (q.v.), and at Düsseldorf in the studio of Schirmer (1851). He was elected a member of the National Academy in 1859, and devoted himself principally to American forest scenery with a preference for autumnal effects. His 'Landscape with Cattle' is in the New York Metropolitan Museum, and his best known pictures are 'On the Croton'; 'Morning in the Adirondacks'; and 'Oaks in Autumn.'

Hart, James Morgan, American scholar: b. Princeton, N. J., 1839. He was the son of John S. Hart (q.v.). He was graduated from Princeton in 1860, studied in Göttingen, and took the degree of A. M. from Princeton in 1863. He was professor of modern languages at Cornell (1868–72); professor of modern languages and English literature in the University of Cincinnati (1876–90); returning to Cornell as professor of rhetoric and English philology in 1890. He has written: 'German Universities' (1874); 'Syllabus of Anglo-Saxon Literature' (1887); 'Hand-book of English Composition' (1895); has revised and edited his father's 'Manual of Composition and Rhetoric' (1897); and has translated 'German Classics' and 'Goethe Prose Selections.'

Hart, Joel T., American sculptor: b. Clarke County, Ky., about 1810; d. Florence, Italy, 2 March 1877. He was of humble parentage, and in 1830 entered a stone-cutter's establishment in Lexington. He was induced to attempt modeling busts in clay, and among others, Gen. Jackson and Cassius M. Clay (q.v.) sat to him, the latter giving him his first commission for a bust in marble. This when completed proved so satisfactory that Hart was commissioned to execute a marble statue of Henry Clay. He began this, but various delays prevented its completion, and it was not set up in Richmond, Va., till 1859. Other important works by Hart are 'Woman Triumphant' in the court-house, Louisville, Ky., and 'Il Penseroso.' He was particularly well known for his portrait busts.

Hart, John, American patriot: b. Hopewell, N. J.; d. there, at an advanced age, 1780. Frequently elected to the colonial assembly he was prominent especially in the legislation for local improvements. In 1774 he was chosen to the general Congress at Philadelphia, where he was noted for his sound judgment and inflexible determination; was re-elected in the two following years, and was one of the signers of the Declaration of Independence. New Jersey was soon invaded by the British army, his estate devastated, and special exertions were made to take him prisoner. The capture of the Hessians by Washington permitted his return home.

Hart, John Seeley, American educator: b. Stockbridge, Mass., 28 Jan. 1810; d. Philadelphia 26 March 1877. He was for many years principal of the New Jersey State Normal School, at Trenton, and subsequently professor of English literature at Princeton College. His text-books on English and American literature had a wide circulation, and in the long course of his career as educator he did much to stimulate a taste for good literature among students.

Hart, Sir Robert, English diplomatist, director of the Chinese imperial maritime customs: b. Portadown, County Armagh, Ireland, 1835. He was educated at the Taunton Wesleyan School, and was graduated at Queen's College, Belfast. He entered the British consular service in China in 1854, was appointed inspector-general of customs in 1863 and accepted his present position in 1885. During the Boxer outbreak in 1900, he underwent the siege in the British legation, at Peking, and since then has published his views on the position of things in China in a very remarkable work, 'These From the Land of Sinim' (1901). He attributes the disturbances in China to the arrogance of foreigners and the unyielding pride of the Chinese. He discusses China's army, law, transportation, communication, currency, education, administration, and religion in a highly optimistic vein, and shows that the Chinese government does a great deal better than it gets credit for. He is a firm believer in the Chinese plans for reform. He is certainly deeply trusted by the Chinese authorities and is one of the best oriental administrators that England has ever been blest with in China.

Hart, Samuel, American Episcopal clergyman: b. Saybrook, Conn., 4 June 1845. He was graduated from Trinity College in 1866, and was ordained priest of the Episcopal Church in 1870. He was at Trinity College as assistant professor of mathematics (1870–3), professor of mathematics (1873–83), and professor of Latin (1883–99). In 1899 he became vice-dean and professor of doctrinal theology at Berkeley Divinity School. In 1886 he was appointed custodian of the Standard Prayer Book of the Episcopal Church of the United States, in 1892, secretary of the House of Bishops, and in 1896, historiographer of the church He is a member of several learned societies, including the American Historical Society, the American Oriental Society, and the Society of Biblical Literature and Exegesis. He is editor of 'Satires of Juvenal,' 'Satires of Persius,' and Bishop Seabury's 'Communion Office.'

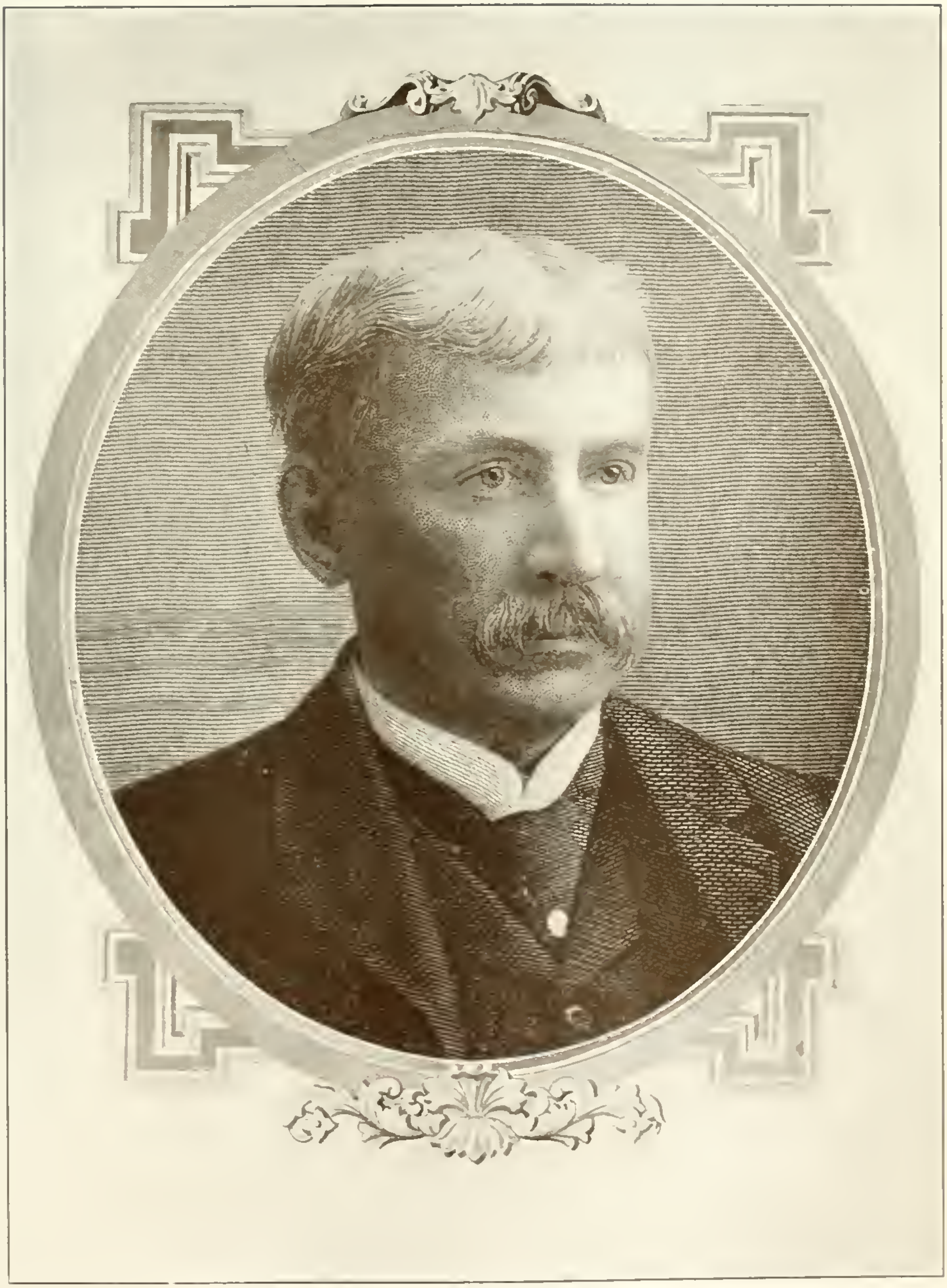
Hart, Thomas Norton, American merchant and politician: b. North Reading, Mass., 20 Jan. 1829. He entered business in Boston as partner in a mercantile firm, later founding a firm under the name of Hart, Taylor & Co. When he withdrew from this business, he became president of the Mount Vernon National Bank, and was connected with many eleemosynary institutions. He has also been active in politics, was a member of the common council, and of the board of aldermen; was nominated for mayor of Boston in 1887 and 1888, but defeated at the election; was, however, elected in 1889, 1890, 1900 and 1901.

Hart, William, American painter: b. Paisley, Scotland, 31 March 1823; d. Mount Vernon, N. Y., 17 June 1894. Emigrating with his parents to the United States in 1831, he settled in Albany, and was at first apprenticed to a firm of coachmakers, in Troy, by whom he was employed to paint the panels of coaches. He subsequently painted landscapes, portraits, and even window shades. In 1848 he became a regular exhibitor at the National Academy of Design, of which in 1858 he was elected as academician. He was president of the American Water Color Society 1870–3. He was a brother of James McDougal Hart (q.v.).

Hart, a hunting term, applied to the male, or stag, of the red deer after it has completed its full antlers at the age of six or seven years.

Hartbeest, härt'bēst, one of the large African antelopes of the genus *Bubalus*, specifically the caama (*B. cama*), formerly excessively numerous on the South African plains. They have long narrowing heads, doubly-curved, ringed horns, cow-like tails, and usually are of a grayish or reddish color, with decided markings on the face, especially in the bontebok (*B. pygargus*), blesbok (*B. albifrons*) and sassaby (*B. lunata*). All were noted for swiftness. Other very distinctive species are the konzi, tora, korigum and hunter's antelope. Most of these have become greatly diminished in numbers since about 1870.

Harte, Francis Bret, American novelist and poet: b. Albany, N. Y., 25 Aug. 1839; d. Aldershot, England, 6 May 1902. In 1854 he went to California, attracted there by the gold excitement. He was first a teacher at Sonora, then tried mining, in which he was unsuccessful. He next entered a printing-office, and in 1857 was compositor on the San Francisco 'Golden Era.' At that time he began to write short sketches, which appeared in the 'Golden Era,' and soon attracted attention; he was invited to join the staff of the 'Californian,' to which he contributed a series of clever parodies on famous contemporary writers of fiction, later published as 'Condensed Novels.' In 1864 he was appointed secretary to the United States branch mint; in 1868 became editor of the 'Overland Monthly,' for which he wrote 'The Luck of Roaring Camp' and others of his most successful stories of frontier life. In 1871 he went to New York and became a regular contributor to the 'Atlantic Monthly.' In 1878 he was appointed United States consul in Crefeld, Germany, and in 1880 received the consulship at Glasgow, Scotland. In 1885 his tenure of office as consul came to an end, and he settled in London, devoting his whole time to literary



BRET HARTE.

work. He was a prolific writer, and continued for the most part to deal with California themes. Among his shorter stories the following may be mentioned: 'Miggles'; 'The Outcasts of Poker Flat'; 'M'Liss' (1872); 'The Twins of Table Mountain' (1879); 'An Heiress of Red Dog' (1879); 'Flip' (1882); 'On the Frontier' (1884); 'By Shore and Sedge' (1885); 'Devil's Ford' (1887); 'A Phyllis of the Sierras,' and 'A Drift from Redwood Camp' (1888); 'The Heritage of Dedlow Marsh' (1889); 'A Sappho of Green Springs' (1891); 'The Bell-Ringer of Angel's' (1894); 'A Protégé of Jack Hamlin's' (1894); 'Barker's Luck' (1896); 'Tales of Trail and Town' (1898); 'Stories in Light and Shadow' (1898); 'Mr. Jack Hamlin's Mediation' (1899); and 'From Sand Hill to Pine' (1900), a collection of short stories. His longer stories and novels include: 'Gabriel Conroy' (1876); 'Thankful Blossom: A Romance of the Jerseys' (1877); 'In the Carquinez Woods' (1883); 'Maruja' (1885); 'Snowbound at Eagle's' (1886); 'The Crusade of the Excelsior' (1887); 'Cressy' (1889); 'A Waif of the Plains' (1890); 'A Ward of the Golden Gate' (1890); 'A First Family of Tasajara' (1892); 'Colonel Starbottle's Client, and Some Other People' (1892); 'Clarence' (1895), dealing with incidents in the American Civil War; 'In a Hollow of the Hills' (1895); and 'Three Partners' (1897). He has also written much verse comprised in volumes entitled 'Poems' (1871); 'East and West Poems' (1871); 'Echoes of the Foot-Hills' (1874); and 'Some Later Verses' (1898).

In estimating Harte's work it must be remembered that it was his rare good fortune to break new ground, and to become the first literary interpreter of a life which with its primitive breadth and freedom, its striking contrasts of circumstance and character, offered singular opportunities to the novelist. That he ever did anything quite so good as his first group of stories and poems cannot be said, for his later volumes are marked, as a whole, by the repetition of well-worn motives and by declining spontaneity and power. Still, the average quality of his output remained high; and when the circumstances of its production are borne in mind, it may perhaps seem remarkable that it should have preserved so many traces of the writer's youthful freshness and vigor. Among qualities of his work those which perhaps most constantly impress the critical reader are his dramatic instinct, his keen insight into character, his broad sympathy, and his subtle and pervasive humor. Dealing for the most part with large, strongly marked, elemental types, as these develop and express themselves under conditions which give free play to instinct and passion, he does not indulge in lengthy analyses or detailed descriptions. His men and women are sketched with a few strokes, and left to work out their own personalities in speech and deed; and yet, such is the skill with which this is accomplished that they stand out before us as creatures of real flesh and blood. He did not purposely soften the shadows in his pictures; the sin and wretchedness of frontier life are frankly portrayed; none the less, there can be little doubt that consciously or unconsciously he contrived to throw an idealizing glamor over the mine and the camp, and that many of his most lifelike and successful characters are wrought in the imagination, though out of the stuff of fact. But it is here that we touch upon what is perhaps one of the finest qualities of his work,— a quality not to be separated from his tendency toward idealization. Though he dwelt habitually upon life's unexplained and inexplicable tragic complexities, he nevertheless suffused his stories with an atmosphere of charity, clear, sweet, and wholesome. The weakness of his writing is closely connected with some of its main elements of strength. A master of condensed and rapid narration, he produced many stories which are too sketchy in method to be completely satisfactory; while in his desire to achieve terseness he occasionally sacrificed clearness of plot. This is particularly the case with his more ambitious efforts, especially with his long novel 'Gabriel Conroy,' an elaborate study of the culture conditions of early California civilization, which, though it abounds in memorable descriptions and vivid character sketches, lacks wholeness and proportion. As a writer of verse, he is unequal: some of his poetry shows the originality and power of his earlier prose, while much is of too temporary a character to find a lasting place in literature. Consult: Pemberton, 'Life of Bret Harte.'

Hartford, Conn., State capital, seat of Hartford County, port of entry, and head of navigation on the Connecticut River, 60 miles from Long Island Sound. By the main line of the New York, N. H. & H. railroad it is 110 miles from New York and 124 from Boston (a midway position which has enhanced its business development), 36 from New Haven, and 26 from Springfield, Mass.; the Highland Division (old N. Y. & N. E.) connects it with Fishkill on the Hudson (110 miles) and Providence, R. I. (90 miles); the Valley Division extends down the river to its mouth, the Connecticut Central to Springfield east of the river. The Central New England runs to Poughkeepsie and beyond. Pop. (1903) about 86,000.

Hartford lies on the west bank of the river, on rolling ground; Prospect Avenue in the west and Fairfield Avenue in the south afford a superb view across the entire Connecticut Valley, some 20 miles wide. It extends about 5½ miles north and south to Windsor and Wethersfield lines, by 3½ west to West Hartford line, about 18 square miles in all; the town and city are conterminous. It is divided about equally by the little Park River, which joins the Connecticut just south of the centre and is crossed by many bridges, and through whose bed runs the great main sewer into the Connecticut. The chief business street is Main, following the river line along the first high ground back from its shore, the latter frequently overflowed in the spring freshets; next Asylum, west past the railroad station, and State east to the steamer landing with the chief wholesale warehouses; Pratt and Pearl parallel to Asylum, and Central Row opposite Pearl across Main. It is a place of great beauty; and from its age, early and continuous business importance, and consequent accumulated wealth and generations of inherited incomes, is of noted social and intellectual cultivation,— more like the old European provincial capitals in a mingling of metropolitan advantages with those of moderate numbers and country roominess than any other American city. There are several costly residence districts: the most notable are Washington Street with its magnificent arch of old elms, Asylum Avenue. and a portion of Farmington, and Woodland Street, with some handsome places on Wethersfield Avenue. One of the finest streets, Prospect Avenue, is the West Hartford boundary, and built up only on that side: and fine places extend well into West Hartford. The street-railway system is very extensive and well managed: it runs in all directions for many miles. The Connecticut is spanned by a wooden bridge to East Hartford: but work has begun on a splendid stone bridge, to be completed by the end of 1904, at a cost with handsome street approaches of nearly $2,000,000.

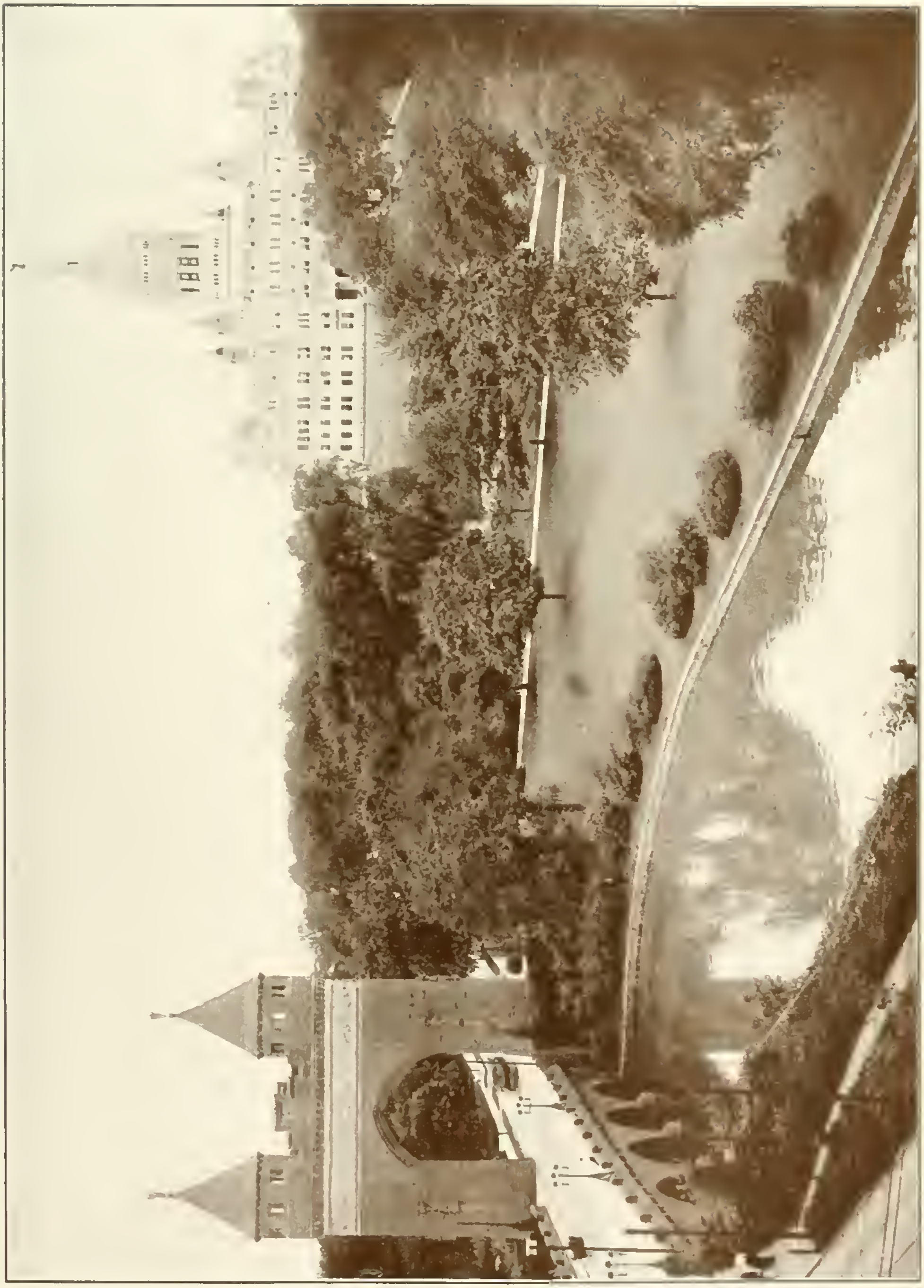
The park system contains some 1,200 acres: within the past few years the munificence of several citizens has endowed the city with a ring of beautiful parks, which with the city's help will ultimately encircle it entire. The oldest is Bushnell Park, in the heart of the city, 48½ acres, crowned by the State capitol and containing monuments to Israel Putnam and Horace Wells. The largest is Keney Park in the extreme north, extending into Windsor, 663.4 acres: next Goodwin Park in the extreme south, some 200 acres. Elizabeth Park in the extreme west, largely in West Hartford, 90 acres, is the nursery for the other parks: Pope Park southwest of the centre has 73 acres, ultimately to be 92 with city additions: and Riverside Park is a reclamation and beautifying of the formerly squalid river front north of the East Hartford bridge. There are also smaller squares and spaces.

The city has a remarkable number of handsome and architecturally notable buildings. Foremost is the State capitol, of white marble, towering over Bushnell Park; the handsomest in the country except the one at Albany, and architecturally surpassing that in many ways. It was completed in January 1880, at a cost of $2,534,024.46; land and other expenses made the total $3,342,550.73. The general plan was of 13th-century Gothic, but modern needs forced very much change in this. Each side is an individual and separately beautiful design: and the interior is as notable as the exterior. Its extreme length is 295 feet 8 inches; depth of centre part, 189 feet 4 inches: depth of wings, 111 feet 8 inches; height from ground line to top of crowning figure, 256 feet 6 inches. It is fireproof, the only known fireproof capitol. The red-sandstone Cheney Building was designed by H. H. Richardson. Trinity College (q.v.) has fine buildings on high ground in the south part, ultimately to form a quadrangle. The homes of the Connecticut Mutual Life, the Ætna Life, the Phœnix Mutual Life, and the National Fire, are the finest insurance buildings; the Phœnix Bank and the First National, of the bank buildings. The white granite government building (post-office and custom-house) may be noted: and the Wadsworth Athenæum is pleasing and dignified. Of several handsome church structures, St. Joseph's Cathedral (R. C.) is most notable. Of interest historically is the city hall, formerly the state house, completed May 1796: the famous Hartford Convention (q.v.) was held here in 1814. Of the city monuments, the two most notable are the Soldiers' Memorial Arch, forming a gateway into Bushnell Park across the Park River: and the superb Corning fountain in that park, a bronze with symbolical figures.

The educational institutions are widely famed. At their head stands Trinity College noted above. The Hartford high school is the most completely equipped in the country; it has cost in buildings, land, and equipment, $598,500. The pupils from surrounding towns are admitted on payment of a fee. A manual-training department was added in a new wing in 1897. The city schools are operated on the district system; several attempts to consolidate them have been heavily defeated. There are nine districts, with 18 buildings altogether. The school expenses are about $400,000 a year. The school tax is assessed with the city taxes, but each district by itself. Hartford has also a theological seminary managed by the Pastoral Union (Congregational) of Connecticut. There are 71 church societies, of which the Congregational (13), Roman Catholic (10), Baptist (9), Episcopal (8), and Methodist (7), are the chief denominations. Hartford is the seat of a Roman Catholic bishop. Its charitable institutions are renowned; it was the earliest seat of attempts to instruct the deaf and dumb in the United States, through Gallaudet and Clerc; and the School for the Deaf, formerly Deaf and Dumb Asylum (whence Asylum Street, where it is located), carries on the work. The Retreat for the Insane, the Hartford Hospital, the Hartford Orphan Asylum, the Y. M. C. A., the City Mission and Open Hearth, and the Union for Home Work, are only part of its overflowing charities. The Connecticut Humane Society also has its head office here.

The library facilities of the city are very large for its size, and far more varied in contents than if they had been collected by a single institution. In the Wadsworth Athenæum are housed the Hartford Free Public Library with 79,000 volumes, the Watkinson Library (reference only) with 59,000, and the Connecticut Historical Society with about 25,000, besides as many pamphlets, and toward 50,000 MSS. The libraries of the Theological Seminary (81,000, and about 40,000 pamphlets) and Trinity College (43,000) contain many valuable specialties: and the State Library in the capitol (40,000, and some 50,000 MSS.), with its great collection of statutes, law reports, public documents, Hansard, etc., is of extreme value.

Hartford, as the head of navigation and therefore distributing point for the Connecticut Valley, early gained an importance as a centre of wholesale trade which it has never lost: to accommodate this, the Hartford Bank, the fifth in the United States, was organized in 1792. But its largest importance is now as one of the leading insurance centres in the world, and third in the United States. This business developed from the marine insurance on its West India cargoes, added fire insurance as a branch, and in 1840 life insurance. The loans of its insurance companies with their vast assets, not restricted by law as are those of New York, have been one of the greatest agencies in developing the West, amounting to several hundred millions of dollars. There are now six life companies, two of which also have accident branches — the latter being the original and chief department in one; five fire companies besides a county mutual, and the United States branches of three foreign companies: and a



THE STATE CAPITOL AND SOLDIERS AND SAILORS MEMORIAL BRIDGE AND ARCH,
IN BUSHNELL PARK.

steam-boiler insurance company. There are 7 national and 5 other banks of discount, 4 savings-banks, and 4 trust companies. The manufacturing interests are heavy and varied. Fire-arms, including Gatling guns, at the famous Colt Works; electric machinery and vehicles; bicycles, of which it is the centre in the United States; cyclometers; woven-wire mattresses; horse nails; screws; steam-engines and boilers; typewriters; leather belting; and special machinery of all kinds, besides knit goods, furniture, carriages, harness, and many other things are manufactured here. It has also one of the largest printing houses in New England, which has manufactured many famous works; four daily papers, one of them the oldest newspaper in the United States (The *Courant*, 1764), and a number of weeklies, monthlies and quarterlies.

The mayor holds office for two years, and the representative body is two-chambered. The assessed valuation of property is about $81,000,000, making it *per capita* one of the richest cities in the United States. The tax rate is under 2 cents on the dollar.

The first white settlement of Hartford was by the Dutch in 1633, at the junction of the Park and Connecticut, still called Dutch Point (though the original point is now out in the Connecticut). They built there a fort called the "House of Hope." (For the settlement by the Newtown men in 1635–6, and the adoption of the first written constitution of modern times, whence Hartford is called the "birthplace of American democracy," see CONNECTICUT.) Hartford was first named Newtown, changed to the present name from Samuel Stone's English birthplace. From here in 1637 sailed the first organized military expedition in the English colonies, John Mason's against the Pequots. The Dutch were ejected from their fort in 1654; they had never really made a settlement. (For the attempt of Andros to seize the charter, in 1687, see CHARTER OAK.) In 1701 Hartford became joint capital with New Haven. In the Revolution, Hartford, as the head of the one rich store of food which the British could not seize, became of prime importance; the second commissary-general of the United States army, Jeremiah Wadsworth, was a Hartford merchant. Gov. Trumbull was also a strong reliance of Washington, who came to Connecticut to consult him; and in 1780 Washington and Rochambeau planned the Yorktown campaign here. The Hartford Convention (q.v.) of 1814 sat here. In 1873 Hartford became the sole capital of the State.

Its native and adopted citizens have made the city one of the literary glories of New England. It was the birthplace of Noah Webster, Frederick Law Olmsted, and John Fiske, with others of note; had the services of George D. Prentice, John G. Whittier, Joel Barlow, and others; and was the long or permanent residence of Harriet Beecher Stowe, Mark Twain, Charles Dudley Warner, and Horace Bushnell, besides John Trumbull and Lydia H. Sigourney. In the business world, both Edwin D. Morgan and Junius S. Morgan began their career as Hartford merchants.

Population.— 1800, 5,347; 1810, 3,955; 1820, 4,726; 1830, 7,074; 1840, 9,468; 1850, 17,966; 1860, 29,152; 1870, 37,180; 1880, 42,015; 1890, 53,230; 1900, 79,850. Of these 23,758 were of foreign birth: 8,076 in Ireland, 3,364 in Germany, and Austria, 2,260 in Russia, 1,952 in Italy, 1,714 in Sweden, 2,073 in England and Canada (English).

FORREST MORGAN,
Of Connecticut Historical Society.

Hartford, Mich., village of Hartford Township, Van Buren County, 15 miles west of Paw Paw on the Paw Paw River, and 17 miles northeast of Benton Harbor, on the Chicago & M. L. S. R.R. It has a graded school and five churches. It carries on a considerable traffic in agricultural produce and stock, has grain elevators, flour, saw-, and planing-mills, canneries, electric light plant, and manufactures staves, cigars, cheese, vinegar, etc. Pop. (1900) 1,077.

Hartford, Vt., town of Windsor County, on the White River, about one mile above its junction with the Connecticut River, and 60 miles south of Montpelier, on the Central Vt. and on the Woodstock R.R.'s. It has woolen, saw, and grist mills, and manufactures of agricultural implements and furniture. Pop. (1900) 3,817.

Hartford City, Ind., city, county-seat of Blackford County; on the Pittsburg, C. C. & St. L. and the Lake E. & W. R.R.'s; about 45 miles southwest of Fort Wayne, and 60 miles northeast of Indianapolis. The natural resources which contribute to the industrial and commercial interests are the products from the surrounding agricultural country, the natural gas supply, and the oil fields. The chief manufactures are iron, glass, flour, pulp, and paper, strawboard, and wagons. The city owns and operates the waterworks. Pop. (1900) 5,912.

Hartford Convention, of 1814: a gathering of New England Federalists to discuss measures for securing New England interests against the South and West; especially in relation to the War of 1812. The convention opposed the war on several grounds,— the vital objection being that it was destroying all American commerce in order to punish Great Britain for crippling a part of it. It was believed by the delegates that the agricultural States were sacrificing New England, whose life-blood was commerce, from ignorance mingled with sectional malice (see EMBARGO). All through the war, the New England Federalists, impoverished and excluded from the national councils, harassed and hampered the government in conducting it; the government retorted by leaving the whole section to its fate; the British inflamed the discord by exempting the New England coast from blockade, and the government countered by laying a new embargo which did the same work. All the New England States and New York were swept by the Federalists on this issue. In November 1813 the governor of Vermont recalled a brigade of militia from garrison duty; the government threatened prosecution, the Massachusetts legislature threatened to use the State power to support him. In the autumn of 1814 the destruction of New England industries had become intolerable; the coast was undefended, the British were occupying that of eastern Maine, and Congress was proposing a conscription so severe as to enlist minors without the consent of their parents; whereupon the Connecticut legislature ordered the governor to call a special session to protect its citizens if the measure were adopted. On 18 October the Massachusetts legislature proposed a convention of the New England States, to take action "not repugnant to their obligations as members of the Union," and "lay the foundation of a radical reform in the national compact" through a future national convention. Connecticut and Rhode Island accepted the proposal with similar qualification; New Hampshire was divided politically and Vermont was excited over Macdonough's victory at Plattsburg, but certain counties sent delegates. The war was a growing and alarming failure. England was demanding the renunciation of the whole Northwest as the price of peace, national bonds were at 25 per cent discount. The government sent a regular army officer to oversee the convention, and use force if it attempted disunion; deputed secret agents to see if it was true that there was a plot to make New England an English grand-duchy under a prince of the blood; and appointed the succeeding 12th of January a national fast-day. The convention met at Hartford, Conn., 15 Dec. 1814, with 12 delegates from Massachusetts, 7 from Connecticut, 4 from Rhode Island, 2 from New Hampshire, and 1 from Vermont,— 26 in all. George Cabot of Massachusetts was chosen president, Theodore Dwight of Connecticut, secretary. A secret session of three weeks was held, a report to the New England legislatures prepared, and 5 Jan. 1815, the convention adjourned. The report stated the before-mentioned grievances, and charged the government with making naturalizations too easy and with destroying the balance of sections by forming new States at will out of the western territory; but denied any present intention to dissolve the Union. It was proposed that Congress should confide the defense of each State to the State itself, and return a share of its taxes for the purpose; and recommended seven changes in the Constitution, namely: abolition of the three fifths slave representation, the requirement of a two thirds vote for the admission of new States, the limitation of embargoes to 60 days, the requirement of a two thirds vote to sanction the prohibition of commercial intercourse, or to declare war or hostilities except in case of invasion; the exclusion of naturalized foreigners from civil offices or a seat in Congress, and prohibition of a President's re-election. They proposed also that two Presidents in succession should never be elected from the same State. They also recommended that another convention should be held at Boston the following June if affairs did not mend or the amendments were rejected. The Massachusetts and Connecticut legislatures adopted the report and sent commissioners to Washington; but before they arrived a satisfactory peace was made, all disasters forgotten in the blaze of the battle of New Orleans, and the promoters of the convention detested as traitors preparing to secede. They were in fact killed for public life. But in 1819 Cabot deposited the journal of the convention with the Massachusetts secretary of state as a permanent testimony that nothing treasonable was attempted; in 1833 Dwight wrote its history.

Hartford Fern. See *Filicales* (2), under FERNS AND FERN ALLIES.

Hartford Theological Seminary, an institution founded in 1834 for the education of Congregational preachers, at East Windsor Hill, Conn. It was formerly called the Theological Institute of Connecticut, and took its present name on its removal to Hartford in 1865. Its control is vested in a board of trustees elected by the Pastoral Union, an association of 200 ministers who have subscribed to the creed of the Union. The aim of the institution is to train ministers for pastoral work on the broadest lines of intellectual and spiritual life. The seminary has always been a leader in theological pedagogy. In 1903 its faculty comprised 12 professors and 12 lecturers, and the number of students was between 80 and 90. It has a library of 81,000 volumes, and nearly 45,000 pamphlets. Hosmer Hall, the main building, was erected 1880 by James B. Hosmer, and as it is estimated, at a cost of $150,000. In 1902 the Case Memorial Library was built by Newton Case at a cost of $100,000. Since 1890 the faculty have issued their valuable theological quarterly, 'The Hartford Seminary Record.'

Harting, James Edmund, English naturalist: b. London 29 April 1841. He was a solicitor until 1878, since when he has devoted himself to zoological research. Among his numerous publications are: 'The Ornithology of Shakespeare' (1871); 'Handbook of British Birds' (1871); 'Rambles in Search of Shells' (1875); 'British Animals Extinct within Historic Times' (1880); 'Essays on Sport and Natural History' (1883).

Har'tington, Spencer Compton Cavendish, MARQUIS OF. See DEVONSHIRE, SPENCER COMPTON, DUKE OF.

Hartington, Neb., city, county-seat of Cedar County; on Bow Creek, and on the Chicago, St. P. & O. R.R.; about 42 miles west by north of Sioux City, Ia., and 18 miles south by east of Yankton, S. D. It is in a fertile agricultural region and is the commercial centre of a large part of Cedar County. Large shipments of wheat and live stock are made annually. Pop. (1900) 971.

Hart'ley, SIR Charles Augustus, English civil engineer: b. Heworth, County of Durham, England, 1825. After being employed on several important engineering works he served in the Crimean war as captain of Turkish engineers, was knighted in 1862, and in 1867 was awarded, against 20 competitors, the prize for plans for extending the harbor of Odessa. He was appointed by President Grant a member of a board of engineers to report on the improvement of the lower Mississippi and recommended the improvement of the South Pass of its delta. He has been consulting engineer on many other notable engineering projects and has received many medals and decorations from home and foreign societies. He has published 'The Delta of the Danube'; 'Public Works of the United States and Canada'; 'Inland Navigation in Europe'; 'History of the Engineering Works of the Suez Canal.'

Hartley, David, English philosopher and physician: b. Armley, Yorkshire, 30 Aug. 1705; d. Bath, Somerset, 25 Aug. 1757. He practised medicine at Newark, Bury St. Edmund's, and London, and is remembered for his 'Observations on Man' (1749) in which is stated his hypothesis of nervous vibration and of the association of ideas.

Hartley, Jonathan Scott, American sculptor: b. Albany, N. Y., 23 Sept. 1845. After spending several years in studying art in England, Rome, and Paris, he established himself in New York where he was professor of anatomy in the schools of the Art Students' League, 1878-84, and president of the league, 1879-80. Among important works by him are: 'King René's Daughter'; 'The Whirlwind'; the Miles Morgan statue at Springfield, Mass.; Daguerre monument, Washington, D. C.; Ericcson monument, New York; statue of Alfred The Great, for Appellate Court building, New York (1900); statue of Thomas K. Beecher, Elmira, N. Y. (1901); etc.

Hart'man, Sadikichi, American author and artist: b. Nagasaki, Japan, 1867. He was educated in Germany. He has published 'Schopenhauer in the Air' (1899); 'Shakespeare in Art' (1901); 'Modern American Sculpture' (1901); etc.

Hartmann, Karl Robert Edouard von, b. Berlin 23 Feb. 1842; d. 6 June 1906. He was educated for the army, but an injury to his knee compelled him to leave the service in 1865. He then began the study of philosophy, and for many years lived the retired life of a student. His most important publications are: 'The Philosophy of the Unconscious' (1869); 'The Phenomenology of the Moral Consciousness' (1879); 'The Religious Consciousness of Mankind in the Stages of its Development' (1881); and 'The Religion of the Spirit' (1882). Among his other works are: 'Critical Grounds of Transcendental Realism'; 'The Crisis of Christianity in Modern Theology' (1880); 'Judaism in the Present and the Future' (1885); 'Lotze's Philosophy' (1888); 'The Ghost Theory in Spiritism' (1891); 'The Fundamental Social Questions' (1894); and many other works on society, religion, etc.

Von Hartmann's philosophy is called by its author a transcendental realism, because in it he professes to reach by means of induction from the broadest possible basis of experience a knowledge of that which lies beyond experience. A certain portion of consciousness, namely sense-perception, begins, changes, and ends without our consent and often in direct opposition to our desires. Sense-perception, then, cannot be adequately explained from the ego alone, and the existence of things outside experience must be posited. Moreover, since they act upon consciousness and do so in different ways at different times, they must have those qualities assigned to them which would make such action possible. Causality is thus made the link that connects the subjective world of ideas with the objective world of things. An examination of the rest of experience, especially such phenomena as instinct, voluntary motion, sexual love, artistic production, and the like, makes it evident that will and idea, unconscious but teleological, are everywhere operative, and that the underlying force is one and not many. This thing-in-itself may be called the Unconscious. It has two equally original attributes, namely, will and idea. Hegel and Schopenhauer (qq.v.) were both wrong in making one of these subordinate to the other; on the contrary, neither can act alone, and neither is the result of the other. The will is illogical and causes the existence, the *Das* of the world; the idea, though not conscious, is logical, and determines the essence, the *Was*. The endless and vain striving of the will necessitates the great preponderance of suffering in the universe, which could not well be more wretched than it is. Nevertheless, it must be characterized as the best possible world, for both nature and history are constantly developing in the manner best adapted to the world-end; and by means of increasing consciousness the idea, instead of prolonging suffering to eternity, provides a refuge from the evils of existence in non-existence.

The original state of the Unconscious is one of potentiality, in which by pure chance the will begins to strive. In the transition state, called that of the empty will, there is no definite end; and to avoid the unhappiness of aimless desire the will realizes the ideas already potentially present and the Unconscious becomes actual. The existence of the universe is the result, then, of the illogical will, but its characteristics and laws are all due to the idea and are, therefore, logical. The history of the world is that given by natural science, and particular emphasis is laid upon the Darwinian theory of evolution (q.v.). Man is developed from the animal, and with the appearance of the first human being the deliverance of the world is in sight, for only in man does consciousness reach such height and complexity as to act independently of the will. As consciousness develops, there is a constantly growing recognition of the fact that deliverance must lie in a return to the original state of non-willing, which means the non-existence of all individuals and the potentiality of the Unconscious.

The one foundation for ethics is pessimism, for no other view of life recognizes that evil necessarily belongs to existence and can cease only with existence itself. The essential feature of the morality built upon this basis is the realization that all is one and that, while every attempt to gain happiness is illusory, yet before deliverance is possible, all forms of the illusion must appear and be tried to the utmost. Even he who recognizes the vanity of life best serves the highest aims by giving himself up to the illusion, and living as eagerly as if he thought life good. It is only through the constant attempt to gain happiness that men can learn the desirability of nothingness; and when this knowledge has become universal, or at least general, deliverance will come and the world will cease. No better proof of the rational nature of the universe is needed than that afforded by the different ways in which men have hoped to find happiness and so have been led unconsciously to work for the final goal. The first of these is the hope of good in the present, the confidence in the pleasures of this world, such as was felt by the Greeks. This is followed by the Christian transference of happiness to another and better life, to which in turn succeeds the illusion that looks for happiness in progress, and dreams of a future made worth while by the achievements of science. All alike are empty promises, and known as such in the final stage, which sees all human desires as equally vain and the only good in the peace of Nirvana.

The relation between philosophy and religion lies in their common recognition of an underlying unity, which transcends all the apparent differences and divisions due to individual phenomena. Many changes must take place in the existing religions before they will be suited to modern conditions, and the resulting religion of the future will be a concrete monism.

The Philosophy of the Unconscious has been the subject of many different estimates, but is regarded as having less intrinsic than historical value. Its influence upon other thinkers was especially marked during the years following its first appearance, but at present that influence has much decreased.

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GRACE NEAL DOLSON,
Professor of Philosophy, Wells College.

Hartmann, Moritz, Austrian poet and novelist: b. Duschnik, Bohemia, 15 Oct. 1821; d. Vienna, 13 May 1872. He was educated at Prague and Vienna and taught in Vienna till 1844, when he left the country on account of his political liberalism. Upon his return to Austria he was imprisoned but released by the revolution of March 1848. He sat in the Frankfort Parliament of 1848 but fled from Vienna to escape imprisonment and took part in the "Rump Parliament" at Stuttgart. From 1849-68 he was in voluntary exile in foreign countries; was Paris correspondent of the 'Kölnische Zeitung' and represented it in Crimea during the Russo-Turkish war; in 1860 lectured on German history and letters in the Academy at Geneva; and in 1865 became one of the editors of the 'Neue Freie Presse'. He wrote: 'Kelch und Schwert' (1845); 'Neure Gedichte' (1847); 'Reimchronik des Pfaffen Marizius' (1849); 'Der Krieg um den Wald' (1850); 'Schatten' (1851); 'Adam and Eve' (1851); 'Tagebuch aus der Provence und Languedoc' (1853); 'Briefe aus Irland'; 'Der Gefangene von Chillon' (1863); 'Die letzen Tage eines Königs' (1866); 'Nach der Natur' (1866); 'Die Diomanten der Baronin' (1868); etc. His select poems were edited in 1874 and his works in 1873-74 (10 vols).

Hartranft, här'tränft, **Chester David,** American educator: b. Frederick Township, Montgomery County, Pa., 15 Oct. 1839. He was graduated at the University of Pennsylvania in 1861 and at the New Brunswick Theological Seminary in 1864; was pastor of the Dutch Reformed church at South Bushwick, N. Y., in 1864-6, and of that in New Brunswick, N. J., in 1866-78. In 1879 he was appointed professor of ecclesiastical history at the Hartford Theological Seminary; in 1888 was elected its president, and held the chair of Biblical theology 1892-7 and of ecclesiastical dogmatics from 1897 to 1903. He resigned the presidency in 1903 to engage in literary work in Germany. He was at one time president of the Conservatory of Music at New Brunswick, N. J.

Hartranft, John Frederick, American soldier: b. New Hanover, Pa., 16 Dec. 1830; d. Norristown, Pa., 17 Oct. 1889. He was graduated at Union College in 1853, and in 1859 was admitted to the bar. At the outbreak of the Civil War he organized the 51st Pennsylvania regiment, was made its colonel, and with it participated in Burnside's expedition to North Carolina (1862). He also commanded the regiment in a charge at Antietam, and at Fredericksburg. In March 1865, he commanded a division of the Ninth corps in their assault on Fort Steadman, and was brevetted major-general. He was elected auditor-general of Pennsylvania in 1865, and re-elected in 1868. From 1872 to 1878 he was governor of Pennsylvania, and thoroughly reorganized the Pennsylvania militia, which from 1879 he commanded, with rank of major-general.

Hart's-horn, the horn of the common stag and its decomposition products. The substances derived from the horns were the volatile liquor, salt, and oil, and the ash which remains when the horns are calcined in the air. The fluid portions are got by destructive distillation in a convenient still, and are separated, the salt mechanically, and the others, after washing with water, by repeated rectification either alone or with quicklime, by which the more volatile portions are got free from the tarry matter and heavier oils. The salt which is formed in this operation is ammonic carbonate, which in part condenses the neck of the retort, in part is washed over by the acqueous vapor into the receiver; and when the ammonia is got pure from the distillate and is condensed in water it constitutes the spirit of hart's-horn. The volatile alkali or spirit of hart's-horn is now no longer obtained from that source, except in special circumstances; the ammonia of commerce is now obtained from gas-liquor, from blast-furnaces, or from other sources.

Hart'suff, George Lucas, American soldier: b. Tyre, Seneca County, N. Y., 28 May 1830; d. New York 16 May 1874. He was graduated from West Point in 1852, entered the artillery, was on duty on the frontier and in Florida in the Civil War became assistant adjutant-general, with rank of captain, in 1861, and major in 1862. Later appointed major-general of volunteers, he was one of the board for revision of the rules and articles of war and the preperation of a code for the government of the armies in the field. He was mustered out of the volunteer service in 1865, and in 1871 was retired from the regular army with rank of lieutenant-colonel and brevet major-general.

Hartsville, Engagements at. Hartsville, Tenn., on the north bank of the Cumberland River, about 35 miles northeast of Nashville, is an important crossing and connected by good roads with Lebanon on the south and Gallatin on the northwest. In August 1862 Gen. John H. Morgan, with his Confederate command, was operating north of the river and Gen. R. W. Johnson, with a cavalry command, was sent to drive him back. Johnson, approaching on the Gallatin road, attacked Morgan 21 August, near Hartsville, and was defeated with a loss of 80 killed and wounded, and 75 prisoners.

On 6 Dec. 1862 Hartsville was held by Col. A. B. Moore, with a Union force of three regiments of infantry, a regiment and a company of cavalry, and a section of artillery, in all about 2,100 men. Morgan had been instructed by Gen. Bragg to operate on Gen. Rosecrans' lines of communication in rear of Nashville and, learning that Moore was isolated, with no supports near, resolved to capture him. While two infantry brigades of Cheatham's division and Wheeler's cavalry demonstrated on Nashville, Morgan, with four regiments and a battalion of cavalry, two regiments of infantry, and a battery, set out from Baird's Mills, 25 miles south of Hartsville, on the morning of 6 Dec. 1862, marched through Lebanon, crossed the Cumberland below Hartsville, during the night, disposed his forces so as to cut off Moore's retreat on the roads leading to Gallatin and Castalian, posts occupied by other Union commands, and early in the morning of 7 December, closed in on the Union camp, surprised it, attacked the troops, who were being hastily drawn up to receive him and, after a stubborn fight of an hour and a half, defeated and captured the entire command. Col. John M. Harlan, in command of a small Union brigade at Castalian Springs, nine miles away, hearing the noise of battle, marched to Hartsville and attacked Morgan's rear-guard as it was recrossing the river, recapturing some of the wagons taken. The Union loss was 58 killed, 204 wounded, and 1,834 captured and missing. The Confederate loss was 21 killed, 104 wounded, and 10 missing. Consult: 'Official Records,' Vol. XX.

E. A. Carman.

Hartt, Charles Frederick, American geologist: b. Fredericton, N. B., 23 Aug. 1840; d. Rio de Janeiro, Brazil, 18 March 1878. He was a pupil of Agassiz in the Museum of comparative anatomy at Harvard, and accompanied the great naturalist as geologist of a Brazilian expedition (1865). During this expedition he explored the coast from Bahia to Rio, made extensive zoological collections, and by his researches made himself a leading authority on the natural history of South America. In 1875 he was appointed chief of the geological surveys of the empire of Brazil. He was also from 1876 director of the National Museum at Rio, where are deposited his collections, the most complete of South American geology in existence. He published: 'Geology and Physical Geography of Brazil' (1870), and 'Contributions to the Geology and Physical Geography of the Lower Amazon' (1874).

Hart'well, Ga., town and county-seat of Hart County, the terminal of a branch of the Southern railway, 50 miles northeast of Athens. Its educational institutions include a high school. There are cotton, flouring, and sawmills, and a fruit cannery. Pop. (1900) 1,672.

Hartwell, Ohio, village of Hamilton County, 11 miles north of Cincinnati, on the Cincinnati, H. & D. and on the Cleveland, C. & C. R.R.'s. It has manufactures of wagons and carriages and a general retail and agricultural trade. Pop. (1900) 1,833.

Harty, Jeremiah J., American Catholic prelate: b. St. Louis 1853. He was graduated from the St. Louis University in 1872, and took a theological course at St. Vincent's College, Cape Girardeau, Mo. He was ordained priest in 1878, and appointed assistant pastor of St. Bridget's parish in St. Louis, holding this position until 1888, when he was commissioned to build the church and organize the parish of St. Leo in the same city. His organizing work has been most successful, and in 1902 he built a school accommodating over 700 children. In 1903 he was appointed archbishop of Manila, the most important see in the Philippines.

Hartz'ell, Joseph Crane, American Methodist bishop and missionary: b. Illinois 1 June 1842. He was graduated from Wesleyan University and Garrett Biblical Institute (Evanston, Ill.), and in 1896 was elected missionary bishop to Africa where he has since been actively engaged in organizing missions. In June of 1903 he sailed from New York on his seventh missionary tour of inspection in Africa.

Harugari, hā-roo-gä'rē, a social and benevolent order established in the United States in 1847. It had in 1903 over 300 lodges with a total membership of 30,000. Its purpose is largely the preservation of German language, customs, and traditions.

Harun-al-Rashid, hä-roon'äl-răsh'ĭd, or **Haroun-al-Rashid,** caliph of Bagdad: b. Rhey about 765 A.D.; d. Thous 2 April 809. (See Caliph.) The popular fame of this caliph is by the 'Arabian Nights' Entertainments,' in which Harun, his wife Zobeide, his vizier Giaffar, and his chief eunuch Mesrur, are frequent and conspicuous characters. He was the fifth caliph of the dynasty of the Abbassides, and the most powerful monarch of his race. In 786 he succeeded his elder brother Hadi, who had vainly attempted to exclude him from the throne, and by his conquests and vigorous internal administration raised the caliphate of Bagdad to its greatest splendor, and made his reign esteemed the golden era of the Mohammedan nations. His favorite ministers were Yahia and his son Giaffar, of the ancient Persian family of the Barmecides, whose ancestors had for many generations been hereditary priests at the fire temple of Balkh, and who now rapidly exalted the family to the highest dignities under the caliphate.

Harus'pices. See Aruspices.

Har'vard, John, American clergyman, founder of Harvard University: b. England, probably in Middlesex; d. Charlestown, Mass., 24 Sept. 1638. He was entered as a pensioner at the university of Cambridge in 1628, was graduated B.A. in 1631–2, and M.A. in 1635, and having emigrated to America was made a freeman of the colony of Massachusetts, Nov. 2, 1637. The following year, as appears from the town records, a portion of land was set off for him in Charlestown, where he exercised the ministry. In April 1638, he was appointed one of a committee "to consider of some things tending toward a body of laws." These are the only particulars known of his life. His property at his death was worth about £1,600, one-half of which he gave for the erection of the institution which bears his name; but part of this bequest, it is said, was diverted from its original purpose. He also left to the college a library of more than 300 volumes, indicating in their selection the taste and skill of a scholar. A monument to his memory was erected in the burial ground of Charlestown by the alumni of the university, and inaugurated with an address by Edward Everett, 26 Sept. 1828. See Harvard University.

Harvard, Ill., a city and important railway junction in Chemung Township, McHenry County, at the intersection of three divisions of the Chicago & N. railroad, 63 miles northwest of Chicago. It has railroad repair shops, a malt house and brewery, manufactures of agricultural implements, wagons, and carriages, and grist and woolen mills. Pop. (1900) 2,602.

Harvard University, the oldest institution of learning in the United States, was founded in Cambridge, Mass., in 1636. At a meeting of the general court of the Colony of Massachusetts Bay, convened on 8 September, 6 years after its first settlement, it was voted to give £400 toward a "schoale or colledge," for the purpose of educating the "English and Indian youth in knowledge and Godliness." The ensuing year 12 of the eminent men of the colony, including John Winthrop and John Cotton, were authorized "to take order for a college at New Towne." The name Cambridge was adopted soon afterward in recognition of the English University where many of the colonists had been educated. In 1638 John Harvard, a young nonconformist minister, died in Charlestown, leaving to the college £750 and his entire library of 300 volumes. The institution was opened soon after and was named Harvard in honor of its first benefactor.

In 1637 the first building was erected. The first president was Rev. Henry Dunster, who was elected in 1640. The first graduating class was in 1642, and consisted of nine members. This same year a change was made in the government of the college; a board of trustees was created, the members of which were the governor, the deputy governor, the teaching elders of the "5 next adjoining towns"— Boston, Cambridge, Charlestown, Dorchester, and Roxbury — the magistrates, and the president of the college. The college was established as a corporation in 1650, with power of control over the educational and financial concerns of the institution. The members of the corporation were the president, the treasurer, and 5 fellows. In 1657 the corporation charter was changed so that the overseers had practically no control over the internal management of the college, although a final appeal might be made to them if necessary. Now there were two governing bodies; the overseers and the corporation, at times working in harmony and again antagonistic to each other. In 1780 the board of overseers consisted of the governor, lieutenant-governor, senate, and council of the commonwealth, the president of the college, and the ministers of the Congregationalist churches of the "6 adjoining towns" already mentioned. In 1810 a further change was made in the board of overseers, and instead of the senate and the ministers of certain churches, there were substituted 15 Congregationalist ministers, 15 laymen, the president of the senate, and the speaker of the house, all to be inhabitants of the State. The members constituting the senate were restored as overseers in 1814. A still further broadening of the spirit of the board was shown by the act of 1834, but not ratified until 1843, when clergymen of all denominations were made eligible for membership to the board, and in 1851 an act was passed in which no mention was made of clergymen, but the clause that made only inhabitants of the State eligible was retained. It was not until 1880 that Harvard was freed from all sectional lines, and non-residents of the State of Massachusetts became eligible for membership to the board of overseers.

During the 17th century Harvard had to contend with serious obstacles, many of which had their origin in religious differences or shades of differences; but the desire to give the youth of Massachusetts an opportunity to learn the things taught to their fathers in the schools of Europe never faltered. It required heroic courage then to persevere in such a work, which at present seems a comparatively easy task. The religious controversies continued even after donations and endowments had come to the aid of the institution and had made its success seem almost certain. Under the presidency of Rev. Increase Mather, the college was placed under the control of the Calvinists (1692), but in 1707 the liberals gained the ascendency. An English merchant, Thomas Hollis, in 1721, founded a chair of divinity, and directed that no religious test should be given to the candidate for the professorship. The gift was refused by the overseers, but the corporation urged its acceptance, and the latter finally prevailed. However, the first candidate for a professorship was really subjected to a religious test, for a confession of faith on various disputed points was exacted of him. The religious controversies were carried so far that at one time there was a strong effort made by the orthodox friends of learning to found another college in the colony; but Governor Bernard refused them a charter.

In 1764 the college met with a serious loss by fire; the first Harvard Hall, containing the library and apparatus, was entirely destroyed, but the loss was repaired to some extent by the generous aid of the Colonies. Harvard was loyal to the American cause during the Revolutionary period; even going so far in the readjustment of its financial affairs as to suffer considerable loss. The alumni and students have ever been patriotic, ready to contribute their best to the needs of their country. The fine building, Memorial Hall, was erected by the alumni in memory of their dead who fell in the Civil War. Harvard has always followed a conservative course when parties were agitating questions of government.

Between 1636 and 1782 Harvard College conferred only the degrees of bachelor and master of arts, but in 1780 the term university was applied to it in the Constitution of the State of Massachusetts. The class of 1768 evidently gave some attention to dress, as they voted to wear homespun at their graduating exercises, although their action on the matter is often quoted to prove their democratic simplicity. In 1782 and 1783 three professorships of medicine were established, and the first degree of bachelor of medicine was conferred in 1788. In 1810 the lectures in medicine were transferred to Boston, and there the first medical college was built. The law school was established in 1817, and it has the distinction of being the earliest school of law in the country connected with a university and authorized to confer degrees in law. The divinity school was a gradual outgrowth of the college; the Hollis professorship of divinity, which has been mentioned, was established in 1721, but the divinity faculty was not formally organized until 1819. It is now undenominational, no assent to the special doctrines of any sect or denomination of Christianity being required of any instructor or student. The schools of medicine, law and divinity are the three oldest additions to the college proper, and it was de-

THE YARD, HARVARD UNIVERSITY.

cided that such an institution, having 4 schools and several departments, justified the title, university.

In about 1822, a number of the friends of education and of the institution thought the time had come when further changes should be made in the work required of the students. George Ticknor (q.v.), professor in the department of modern languages, urged that some division of studies should be made whereby students might be permitted to pursue special courses or specialize on certain subjects. A committee, with Joseph Story as chairman, was appointed to investigate the wisdom of such a change, and how best to meet the needs of the students. The committee reported (1824) the advisability of instituting two lines of study — the one a course necessary for a degree, the other a scientific and mechanical course for those not intending to take degrees, but who desired to fit themselves for certain departments of work. The departure from old customs as recommended by the committee was opposed by many, but in 1825 changes were made and the special students were admitted. Prof. Ticknor and later his successor, Henry W. Longfellow, introduced to some extent elective courses in the department of modern languages, but not until a number of years later did they become popular in other departments.

Charles William Eliot (q.v.) was elected president in 1869. At this time the departments were almost independent schools, to which no entrance examinations were required; but the students were largely from classical preparatory schools, the majority of which were located in New England. The college required certain courses, and all demanded good work and a high degree of scholarship before graduation. In four years, so rigorous and thorough had been the work of President Eliot, that practically a reorganization had been made, the departments had been correlated, and individual work had been given recognition.

To Harvard much credit is due for the conservative manner in which it has dealt with the question of higher education of women. The Society for the Collegiate Instruction of Women was the name of an organization which began the work (1869) of providing ways and means for giving young women an opportunity to obtain a collegiate education. The name of the organization was changed, in 1894, by the general court of Massachusetts to that of Radcliffe College (q.v.). Systematic collegiate instruction is now given in this college, under the professors and teachers of Harvard University. The requirements are the same as for admission to the university. The schools and departments of Harvard University now comprise: (1) Harvard College, the Lawrence Scientific School, and the Graduate School, established in 1872 for students making original research. The Scientific School was established in 1847 as an advanced school in science and literature; later the name was changed to Lawrence Scientific School, in honor of Abbott Lawrence who presented it with $50,000. Those three schools, which include 14 departments offering elective courses, were placed, in 1890, under the charge of the faculty of arts and sciences. In 1904–5 there were in attendance 2,905 students under the faculty of arts and science. Of this number 366 were in the graduate school and were engaged in original research. For the students of this school who are engaged in original investigations there is available a number of fellowships, at present 58, which are from $200 to $1,000. The Edward Austin Fellowship and the Austin Teaching Fellowship are given only to resident graduate students. Some of the fellowships may be given to persons pursuing their studies in other parts of the country or abroad; but non-resident appointments are given only to persons who have been resident students in some department of the university. (2) The law school has been mentioned. The attendance in 1904–5 was 758. (3) The divinity school, already noticed, has an attendance of 43. (4) The medical school, founded in 1782, and the dental school, established in 1867, were united in 1899 and are in charge of the faculty of medicine. The school is located in Boston. The attendance in 1904–5 was, in the medical school, 307; in the dental school, 106. The new buildings for the medical school (1903), in process of erection, promise to be second to none other in the world. There will be seven separate buildings, the central structure and two of the side pavilions are provided for by the gift of $1,000,000 from J. Pierpont Morgan, and $1,000,000 from other friends. The site comprises 26 acres, in Brookline, about three miles from the main buildings of the university in Cambridge (5) The Bussey Institute, a school of agriculture and horticulture, was established in 1870 in accordance with the will of Benjamin Bussey. It is at Jamaica Plain, in the southwestern part of Boston. (6) The Arnold Arboretum, established in 1872, is devoted to scientific research in forestry, dendrology, and arboriculture. It was founded under the will of James Arnold. It is practically a large park containing about 220 acres, and is located in West Roxbury. (7) The astronomical observatory was established in 1843 by means of a public subscription. The Sears Tier was built in 1846, and two years later Edward Bromfield Phillips bequeathed to the university the sum of $100,000 for the observatory; this early bequest has since been supplemented by many others, so that the observatory now has an endowment of about $900,000. It has a director and four other professors and 40 assistants. A branch station is established on a mountain 8,000 feet high, near Arequipa, Peru. The annals of the observatory fill about 50 volumes. Among the more important instruments are the 15-inch and 6-inch equatorial telescopes, the 8-inch transit-circle, the 11-inch Draper photographic telescope, the 8-inch photographic telescope, and the meridian photometer. A grant has recently (1903) been made by the Carnegie Institution, for the study of the collection of photographs at the Harvard Observatory. The amount of material, including photographs and photographic charts of the sky that has been collected in this department, requires a special building for its accommodation. (8) The university library, including the libraries of the schools and departments, contains about 673,394 volumes and 393,892 pamphlets. (9) The Gray Herbarium, so named because it contains the Herbarium of Asa Gray (q.v.), presented to the university in 1864. (10) The university museum is made up of the following collections:

the Peabody Museum of American Archæology and Ethnology; the Museum of Comparative Zoology, established in 1859 by private subscription, State aid, and the collection of Louis Agassiz, and valuable gifts from his son; the Mineralogical Museum, established in 1890–1; the Semitic Museum, completed in 1902; the William Hayes Fogg Art Museum, completed in 1895; and the Germanic Museum, established in 1902. (11) The botanical garden, established in 1809, covers about seven acres and contains thousands of plants for scientific study.

Great credit is due Harvard for its leadership in the movement to better the teaching of the English language and literature in the schools of the country. Harvard mentioned the subject in its catalogue of 1865–6; an announcement was made, in the catalogue of 1869–70, that «Students would be examined, as early as possible after their admission, in English.» In 1874, for the first time, every applicant for admission to Harvard was required to present English composition. The report of the committee who visited the preparatory schools to ascertain what they were doing with the subject of English, the discussions by educators on the «new demands of Harvard,» the progress of the movement, the grand results, all now are parts of the «History of Education» of America.

The university summer school gives short courses of study under the charge of a committee of the faculty of arts and sciences, and is held in the college buildings during the summer vacation. The school is popular and has had a large attendance each year. In 1904 the students numbered about 1,007. Athletics are provided for — two fields of 24 acres each and the Hemmeniday gymnasium furnish opportunities for physical training The stadium erected on Soldiers' Field has a seating capacity of about 30,000. It is shaped like the letter «U,» with the open space toward the Charles River. It is of steel and concrete construction. The mezzanine floor under the seats, the promenade above the seats, the stairs, the perfect arrangement of all the parts make this stadium a model of construction. It was built under the auspices of the class of '79. A club house, called the Harvard Union, was donated by Henry Lee Higginson in 1901. The Phillips Brooks house is used for religious meetings. In 1903 Harvard received a valuable collection of plaster replicas of Germanic art; a number of them were given by Emperor William III. of Germany. Among them is a replica of the equestrian statue of the Great Elector, by Schülter, one of Frederick the Great, by Schadow, a cast of the golden gate of the Cathedral of Freiburg, the bronze door of Hildesheim Cathedral, on which the Biblical story of Creation, the wood screen of Naumburg Cathedral, and several other reproductions of great value.

The university has now about 60 buildings. In 1904–5 the number of members of the corporation was 6; of overseers, 30; of professors and instructors composing the faculty, 525; of students in all the schools and departments, 5,143. In 1904 the invested funds of the university amounted to $16,755,753.10; and the grounds, buildings, and apparatus were estimated to be worth about $21,000,000: the annual income was $1,572,-539.50; and bequests and gifts amounted to $1,509,563.76. Harvard has had 22 presidents, including the present incumbent (1903), Charles William Eliot. There are 13 periodicals which represents the interests of the university as a whole, and of special schools and departments.

Consult: Quincy 'The History of Harvard University'; Thayer, 'Historical Sketch of Harvard University'; Hill, 'Harvard College by an Oxonian'; Peabody, 'Harvard Graduates Whom I Have Known'; Bush, 'History of Harvard'; Eliot, 'A Sketch of the History of Harvard University'; Thayer, 'History of Middlesex County.'

Harvest Bug or Mite. See MITES.

Harvest-fish. See BUTTERFISH.

Harvest-fly. A cicada (q.v.).

Harvest-moon, the full moon nearest to the autumnal equinox, when the earth's satellite, almost full, rises for several nights in succession about the same hour. This phenomenon is less plainly seen in the United States than in higher latitudes, and is not met with in the tropics. It is due to the fact that at the time of the autumnal equinox the full moon, being exactly opposite the sun, is in that part of her orbit which makes a small angle with the horizon at the point of moon-rise.

Harvest Mouse. See MOUSE.

Harvestman, or Harvest Spider. See DADDY-LONGLEGS.

Harvey, George Rossiter McClellan, American publisher and editor: b. Peacham, Vt., 16 Feb. 1864. After a secondary education, he became a reporter successively for the Springfield (Mass.) *Republican,* the Chicago *News,* and the New York *World,* was for a time managing editor of the *World,* and later a constructor and president of various electric railways. He purchased and became editor of the 'North American Review' in 1899, and in 1900 received the presidency of the reorganized firm of Harper and Brothers, publishers.

Harvey, Moses, Newfoundland historian: b. Armagh, Ireland, 25 March 1820; d. St. John's, Newfoundland, 3 Sept. 1901. He was graduated at Queen's College, Belfast, in 1840; later studied theology; and was ordained in the Presbyterian Church. He was pastor of the Free Presbyterian Church, St. John's, Newfoundland, 1852–78, when he retired from the ministry and devoted himself to literary and scientific studies, and became popular as a lecturer. He published 'Thoughts on the Poetry and Literature of the Bible' (1853); 'Lectures on the Harmony of Science and Revelation' (1856); 'Newfoundland, the Oldest British Colony' (1883); 'Text-Book of Newfoundland History'; etc. He also contributed articles to the Encyclopædia Britannica on Newfoundland, St. John's, Labrador, and the seal fisheries of the world.

Harvey, William, English physician: b. Folkestone, Kent, April 1578; d. Hempstead, Essex, 3 June 1657; he was graduated at the University of Cambridge in 1593, and later at Padua. He is famous as the discoverer of the circulation of the blood.

Harvey, William Hope, American author: b. Buffalo, Putnam County, W. Va., 16 Aug. 1851. He was educated at Marshall College

THE GREAT ELECTOR,

THE STATUE PRESENTED BY EMPEROR WILLIAM II, TO HARVARD UNIVERSITY.

(W. Va.), and practised law in 1871–84. He appeared as an author under the pseudonym "COIN" in 'Coin's Financial School' (1894), in advocacy of bimetallism as a currency standard. Other works by him are: 'A Tale of Two Nations' (1894); 'Coin's Financial School Up to Date' (1895); 'Patriots of America' (1895); and 'Coin on Money, Trusts, and Imperialism' (1899).

Harvey, Ill., city in Cook County; on the Cleveland, C., C. & St. L. and the Illinois C. R.R.'s; south of Chicago, about seven miles from Blue Island. It was founded in 1891 and incorporated in 1892. Its proximity to Chicago gives it the advantages of a residential city and its railroad facilities are an aid in the development of its manufactories. Some of the chief industrial establishments are railroad supply shops, an automobile factory, gas-stove factories, machine-shops in which are manufactured ditching and mining machinery. The trade is principally in its manufactures and agricultural products. Pop. (1900) 5,395.

Harveyized Steel. See STEEL.

Harwood, Andrew Allen, American naval officer: b. Settle, Pa., 1802; d. Marion, Mass., 28 Aug. 1884. He was a great-grandson of Benjamin Franklin (q.v.). In 1818 he entered the navy and served in the suppressing of the slave trade and piracy in the West Indies; in 1835–7 was with the Mediterranean squadron; in 1848 was given the command of the Cumberland, and in 1855 promoted to the rank of captain. In 1862 he was appointed chief of the bureau of ordnance and hydrography; in 1863 he was made commandant of the Washington navy yard and Potomac flotilla, having the rank of commodore, and retired in 1869 with the rank of rear-admiral. He published 'Law and Practice of United States Navy Courts-Martial' (1867), and 'Summary Courts-Martial.'

Harz (härts) **Mountain** (Ger. *Harzgebirge*), the northernmost mountain range of Germany, extending about 60 miles through Prussia, Brunswick, and Anhalt, between the rivers Weser and Elbe, and occupying an area of about 786 square miles. The range, composed chiefly of Devonian and Lower Carboniferous formations, broken through with granite, is divided into the Upper and Lower Harz, with average elevations of 2,100 and 1,000 feet, respectively, the maximum altitude, 3,745 feet, being reached in the Brocken (q.v.). Woods and fine pastures abound; silver, iron, lead, copper, and zinc are mined, and marble, alabaster, and granite quarried. Traversed by fine roads and accessible by railroads, the range is a favorite touring ground, its interest enhanced by the traditions and weird legends which had their birth in this romantic region.

Has'call, Milo Smith, American soldier: b. Le Roy, Genesee County, N. Y., 5 Aug. 1829; d. Oak Park, Ill., 30 Aug. 1904. He was graduated from West Point in 1852, resigned from the army, practised law in Indiana, entered the Federal army as a private at the outbreak of the Civil War, rose to the grade of brigadier-general of volunteers, distinguished himself at the battle of Stone River, where he saved the day; was present at the siege of Atlanta, and resigned his commission in 1864. Subsequently he was a banker at Goshen, Ind., and a real estate dealer in Chicago.

Hasdrubal, häs'droo-bal, Carthaginian general. He was the son of Hamilcar Barca, and brother of Hannibal (q.v.), and, on the departure of the latter for Italy 218 B.C., was left in command of the army in Spain. Hanno, who had charge of the province north of the Iberus, was defeated and dispossessed by Cn. Scipio before Hasdrubal could come to his aid. Scipio, reinforced by his brother, now crossed the Iberus, and in 216 defeated Hasdrubal near that river. The Carthaginians then sent a force, intended for the assistance of Hannibal, to the relief of Hasdrubal under the command of his brother Mago. In 212 Cn. Scipio was defeated and killed by the Carthaginians. Publius Scipio was sent into Spain in 211, and after seizing New Carthage defeated Hasdrubal in his camp at Bæcula in 209. Hasdrubal withdrawing to the northern provinces, determined to proceed to Italy, leaving his colleagues, Hasdrubal, the son of Gisco, and Mago, to make head against Scipio. He crossed the Alps in 207, accompanied by Gallic allies, and descended into Italy, and sent messengers to concert a junction with Hannibal in Umbria, but his despatches fell into the hands of the consul, Claudius Nero, who joined his colleague, M. Livius, at Sena, and forced Hasdrubal to give battle on the right bank of the Metaurus. Being outnumbered, and ill-supported by his Gallic allies, he was defeated, after an obstinate engagement, in which both sides suffered severely. When he saw the battle irretrievably lost he rushed into the midst of the enemy, and perished fighting sword in hand. Nero hastened back to Apulia, and is said to have announced to Hannibal the defeat of his brother by causing Hasdrubal's head to be thrown into his camp, 207 B.C.

Haseltine, hā'zĕl-tīn, **William Stanley,** American artist: b. Philadelphia, 11 Jan. 1835. He was graduated from Harvard in 1854, studied art in Düsseldorf and Rome, and has been a member of the National Academy from 1861. Among paintings by him may be named 'Indian Rock, Nahant'; 'Castle Rock, Nahant'; 'Bay of Naples'; 'Ruins of a Roman Theatre.'

Hashish, hăsh'ēsh, an eastern narcotic preparation, made from the tops and tender parts of the cultivated hemp, the variety known as *Cannabis Indica* being chiefly employed. The resin picked from the hemp is kneaded together, or sometimes the drug is obtained by decoction or infusion of the leaves. The resin is taken in the form of pills or pellets, and the leaves are chewed, or smoked in conjunction with tobacco. It is called bhang in India, where it is mixed with sugar and eaten as confectionery. It is as powerful as opium and produces intoxication and hallucinations; sometimes transporting the hashish-eater into an ecstacy, or lulling him into somnolency or torpor. Its after-effects are not so depressing as those of opium, and it is often prescribed medicinally as a soporific or anti-spasmodic.

Haskell, Edwin Bradbury, American publisher and editor: b. Livermore, Maine, 24 Aug. 1837. He entered the office of the Portland (Maine) *Advertiser* in 1854, was a reporter for the *Journal* (1857–60) and *Herald* of Boston, bought an interest in the *Herald* in 1865, and was editor of that paper 1862–87. He still holds an interest in the *Herald*, as well as in the Minneapolis *Journal*, the St. Joseph (Mo.) *News*, and the Los Angeles *Express*.

Haskell Institute. See INDIAN, EDUCATION OF.

Has'kins, Charles Homer, American historical scholar: b. Meadville, Pa., 21 Dec. 1870. He was graduated from the Johns Hopkins University in 1887, studied also at Paris and Berlin, was instructor in history at Johns Hopkins in 1889–90, and in the University of Wisconsin was successively instructor in history (1890–1), assistant-professor (1891–2), and professor of European history (1892–1902). In 1899–1900 he was a lecturer in history at Harvard, and in 1902 was appointed professor of history there.

Has'sall, Arthur, English historian: b. Bebington, Cheshire, England, 23 Sept. 1853. He was educated at Oxford, where he has been at various times since lecturer, tutor, and examiner. He is one of the recognized authorities upon European history, his published books including 'Life of Bolingbroke' (1889); 'Louis XIV.' (1895); 'Handbook of European History' (1897); 'The Balance of Power 1715–89' (1896); 'Class-book of English History' (1901); 'History of France' (1901); 'The French People' (1901).

Has'sam, Childe, American artist: b. Boston 1859. He studied art in Boston and Paris; he is a member of Ten American Painters, of New York, and of the Societé National des Beaux Arts of Paris. He is one of the freshest in style and most original of the American impressionists, and has gained medals at Paris, Munich, Chicago, and Philadelphia.

Hassen Ben Sabbah, the founder of the sect of the Assassins (q.v.).

Hasselquist, hās'sĕl-kwist, **Frederick,** Swedish naturalist: b. Ostrogothia 1722; d. Smyrna 9 Feb. 1752. In 1741 he went to the University of Upsala, where his talents and industry drew the attention of Linnæus. In 1747 he published a dissertation 'De Viribus Plantarum.' Wishing to make researches on the spot into the natural history of Palestine he spent some time at Jerusalem, and afterward visited other parts of the country. Returning to Smyrna he brought with him a collection of plants, minerals, fishes, reptiles, insects, and other natural curiosities. The Swedish queen, Louisa Ulrica, purchased the whole of Hasselquist's acquisitions, which were deposited in the castle of Drottningholm. Linnæus, from the papers and specimens of natural history collected by his pupil, prepared for the press the 'Iter Palestinum, or Travels in Palestine, with Remarks on its Natural History' (1757), which has been translated into English and other European languages.

Hassler, hās'lĕr, **Ferdinand Rudolph,** Swiss-American scientist: b. Switzerland, 6 Oct. 1770; d. Philadelphia, Pa., 20 Nov. 1843. After serving on the trigonometrical survey of Switzerland, he emigrated to the United States. He was appointed acting professor of mathematics at West Point in 1807, and held the post for three years. He was superintendent of the United States Coast Survey in 1815, and from 1832 worked on the same commission until his death.

Hassler Expedition, a scientific expedition of great importance despatched by the United States Government. In 1871 the steamship Hassler was fitted out for coast survey and marine exploration. The personnel of the expedition included Prof. Louis Agassiz, and Mrs. Agassiz; Dr. F. Steindacher, ichthyologist; Dr. Thomas Hill, botanist; Count L. F. de Pourtales, Mr. J. A. Allen, and others. The party left Boston 4 Dec. 1871 and reached San Francisco, August 1872. Deep-sea dredging was carried on at several points in the West Indies and South Atlantic. The glaciers in the neighborhood of the Straits of Magellan were explored. Collections were made at every point of the voyage; the results of the expedition have been published by Agassiz, Lyman, and Pourtales, and much valuable material, zoological, geological and botanical, deposited in the Museum of Comparative Zoology, Cambridge.

Hastings, hās'tĭngz, **Francis Rawdon,** 1ST MARQUIS OF HASTINGS and 2D EARL OF MOIRA, English soldier and statesman: b. 9 Dec. 1754; d. off Naples 26 Nov. 1826. He entered the army as an ensign, served in America during the Revolution, and on 25 April 1781 gained the battle of Hobkirk's Hill, which Lord Cornwallis described as the most splendid of the war. In 1781 he was elected a member of the Irish House of Commons, and two years later he was promoted to the English House of Lords with the title of baron. He was in command of a force which sought to aid the royalists of Brittany in 1793, and in the following year co-operated with the Duke of York in the Netherlands. In 1812 he was appointed governor-general of Bengal and commander-in-chief of the forces in India. His administration was distinguished by successful wars against the Ghurkhas of Nepaul and the Pindarees of Central India, but in 1821 he resigned because certain charges had been brought against him in connection with a banking firm in which he was interested. In 1824 he was appointed governor of Malta.

Hastings, Thomas, American musician: b. Washington, Conn., 1787; d. 1872. He early made sacred music the subject of his careful study; from 1823 to 1832 he edited a religious paper, 'The Recorder,' in Utica, but removed to New York, where he made his fame as a musical instructor and composer. His works include: 'Mother's Hymn Book' (1849); 'History of Forty Choirs' (1854); and 'Dissertation on Musical Taste' (1853).

Hastings, Warren, English soldier and administrator: b. Churchill, Oxfordshire, 6 Dec. 1732; d. Daylesford, Warwickshire, 22 Aug 1818. An uncle in London sent him at 10 years of age to Westminster School. On the death of his uncle he obtained an appointment in the East India Company's service, and he arrived at Bengal in October 1750. He was appointed to the factory at Cossimbazar, and was taken prisoner by Surajah Dowlah (1756). On obtaining his freedom he joined Clive, under whom he served with distinction as a volunteer in his campaign of 1757. In 1758 he was appointed resident agent of the company at Moorshedabad, in which capacity he continued to act till 1761. It is recorded to his honor that he did not avail himself of the opportunity of making his fortune in the mode then common among the servants of the company, by "presents" (forced) from the native princes. In 1764 he returned to England, but as a result of a bad investment of his fortune was compelled again to ask for employment from the company; and sailed for India in the spring of 1769. In 1771 the East India Company were contemplating extensive changes in the government of India. The government of Bengal was still carried on in the name of the nabob, although he had become a mere cipher, all his officers being appointed by the company, and they cast their eyes upon Warren Hastings as a fitting instrument to carry out their policy. Clive strenuously supported his appointment to the Calcutta council (1772), with succession as president of the council and governor of Bengal. He now received instructions from the directors to deprive of his offices Mohammed Reza Khan, who had exercised under the company the complete control of the revenues and administration of Bengal, and to bring him to trial for corruption. Mohammed bore a high character, and he was accused by Nuncomar, a man of notoriously bad reputation. Shitab Roy, dewan of Behar, was subjected to similar charges. After a protracted inquiry both Mohammed and Shitab were fully acquitted of all the charges against them. The object of these charges — the reorganization of the judicial and financial administration of the province under the direct control of the company's officers, had in the meantime been carried out by Hastings to the entire satisfaction of the directors. Another important step taken by him was to enter into a treaty with the Nabob of Oude (Treaty of Benares, 7 Sept. 1773), by which he ceded to him the districts of Corah and Allahabad for fifty lacs of rupees, and engaged to hire out the company's troops to him for the reduction of the Rohillas, whose territory the nabob coveted. By the subsequent act of 1773, Hastings was appointed first governor-general of India, and a supreme council was named, of whom three formed a majority unfavorable to Hastings. The natives were encouraged to bring charges against him, and Nuncomar, his old ally, came forward with various charges of bribery. A supreme court of justice had been appointed at the same time with the supreme council of Calcutta. The chief-justice, Sir Elijah Impey, its head, was a friend of Hastings. Nuncomar was brought before this court, charged with forgery, convicted, and executed. This stretch of jurisdiction, which Hastings could easily have prevented, alienated from him public sympathy in England. The directors of the company petitioned the crown on 8 May 1776 for his removal from the council. Hastings had deputed Colonel MacLean, who returned to England in 1776 to insist on certain conditions or tender his resignation. It was accepted, and a successor appointed to take his place in the council, 23 Oct. 1776. General Clavering assumed the title of governor-general, which Hastings still insisted on retaining, as the change had been made without the conditions he had appended to his resignation. The supreme court, which was appealed to, decided in favor of Hastings. To end a dispute between the council and the supreme court of Calcutta, and to bring the chief-justice under the influence of the council, Hastings now appointed Sir Elijah Impey superintendent of the native courts with a salary of £8,000 a year, an appointment regarded by some as equivalent to a bribe. He involved himself in disputes with the Madras government, made demands for a large war contribution upon the Rajah of Benares, and when the rajah resisted arrested and deposed him. He caused the "begums of Oude," mother and grandmother of the Nabob of Oude, to give up extensive estates in land and a large amount of treasure. The House of Commons had passed a resolution (30 May 1782) requiring the directors to pursue all legal and effectual means for his removal. In November 1784 he resigned his post, and in February 1785 elft India. In 1786 articles of impeachment were brought in by Burke against him. The preliminary forms were gone through from 13 to 14 February, and Burke opened the charges against him in a speech of three days' duration, begun on the 15th. He was supported by Fox, Sheridan, and Grey. Hastings began his defense on 2 June 1791, and on 17 April 1795 was acquitted by large majorities on all the charges. His acquittal met with general approval. The legal expenses of his trial amounted to £76,080. The company in 1796 settled on him an annuity of £4,000 a year for 28½ years, and lent him £50,000 for 18 years free of interest. He passed the remainder of his life in retirement. In 1813 he received the degree of LL.D. from the University of Oxford, and in 1814 was created a privy-councillor.

Hastings, Mich., city, county-seat of Barry County; on the Thornapple River, and on the Chicago, K. & S. and the Michigan C. R.R.'s; about 38 miles west by south of Lansing and 32 miles southeast of Grand Rapids. The city is in a fertile agricultural region. The chief manufactures are furniture, pumps, wagons and carriages, hose-reels, car-seats, flour, cigars, felt boots and lumber camp supplies. The principal buildings are the library, the city hall, jail and courthouse. The city owns and operates the waterworks. Pop. (1900) 3,172.

Hastings, Minn., city, county-seat of Dakota County; on the Mississippi River at the mouth of the Vermilion River, and on the Chicago, M. & S. P. railroad; about 15 miles southeast of Saint Paul. Its chief industrial establishments are breweries, a malt-house, flour-mills, grain-elevators, saw and planing-mills, sash, door, and blind factories, carriage and wagon factories, furniture factories, lumber and brick yards. In addition to the trade in manufactured articles, grain, lumber, and live stock are among the important shipments. Pop. (1900) 3,811.

Hastings, Neb., city in Adams County; on the Missouri P., the Burlington & M., the Fremont, E. & M. V., the Saint J. & G. I. R.R.'s; about 25 miles south of Grand Island and 95 miles west of Lincoln. Its first settlers were Eastern people who availed themselves of the benefits of the government "Homestead Act," but the city was not incorporated until 1874. It is in a fertile agricultural section. The chief manufactures are flour, wagons, and agricultural implements. The trade is principally in wheat, corn, and live stock. It is the seat of Hastings College, under the auspices of the Presbyterian Church, and opened in 1882, and of the State asylum for chronic insane. The government is vested in a mayor, who holds office two years, and in a city council. The present charter is that of 1891. The city owns and operates the electric light plant and the waterworks. Pop. (1890) 13,584; (1900) 7,188.

Hastings-upon-Hudson, N. Y., village in the town of Greensburg, in Westchester County; on the Hudson River, and the New York Central & H. R. railroad; about three miles north of Yonkers and 20 miles from New York. It is largely a residential village; but in the vicinity are marble quarries which add to the industrial wealth of the place. It has some manufactures, chiefly chemicals and cigars; it has a large trade in coal and lumber. It is the seat of the Hastings Commercial and Collegiate Institute, and has several churches and good schools. Pop. (1900) 2,002.

Hastings, Battle of. See SENLAC.

Has'well, Charles Haynes, American engineer: b. New York 22 May 1809; d. 12 May 1907. His practical education as marine and mechanical engineer was learned in a steam-engine factory. In 1836 he was appointed chief engineer in the United States navy. He built the first practical steam-launch in 1837 and was the first to use zinc to protect the hulls of iron vessels and boilers from the galvanic action of salt water and copper. After 1898 he was the consulting engineer of the board of public improvements in New York city. His published works include 'The Mechanics' and Engineers' Pocket Book' (1901); 'Mechanics' Tables' (1854); 'Reminiscences of an Octagenarian' (1895).

Hatch, John Porter, American general: b. Oswego, N. Y., 29 Jan. 1822; d. 12 April 1901. He was graduated at West Point and rose through successive grades to lieutenant-colonel of cavalry in 1873. He served in the Mexican War from Palo Alto to the capture of the city of Mexico; and in the Civil War was appointed brigadier-general of volunteers in September 1861, and commanded a cavalry brigade in the Shenandoah Valley and Northern Virginia. He subsequently commanded various districts in the South; and was brevetted major-general.

Hatch, Rufus, American banker: b. Wells, York County, Maine, 1832; d. 1893. He began life as clerk in a grocery store, in Rockford, Ill., in 1854 entered the grain commission business in Chicago, and amassed a fortune. He managed the Chicago and Northwestern railroad combination in 1868 and made a financial failure in the Northern Pacific collapse of 1883.

Hatch, William Henry, American lawyer: b. Georgetown, Ky., 1833; d. 1896. He was admitted to the bar in 1854; served through the Civil War in the Confederate army, and was a member from Missouri in the United States House of Representatives from 1870 to 1895. The Hatch Act which distributed Federal aid to agricultural experiment stations in all the States and Territories was inspired by him.

Hatchee, or Big Hatchee, a river which has its rise in the northeastern part of the State of Mississippi, flows north by west into Tennessee, then northwest and west joining the Mississippi River about 30 miles in direct line above Memphis. It is navigable for small steamboats as far as Bolivar, about 100 miles from its mouth, or half its whole length. The area drained by the Hatchee, about 4,000 square miles, is excellent cotton land.

Hatcher's Run (BOYDTON ROAD), Battle of. On 27 Oct. 1864, Gen. Grant, with the intention to extend his lines to the South Side railroad, and under the belief that the Confederate works around Petersburg extended only to the Boydton road crossing of Hatcher's Run, and were but feebly manned, moved parts of the Ninth, Fifth, and Second corps, together with Gregg's cavalry division, in all about 38,000 men, in three columns to the left. Gen. Parke, commanding the Ninth corps, moving to surprise the right of the Confederate works, found them strongly held, and made no attack. The Fifth corps, on the left of the Ninth, crossed Hatcher's Run and endeavored to seize the bridge by which the Boydton road crossed that stream, and was repulsed. The Second corps and Gregg's cavalry succeeded in forcing a passage over Hatcher's Run by the Vaughan road, and reaching the Boydton road, moved down it to Burgess' Tavern, near the bridge over Hatcher's Run, some four miles above Armstrong's Mill, where the infantry was checked. Hancock's Second corps having effected the passage of Hatcher's Run, by the Vaughan road, Warren was ordered to cross Crawford's division of the Fifth corps at Armstrong's Mill and, sweeping up the right bank of the stream, endeavor to recross and assault the Confederate line in the rear, while Griffin's division assaulted in front. Hancock was advised of the orders given Warren and authorized to make the attempt to carry the bridge in his front and gain some high ground beyond. At 4.30 P.M., when Hancock was extending his right to connect with Crawford, and was about to assault the bridge, Gen. Heth, with his own division and a part of Mahone's, having crossed Hatcher's Run and penetrated the interval between Hancock and Crawford, vigorously attacked Hancock's right and rear, throwing it into some confusion and capturing many prisoners, but Heth was finally repulsed. At about the same time Hampton, with five cavalry brigades, attacked Hancock's left and rear and Gregg's cavalry, but was repulsed. Crawford, who had crossed at Armstrong's Mill, found great difficulty in moving up the bank of Hatcher's Run, and failed to make connection with Hancock. The object of the entire movement failed, with Hancock still six miles from the South Side railroad. The Union troops were withdrawn during the night and, next day, moved back to the line of entrenchments. The Union loss, the greater part of which fell upon the Second corps, was 1,194 killed and wounded, and 564 missing. The Confederate loss is unknown. Consult: 'Official Records,' Vol. XLII.; Humphreys, 'The Virginia Campaign of 1864–5'; Walker, 'History of the Second Army Corps'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

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Hatcher's Run (DABNEY'S MILL and ARMSTRONG'S MILL), Battle of. It was on 5 Feb. 1865 that Gen. Grant put in motion an expedition to interrupt the Confederate line of communication by the Boydton road, running through Dinwiddie Court House to Petersburg. Gregg's cavalry division was directed to march early in the morning by way of Ream's Station to Dinwiddie Court House and strike the road; Warren's Fifth corps was to cross Hatcher's Run and support Gregg; Gen. Humphreys, commanding the Second corps, was ordered with two divisions to the crossing of the Vaughan road over the Run, and to Armstrong's Mill, to hold these two points and to keep up communication with Warren, four miles distant, on the one side, and with Miles' division in the Union entrenchments, three or four miles distant, on the other side. After severe skirmishing, Humphreys pushed Motts' division to the south side of Hatcher's Run, and established Smyth's division at Armstrong's Mill on the north side, about 1,000 yards from the Confederate works, where two brigades were brought to Smyth's support. At 5 P.M. parts of A. P. Hill's and Gordon's corps came out of their works and, under cover of the woods, attacked Smyth, but were repulsed. Smyth's line was now further strengthened by Hartranft's division of the Ninth corps and Wheaton's of the Sixth. Gregg captured some wagons and prisoners on the Boydton road, and in the evening fell back to Malone's Bridge on Rowanty Creek, from which he moved up to the Vaughan road crossing, where he arrived early in the morning of the 6th, with Warren, who had been ordered to support Humphreys. About 1 P.M. Warren, with two divisions, moved along the Vaughan and Dabney's Mill roads; Gregg, supported by one of Warren's divisions, going down the Vaughan road to Gravelly Run to observe the left. Gregg was attacked by a part of Pegram's division, but held his ground and, with the support given him by part of Griffin's division, drove Pegram's men back. Warren's leading division (Crawford's) moving on the Dabney's Mill road, also encountered part of Pegram's division, which was forced back to Dabney's Mill, where Evans' division came to Pegram's support, and Crawford in turn was driven back. Three Union brigades were now brought up to Crawford's support and, at the same time, Mahone's division arrived and took position between Evans and Pegram, and the whole Confederate line advanced, driving Warren back in great disorder, but some of his men rallied upon Wheaton's division, which had crossed from the north bank of the stream, and the Confederates were checked. On the morning of the 7th Warren made a reconnoissance, but did not find the enemy in force. The Union works were now extended to Hatcher's Run at the Vaughan road crossing. The Union loss was 1,352 killed and wounded, and 187 missing. The Confederate loss was about 1,500, among the killed being Gen. John Pegram. Consult: 'Official Records,' Vol. XLVI.; Humphreys, 'The Virginia Campaign of 1864–5'; Walker, 'History of the Second Army Corps'; Powell, 'History of the Fifth Army Corps.'

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Hatch'ettite, Adipocerite, or Mineral Adipocere, a native hydrocarbon, probably of the nature of a paraffin, occurring in certain parts of England and Scotland, mainly in connection with bogs and coal measures. It is wax-like, and melts at about 115° F. The specific gravity of the natural mineral is about 0.61, but after melting the specific gravity rises to 0.92 or even higher, owing to the elimination of air bubbles. Hatchettite is without odor, and when fresh it is commonly translucent and yellowish. Upon exposure, however, it blackens and becomes opaque.

Hatchie River, or Davis' Bridge, Battle of. After Gen. Van Dorn's defeat at Corinth, Miss., 4 Oct. 1862, he retreated and bivouacked for the night at Chewalla. Early on the morning of the 5th he continued his retreat on Pocahontas, but when his advance had crossed Hatchie River, at Davis' Bridge, he was met by Gen. Hurlbut's division, which had been sent by Gen. Grant from Bolivar, Tenn., to Pocahontas to intercept his retreat. Van Dorn's advance was driven back across the bridge, his main body came up, and Gen. Ord, who had arrived on the field from Jackson, took command of Hurlbut's division and attacked Van Dorn vigorously. A severe engagement ensued, in which Ord was severely wounded, and Hurlbut resumed command of the Union troops. Van Dorn, not closely followed from Corinth by Rosecrans, who was 12 miles away, held his position before Hurlbut the greater part of the day and, cut off from his route through Pocahontas, continued his retreat on the east bank of the Hatchie for six miles to Crum's Mill, where he crossed his army on a bridge during the night and continued his retreat to Ripley and thence to Holly Springs. Rosecrans followed as far as Ripley, when Grant ordered him to return to Corinth and Hurlbut to Bolivar. See CORINTH, ADVANCE ON AND BATTLE OF.

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Hatch'ment (a corruption of achievement, coat of arms) a funeral escutcheon, the arms of a deceased person within a black lozenge-shaped frame meant to be placed on the front of his home. If the deceased was unmarried or a widower or widow, the whole field of the escutcheon is black. In the hatchment of a married person the arms of husband and wife are impaled, and only that part is black which adjoins the side of it occupied by the arms of the deceased. Thus, in the hatchment of a husband the dexter side is black, the sinister white; in that of the wife the reverse. In a bishop's hatchment his arms being impaled with that of the see, those of the see have a white background. When the deceased is the last of his race a skull is set above the shield in place of a crest.

Hat'field, James Taft, American German scholar: b. Brooklyn, N. Y., 15 June 1862. He was graduated from the Northwestern University in 1883, from the Johns Hopkins University in 1890; was appointed professor of German language and literature at Northwestern in 1890, and became contributing editor of 'Americana Germanica.' During the Spanish-American War he served from seaman to chief yeoman on board the cruiser Yale. His publications include 'Materials for German Composition' (1896), editions of Freytag's 'Rittmeister von Alt-Rosen' and Goethe's 'Hermann und Dorothea,' and various articles and monographs on subjects of German literature.

Hath'amite, an explosive invented in 1902 by G. M. Hathaway, of Wellsboro, Pa., and remarkable not only for the enormous energy liberated by its explosion, but also for the safety with which the substance may be handled. Hathamite may be pulverized on an anvil with a sledge hammer without exploding, and rifle balls may be fired through it without effect. Lighted matches may also be thrown into it with impunity, and when poured upon a fire it burns quietly, with the evolution of immense quantities of smoke. Apparently, explosion can be induced only through the agency of a dynamite percussion cap. Hathamite is a coarse powder, of a bluish-gray color, whose composition has not yet been divulged. It explodes with exceeding violence when fired with a suitable percussion cap. In one test a charge of an ounce and a half blew a two-inch hole through a piece of quarter-inch boiler plate, when merely laid upon the plate, and detonated in the open air. In another test a little over eight ounces of the explosive was actually melted and poured into a six-pound shell; and when the charge was afterward detonated, the shell was thoroughly fragmented. One marked advantage of hathamite is, that it will explode even when frozen.

Hath'away, Anne, the wife of Shakespeare. See SHAKESPEARE.

Hats and Hat-making. It is difficult to state just when hats were first worn, but it is a fact that fur-felt hats now form part of the attire of civilized man the world over. There is no record as to when or where the first hat was made. We find head covering in one form or another in vogue in the earliest times referred to in history. The first modern hat, as we now know this article of men's wear, was made in Paris about 1404 by a Swiss manufacturer, but it was not until 49 years afterwards that the French adopted any sort of a head covering. Charles XII., upon his entry in triumph into the city of Rouen in 1453, wore a huge hat made of fur, lined with red velvet, from which protruded a great feather. With royalty as its sponsor the hat at once became a necessary detail of man's wardrobe. The hat is distinguished from the cap or bonnet by its continuous brim. It has been traced back to the "petasus" of ancient Greece, just as the cap has been regarded as the descendant of the brimless "Pileus," also a form of Grecian head attire. These articles, as far as we know, were made almost exclusively of felt.

Felt hats became popular in England during the Norman occupation. In Queen Elizabeth's reign great beaver hats, usually black, were the favorite among the nobility, and they remained in vogue for more than 300 years. About the middle of the 17th century an effort was made to encourage this industry in America. In 1662 the assembly of Virginia, to stimulate activity among the colonists, offered, by special enactment, to give 10 pounds of tobacco for every good wool or fur hat produced in that colony from materials taken from animals native thereto. Hats were then made by hand, and no effort of any consequence was made to improve the primitive conditions until 1820, when the energy of the American inventor produced the first labor-saving machine. Improvement now followed improvement, each one, in its way, tending to economize the cost of making.

In 1810 the silk hat appeared. It was made by hand, and failed in its purpose to supplant the tiled beaver. It was not until 1830 that the silk plush hat was manufactured upon a paying basis.

In 1840 the soft felt hat made its bow in the United States. Its sponsor was the famous Hungarian patriot, Kossuth, who visited America in that year. He was given tremendous receptions everywhere, and won the heart of the great American republic. His great hat seemed to be typical of the vigorous character of the man, and it was not surprising that the "Kossuth" became a general favorite. From that time the soft hat has steadily gained friends, and to-day in many sections it is a predominant type.

While the industry in this country, prior to the Civil War, kept pace with progress in other lines, it was not able to hat the heads of thousands of Americans, and the foreign manufacturer found the States a very profitable territory. But to-day America has become a great exporter of hats. By far the largest share of this foreign trade is controlled by the city of Philadelphia, where the finest grades of hats in the world are made. The other well-known hat centres in America are Orange and Newark, N. J., Danbury, Bethel, and Norwalk, Conn., Brooklyn, N. Y., and Reading, Pa.

The kinds of hats now made are so numerous as to be almost beyond the possibility of listing. There are, however, three principal classifications: the felt hat, which includes the soft and the stiff or derby shape, the silk hat, and the straw hat. All other kinds are but variations in some way of these three. In this article the writer will deal exclusively with the felt hat, concerning which there is the greatest interest. But few people have any conception of the numerous perplexing details and methods which enter into the construction of the hat.

The furs most generally used in manufacturing felt hats are the beaver, which is found in the northwestern part of the United States and Canada; the coypou or nutria, known as the South American beaver; the Saxony and the Russian hare; the Scotch, English and French coney, and muskrats. The finest furs are taken from the nutria, beaver and otter, all water animals, that portion which is taken from the belly being regarded as the choicest. The others are land animals, the fur from the back being regarded as the best. In the more common grades of hats sheep's wool is used, while in the inferior grades wool is mixed with cotton and other vegetable fibres. These, however, cannot be properly termed felt hats, because the materials used are not felted together. They are cemented and are then stiffened by shellac.

Furs for the higher grade hats require the most exhaustive preparation. Upon their arrival at the factory the pelts are first washed with whale-oil soap to remove the superficial fatty matter which clings to the fur. A further purification is necessary, however, and for this purpose "carrotting" is employed. A solution of mercury and nitric acid is applied to the pelts. This chemical, deposited in the cellular tissues, absorbs and thoroughly destroys all animal fats and gives to the fur its felting properties.

After a thorough brushing the fur is next cut from the pelts and is then stored away to mellow and season, for the reason that, like good wine, it strengthens and improves with age. When these furs have become properly seasoned, and are in prime condition, they are subjected to an interesting process for the purpose of removing the hair; a machine, known as a "blower," containing powerful air blasts, accomplishes this work in a very thorough manner. The hair is blown from the fur without harming the latter. This is repeated over and over again, until all foreign matter has been removed. The by-products obtained through these preliminary operations are extensive. Many of them are used for other purposes than hatting; for instance, the shreds of the skins are used in the manufacture of the highest grades of glue.

The task of selecting the furs and of combining them in proper proportion to produce the best results in a high-grade hat demands the most careful attention of the experienced experts. Many years of experiment have been necessary, in order to learn just how these furs should be mixed, and just what would constitute the correct proportion. The strength and perfection, as well as the beauty of the completed hat, depend largely upon the efforts of those intrusted with this portion of the work.

The next stage in the life of the hat is the forming. Until recently this was a business in itself. Few hat-making firms engaged in it. To-day, however, many of the larger manufacturers are successfully doing their own forming. This work can be accomplished only by experts. It is one of the most interesting features of hat making. The exact quantity of properly mixed fur is carefully weighed and placed upon an endless apron at one end of a box-like machine. At the other end of the machine there is a large perforated cone of sheet copper, revolving rapidly over a funnel, under which there is a powerful suction fan at work. As the attendant carefully feeds the fur to the machine in the proper quantity it is carried by the apron toward the cone. The suction of air attracts this fur and causes it to adhere to the surface of the cone. This continues until the cone is covered with a sufficient quantity of fur to make the hat. The whole operation requires only two or three minutes. As soon as the cone has accumulated the necessary fur a wet cloth is thrown over it, and a second cone, larger in dimension, is placed over that. Both are immersed in a tank of hot water for a few moments. This is the first stage of the felting. It causes the perfect adhesion of the various fibres. The operator slips this conical body from the cone. It is now several times larger than its ultimate size. It has assumed the primary form.

Sizing, as the felting is termed, is the next process. The body, which has just been removed from the cone, is placed in a sizing kettle, where it is shrunk in hot water. Continuous rubbing and rolling reduces it in size almost one-quarter. It still retains its cone shape, but it is now firmly felted. Care as well as skill is required to insure the even shrinking and the uniform distribution of the stock. Failure in any detail will cause streaks and weak spots in the finished article. The hat is now ready for dyeing. It is immersed in a great color vat and dyed to meet the prevailing fashion. Great improvements have been made in this detail during the past few years. The old wood colorings have been discarded, and coal-tar products are now used because they have been found more serviceable and increase the durability of the hat. Up to this point the manufacturing of stiff and soft hats has been along similar lines, but from this time on different methods are used. After dyeing the next step is to stiffen slightly the brim of the soft hat by the application of "water stiff," a solution of shellac. The body is now beginning to assume a definite form. It is stretched, blocked and pulled, and, with the aid of hot water, steam and ingenious machinery, it is given stability of shape and form The rough surface must now be cut off. This operation requires great care. If too much of the fur is removed all the previous skilled manipulation becomes valueless and the hat is ruined. This operation is known as "pouncing." It was formerly accomplished with a great deal of hand labor. It is now done by a machine and emery paper. This machine is a great time saver, and greatly facilitates the production of the plant. The crown is next given its shape, as demanded by the style. It is stretched over wooden blocks, ironed and re-ironed. It must then be carefully pounced by hand and steamed to tighten the felt. The brim must be treated exactly the same way, although it is not given shape at this time. Only men of skill and experience can engage in this portion of the work. There is a knack about pouncing by hand that can be acquired only by experience.

The hat is next flanged, or, rather, the brim is given its shape. The brim is placed upon a flange of metal or wood so as not to affect the crown. The entire hat resting on the flange is then placed under a huge receptacle containing heated sand and having on the under side a heavy cotton fabric, which comes in direct contact with the felt. After remaining in this position for several minutes the brim of the hat has its correct shape and trimming is in order. The turning up and edging each play an important part in the final process of shaping. In trimming artistic treatment is a necessity. Care must be taken in attaching the bands and bindings to preserve the neatness as well as the character of the design. The insertion of the sweat leather must be carefully done. All these and other details add greatly to the appearance and durability of the finished product.

The stiffening of the derby, better known as "the stiff hat," because of the character of the felting, is an interesting process. The hat body is impregnated with a solution of shellac and alcohol of given density. This substance is carefully worked into the heart of the body, and as a result the felting attains a condition of firmness. The hat is then placed on a wooden block, is immersed in hot water, and is given the proper proportion and shape before the final pressing. At the conclusion of this operation the superfluous gum is cleared away by a soda bath. When dry the hat is rigid throughout. It is then placed in an oven and kept there until it becomes pliable. A mould, to which tremendous pressure is given by mechanical or hydraulic means, completes the pressing after the derby has been pounced or finished. The pouncing of a derby is done upon a lathe. It is placed on a wooden block similar to the moulds used in pressing. Should the operator cut off too much of the surface fur, thus destroying the nap, the stiffening will be exposed and the work of the skilled men who preceded him loses its value. Curling or shaping of the brim is done with a variety of small tools, heat, steam, deftness of fingers and a good eye. The work of some of the experts who develop the stiff hat brims by the eye is little less than marvelous. The trimming, binding, etc., of stiff hats require even greater care in their selection and adjustment than in the case of soft hats.

Among American hat makers Charles Knox was one of the early specialists in beaver and silk hats in New York. Robert Dunlop, of New York, has also an eminent name in the hat trade of America. The history of the John B. Stetson Company, of Philadelphia, is to a large degree the history of hat making in the United States for the last 39 years. From the small beginning of one room and two mechanics the Stetson factories have been developed to nine immense plants, having a floor space of over ten acres and a force of more than 2,500 employees. When John B. Stetson, in 1865, determined to manufacture hats he was known as the foremost expert in the mixing of furs and as one of the best hat finishers in the trade. He determined to avoid the cheap hat and to make only the highest grade of goods and to make them better than any other manufacturer. His output the first year did not exceed one hundred dozen hats. His capital was not more than $1,000. In 1903 the John B. Stetson Company, with its great force of employees, supplemented by improved machinery, most of the patents for which are owned by the company, produced 105,800 dozens of hats. This company has introduced new machinery, which cheapens the cost of production without a sacrifice in quality, and has carried the fame of the city of Philadelphia to every quarter of the globe. A process has also been perfected whereby pure nutria and beaver fur may be successfully utilized in superfine hat making.

Another important improvement in hat making is that known as the «Boss» raw-edge kettle finished hat. This was introduced in the early seventies. Prior to this time all soft hats were made with bands and bindings, the latter being used to hold the brim in shape. The «Boss» raw-edge hat, as its name indicates, has no binding around the edge. It is shaped in hot water by frequent immersions and by the skillful hand work of an expert. The brim curling is a feature that cannot be accomplished in any other factory. This hat is, beyond question, the most remarkable specimen of headwear the world has ever seen. The John B. Stetson Company has been awarded the grand prize or gold medal at nearly every world's fair since 1876, but it holds as of almost equal value an order which it received from the British government for 10,000 hats for the South African constabulary during the Boer war. Prior to this war a number of American miners and cattlemen drifted into South Africa wearing Stetson's hats. They came in contact with General Baden-Powell, who admired the hats they wore and made inquiries about them. They were made of nutria fur, were better in quality than those produced anywhere in Europe. General Powell requested his government to order 10,000 of these hats, and the Stetson factories made and delivered them within six weeks of the receipt of the order. In 1876 the Stetson Company was awarded a gold medal by the Philadelphia Centennial Exposition. In 1879 it won a medal at Paris. In 1889 and in 1900 it won the grand prix at Paris. The official report making the award at the Paris Exposition in 1900 said, concerning the Stetson exhibit: "The products displayed here are, from every point of view, absolutely remarkable, but very especially the manufacture of soft hats, which is incontestably the acme of perfection of this epoch." WILLIAM F. FRAY,

First Vice-Pres. John B. Stetson Company.

Hat'teras, Cape. See CAPE HATTERAS.

Hatteras Inlet, Capture of. In the forenoon of 26 Aug. 1861, a Union fleet of 7 vessels carrying 143 guns, under command of Flag-officer Silas H. Stringham, and 3 transports, carrying 930 men and a light battery, under command of Gen. Butler, set sail from Hampton Roads. Next afternoon the fleet arrived off Hatteras Inlet, the entrance to Pamlico Sound, which was guarded by Forts Hatteras and Clark, built by North Carolina on the south end of Hatteras Island, and mounting respectively 25 and 5 heavy guns. The forts, which were garrisoned by over 700 men, were under command of Maj. Andrews. At 10 A.M. of the 28th Stringham began the bombardment of the forts, and a little later about 300 troops, with two howitzers, were landed on the island above the forts. Fort Clark was silenced before noon, the greater part of its garrison retreating to Fort Hatteras, some escaping from the island by boats. At night the fleet withdrew, but renewed the attack upon Fort Hatteras early in the morning of the 29th, drove the gunners from their guns to the shelter of the bomb-proofs, and before noon the fort surrendered, after a loss of 30 killed and wounded. The Union loss was one wounded. Stringham and Butler returned to Hampton Roads, leaving three vessels as a sea-force and detachments of the Ninth and Twentieth New York and the Union coast-guard, under Col. R. C. Hawkins, to garrison the captured forts. The immediate results of the expedition were the capture of the two strong forts with their garrisons of 715 men, 31 heavy guns, 1,000 stand of arms, and the possession of the best sea entrance to the inland waters of North Carolina. Consult: The Century Company's 'Battles and Leaders of the Civil War,' Vol. I.; Maclay, 'History of the Navy,' Vol. II.

E. A. CARMAN.

Hatti-Sheriff, the Turkish name of an edict signed by the sultan, who subscribes it usually with these words: «Let my order be executed according to its form and import.» These words are usually edged with gold, or otherwise ornamented. An order given in this way is irrevocable. The firman of 18 Feb. 1856, called usually Hatti humayun, «exalted writing,» is the constitutional charter of the Turkish empire. It is a long document, undivided into articles, and prescribing various reforms administrative and financial, etc., but its chief importance consists in its explicit recognition of the principle of religious liberty, already admitted by the hatti of Gulhana, 3 Nov. 1839.

Hattiesburg, Miss., city, county-seat of Perry County; on the Leaf River, and on the Gulf & S. I., the New Orleans & N., the Mobile, J. & K. C., and the Pearl & L. R. R.R.'s; about 65 miles north of Biloxi and 84 miles southeast of Jackson. The Gulf & Ship Island railroad is the shortest route to the Gulf of Mexico. Hattiesburg is the trade centre of a large fertile agricultural region in which an excellent quality of cotton is extensively cultivated. The industries are growing rapidly and its good railroad facilities mean good markets. The chief industrial establishments are saw-mills, planing-mills, cottonseed-oil mills, a cotton compress, a foundry, machine-shops, boiler works, brick-yards, a naval store factory, railroad shops, an ice-plant, and the electric light and power plant. It has three banks, a number of fine public buildings. Pop. (1900) 4,175; (1903) 7,000.

Hatto, hät'tō, the name of two archbishops of Mainz, both somewhat conspicuous in the history of Germany. The first was chosen archbishop of Mainz in 891, d. 913. The second Hatto (d. 970) was a monk of the monastery of Fulda, and succeeded the celebrated Rabanus Maurus as abbot of the monastery of St. Boniface, about the year 942 and in 968 was raised to the see of Mainz, and continued one of the chief advisers of the emperor. Of his after-life and of his personal character most opposite accounts have been given. By some he is represented as an upright and successful administrator; by others as a selfish and hard-hearted oppressor of the poor; and the strange legend of his being devoured by rats, which Southey has perpetuated in his well-known ballad, is represented as an evidence of the estimate that was popularly formed regarding him. It is quite possible that this legend is of much later date, and that its real origin is to be traced to the equivocal designation of the tower on the Rhine, Mäusethurm, near Bingen, which has been selected as the scene of the occurrence. *Mäusethurm*, "Mouse-tower," is possibly only a corrupted form of *Mauth Thurm*, "Toll-tower," a sufficiently descriptive name: but the modified form of the word might readily suggest a legend of mice or rats. The date at which the Mäusethurm was built is unknown, and it is far from certain that it is not much later than the time of Hatto. See Baring-Gould, 'Curious Myths of the Middle Ages' (1869); Max Beheim, 'Die Mäusethurmsage' (1888).

Hat'ton, Sir Christopher, English statesman: b. at Holdenby about 1540; d. 1591. Lord chancellor of England, a favorite of Queen Elizabeth; was entered a gentleman commoner at Saint Mary Hall, Oxford, but removed without taking a degree, to the Inner Temple in 1560. He was introduced at court some time previous to the middle of the year 1564, and it is said Queen Elizabeth was so much struck with his graceful person and dancing that an introduction to her favor was the result, and gained him the name of "the dancing chancellor." He was a furious enemy of the Jesuits, and did not hesitate to accuse Parry, their defender in Parliament, and secure his execution. He was elected a member of Parliament in 1571, became captain of the Queen's Guard in 1572, vice-chamberlain and a privy-councillor in 1577, lord-chancellor in 1587. He was one of the commissioners for the trial of Mary Queen of Scots, in 1586. His artful speech to the unhappy queen, "If you are innocent you have nothing to fear: but by seeking to avoid a trial you stain your reputation by an everlasting blot," is supposed to have been mainly influential in inducing her to submit to trial. Spenser, whose patron he was, dedicated to him 'The Faerie Queen.'

Hatton, Frank, American journalist: b. Cambridge, Ohio, 28 April 1846; d. Washington, D. C., 30 April 1894. He served through the Civil War in the Army of the Cumberland, being commissioned and was subsequently partner with Robert J. Burdette (q.v.) in the proprietorship of the Burlington *Hawkeye*. He was assistant postmaster-general (1881-4); postmaster-general (1884-5); editor of Chicago *Mail* (1884-8); and editor of the Washington *Post* (1888-94).

Hatton, John Liptrot, English composer: b. Liverpool 1809; d. Margate, Kent, 20 Sept. 1886. Removing to London in 1832 he became famous for his many operas, cantatas, overtures, entr'actes, etc., and was musical director of the Princess Theatre 1853-9. He is now, however, remembered chiefly for his admirable settings of English songs, such as 'Good-bye, Sweetheart,' 'The Tar's Song,' 'The Bait,' etc.

Hatton, Joseph, English journalist, novelist, and playwright: b. Andover 3 Feb. 1841; d. London 31 July 1907. Beginning journalism on the Derbyshire *Times*, he went to London, where he edited the 'Gentleman's Magazine' (1868-74); and became a newspaper correspondent for the New York *Times* and other journals. Among his numerous novels are: 'Clytie' (1874); 'Queen of Bohemia' (1877); 'John Needham's Double' (1885), dramatized for E. S. Willard; 'By Order of the Czar,' a novel of Russian life; 'Princess Mazaroff'; 'Under the Great Seal'; 'When Greek Meets Greek,' a novel of the French Revolution successfully dramatized; 'When Rogues Fall Out' (1899). Among his miscellaneous publications the best-known are: 'Journalistic London'; 'The New Ceylon'; 'Henry Irving's Impressions of America'; 'Old Lamps and New'; while among his plays may be cited a version of 'The Scarlet Letter' successfully acted in the United States; 'The Prince and the Pauper'; 'Liz'; and 'A Daughter of France.'

Hauck, hâk, **Minnie**, American vocalist: b. New York 16 Nov. 1852. She appeared in concert in New Orleans at 13, afterward studied with Errani in New York and made her début as an opera singer in 'La Sonnambula' in 1868. She has been uniformly successful both in the United States and Europe, but is best known in the title role of Carmen. She is married to the Chevalier de Hesse-Wartegg.

Haupt, howpt, **Herman**, American engineer: b. Philadelphia, Pa., 26 March 1817; d. 14 Dec. 1905. He was graduated at West Point in 1835, but became a civil engineer, and joined the staff engaged on the public works of Pennsylvania. For three years he was professor of civil engineering and mathematics in Pennsylvania College but in 1847 became consulting engineer of the Philadelphia Railroad. He was afterward chief engineer of the Hoosac Tunnel and during the Civil War chief of the United States Bureau of Military Railroads. The Royal Polytechnic Society of Great Britain gave him their highest prize for the drilling machine which he invented, and he first made practicable the transportation and distribution of oil from the well side. He wrote 'Hints on Bridge Building' (1840); 'General Theory of Bridge Construction' (1852); 'A Consideration of the Plans Proposed for the Improvement of the Ohio River' (1855); 'Military Bridges' (1864).

Haupt, Lewis Muhlenberg, American engineer: b. Gettysburg, Pa., 21 March 1841. He was educated at Harvard and West Point. From 1872 to 1892 he was professor of civil engineering in the University of Pennsylvania, and for the year ending 1886 edited the 'Engineering Register.' From 1897 to 1899 he was a member of the Nicaraguan and the Isthmian Canal Commissions. His published works include: 'Working Drawings and How to Make and Use Them' (1881); 'Canals and Their Economic Relation to Transportation' (1890).

Haupt, Paul, American Assyriologist: b. Görlitz, Germany, 25 Nov. 1858. He was graduated at the Gymnasium Augustum, Görlitz, in 1876; studied in Leipsic and Berlin, and settled in Göttingen where in 1883 he was appointed extraordinary professor of Assyriology. In the autumn of the same year he accepted the chair of Semitic languages at Johns Hopkins University, Baltimore, Md. He projected and continued to edit the so-called Polychrome Bible. (See BIBLE, POLYCHROME.) Among his many writings in periodical, pamphlet and book form, the most important volumes are 'Das babylonische Nimrod-Epos' (1891); 'Akkadische und sumerische Keilschrifttexte' (1882); 'Prolegomena to a Comparative Assyrian Grammar' (1888).

Hauptmann, howpt'män, **Gerhart**, German dramatist: b. Salzbrunn, Silesia, 15 Nov. 1862. After study at the Breslau Art School, he attended the universities of Jena and Berlin, traveled in Italy and Switzerland, and first appeared in literature with his epic, 'Promethidenlos' (1885). This he followed by a swift succession of dramas — 'Vor Sonnenaufgang' (1889), frankly socialistic and provocative of violent discussion; 'Das Friedensfest' (1890); 'Einsame Menschen' (1891); and 'Die Weber' (1892), a story of an unsuccessful uprising of the Silesian weavers, typifying the hopeless condition of the proletariat. In these works Hauptmann reveals the influence of Tolstoi and Ibsen, and a strong revolt against the conditions imposed, particularly upon the working-class, by a military and plutocratic regime. To this motif he returns in 'Fuhrmann Henschel' (1898). But he strikes a different note in 'Hanneles Himmelfahrt' (1893), a mystic 'dream-poem' as the author styles it, and 'Die versunkene Glocke' (1897; Eng. trans. by Meltzer 1900), which harks back to an indefinite period of the Middle Ages and makes artistic use of the primitive Germanic fairy-lore. In 'Kollege Crampton' (1892), 'Der Biberpelz' (1893) with its inferior sequel 'Der rote Hahn' (1901), and 'Schluck und Jan' (1900) he displays gifts of humor and satire. Other works are 'Florian Geyer' (1895) and 'Michael Kramer' (1900). Hauptmann is the chief figure in modern German drama. He excels less in dramatic structure than in art of characterization, and despite crudity and occasional lawlessness attains genuine poetic value.

Hauptmann, Moritz, German musician: b. Dresden 13 Oct. 1792; d. Leipsic 3 Jan. 1868. He studied at Gotha; was violinist at the court in Dresden in 1812; in 1815–20 was employed as music teacher in the family of a Russian prince; in 1842 he was appointed cantor of the Thomasschule in Leipsic, and the next year became professor of counterpoint at the Leipsic Conservatory, where he was very successful and popular as a teacher. His compositions include motettes, an offertory, and sonatas for violin and piano. In 1853 he published his 'Die Natur der Harmonik und Metrik,' a very important theoretical work.

Haus'mannite, a native manganate of manganese, having the formula $MnO.Mn_2O_3$, and crystallizing in the tetragonal system, with octahedral habit. It is brownish black in color, and opaque with a submetallic lustre. It has a hardness of from 5 to 5.5, and a specific gravity of from 4.72 to 4.86. Hausmannite dissolves in hydrochloric acid, with evolution of chlorine gas. It occurs in Germany, Sweden, and elsewhere, usually in connection with porphyry. It was named in honor of the German metallurgist, J. F. L. Hausmann.

Haussa, how'sä. See HOUSSA.

Haussmann, Georges Eugène, zhŏrzh ė-zhān ōs-mān, BARON DE, French municipal officer: b. Paris 27 March 1809; d. there 11 Jan. 1891. He studied law, and under Louis Philippe was sous-prefect of various places. The February revolution of 1848 caused the forfeiture of his office, but Louis Napoleon in 1853 made him prefect of the Seine, and he applied himself to the improvement and adornment of Paris with such energy that the city became transformed under his administration.

Hautboy, hō'boi (French *hautbois*, "high wood," alluding to its tone); a wooden wind-instrument of two-foot tone, played with a double reed. Also an organ stop, consisting of reed pipes slightly conical, and surmounted by a bell and cap of eight feet pitch. The tone is thin and soft.

Haüy, René Just, rė-nā zhüst ā-ü-ē or ā-wē, French mineralogist: b. St. Just, Oise, 28 Feb. 1743; d. 3 June 1822. He was trained for the Church and took priest's orders, but turned to mineralogy, and acquired a great reputation by a series of important discoveries. Among the chief of these is the geometrical law of crystallization, according to which a given mineral uniformly contains the same primary form as its basis of crystallization. From that time, according to Herschel, mineralogy first ceased to be "a mere laborious cataloguing of stones and rubbish." In 1794 Haüy became keeper of the cabinet of the School of Mines, and in 1802 professor of mineralogy in the Museum of Natural History. His works include 'Traité de Mineralogie' (1801), and 'Traité de Crystallographie' (1822).

Haüynite, hä'win-īt, or **Haüyne**, hä'win, a mineral of the sodalite group, occurring in certain igneous rocks, and notably in the lavas of Mt. Vesuvius. It is a silicate and sulphate of sodium, calcium and aluminum, crystallizing in the isometric system. It is usually translucent with a vitreous lustre, a hardness of from 5.5 to 6, and a specific gravity of about 2.45. Haüynite is commonly blue or green, though red and yellow specimens are also known. It was named in honor of the French mineralogist, R. J. Haüy.

Havan'a (Sp. LA HABANA, lä häbä'nä), Cuba, its capital and the commercial centre of the West Indies, second city of Spanish North America; pop. 242,055. It occupies nine square miles on the west side of the Bay of Havana on the north coast, one of the noblest

HAVANA.

1. Cathedral of Havana. 2. Colon Park, Havana.

harbors in the world, with deep water up to the quays; entered by a narrow channel ⅜ of a mile long, protected by Punta Castle on the west and Morro Castle and La Cabaña on the east. It is in two sharply distinct sections. The old city, the commercial quarter, was built on the small western peninsula dividing the sea from the harbor, a low plain cut by a small stream on the west, strengthened by a city wall only torn down a generation ago. It is largely, and was entirely till the American occupation, a maze of narrow, crooked lanes traversed by one or two broader streets; the chief of which are the Calle O'Reilly, the main business street, running from the governor's palace to the city wall, and the Calle Obispo (Bishop Street). The new city is on a ring of hills 150 feet high south and west of the old, with the castle of El Principe on the crest, and has a wealth of broad and finely shaded macadamized streets, drives, promenades, parks, plazas, flower-gardens, fountains, statues, etc., which make it one of the handsomest cities in the world. There is no "West End" in Havana, the houses of the wealthy being scattered through every part, usually of classic pattern, with an inner courtyard or patio surrounded by marble or stucco columns, containing a garden of tropical vegetation and a central fountain. The handsomest residence street, next to the new suburb Vedado, is the Cerro, a long thoroughfare running up a hill at the farther end, and bordered by immense old villas in the midst of splendid gardens. The finest drives and promenades are the Malecon, a new thoroughfare along the water front from Prado to the Vedado, the Prado, a boulevard with a double row of shade-trees in the middle, running from Punta Castle outside the old wall, and ending in the largest park in the city, Colón Park or Campo Marte, and the Calle de la Reina (Queen Street) starting west from this park and continued as the Paseo de Tacón to the citadel of El Principe. The Alameda de Paula along the bay is also a favorite promenade.

Among buildings, the most interesting are the palace of the old captains-general, facing the Plaza de Armas near the harbor front, the cathedral, built 1764, and supposed to contain the ashes of Columbus in an urn till it was removed to Spain in 1898 (but the San Domingans claim they have his authentic bones), and the Tacón Theatre, perhaps the largest in the world. There are several other theatres and opera-houses, and many clubs, etc. The chief educational institutions are the University of Havana, founded 1670 by the Dominicans; the Jesuit boys' college de Belén, with a museum, observatory, a library rich in old Cuban history, etc.; College of American Augustinian Fathers, founded 1901. Famous among benevolent institutions are the Casa de Beneficencia, founded by Las Casas for infants. There are three general hospitals, a great lazaretto for lepers, and an insane hospital in the city and vicinity. Over 100 newspapers, etc., are published in the city.

The water supply of the city was installed by a Cuban engineer, Albear, some 40 years ago, and is considered a remarkable specimen of good workmanship. It comes from the Vento by an aqueduct 12 miles long, known as the Canal of Albear. In all other respects the Americans at the conquest found an undescribable state of filth and disease. The city was the prey of yellow fever, the sewers had seldom been cleaned since they were laid down, and some of them were choked with generations of rottenness, the buildings were pest-holes; and in that dungeon of horrors, the military hospital, 70 per cent of the inmates died. The United States forces in their short stay transformed this reeking home of pestilence into one of the healthiest cities in America. In systematic order streets were cleaned, repaved, widened; squads of cleaners were sent from house to house, emptying the Augean stables under them, whitewashing and disinfecting them, and where they were shanties that were nests of infection, tearing them down; the hospital was cleaned, disinfected, and covered deep with whitewash, and turned into a schoolhouse. New business streets were made by widening old lanes; parks were cleared up, and a fine sea-wall along the ocean to the north was built. The average deaths from yellow fever 1887–98 were 440; in 1896 they were 1,262; in 1901, for the first time in its history, only three or four. A Cuban physician of Irish descent, Dr. Carlos Finlay, now chief sanitary officer of Havana, was the originator of the mosquito theory of the yellow fever. Gen. Wood and the American army surgeons, however, deserve much credit for making the theory of practical use.

The climate is not severe. The mean annual temperature is 77°; the range from hottest to coldest 82° to 71°; the highest recorded, 100.6°, the lowest 49.6°. The mean rainfall is 54 inches.

Havana is the market of western Cuba, the head of the island's banking and commercial interests, and the emporium of the West Indies. Besides being the centre of the island railway system and of a great domestic shipping trade, especially with Santiago, it is the focus of a vast foreign commerce with Spain, France, England, and the United States, regular ocean lines running weekly to the first three and semi-weekly to the latter, besides others to the other West Indies. It has excellent covered wharves and a capacious dry-dock to aid this. Regla, on the opposite side of the bay, contains the sugar wharves and railway termini. In 1902 it had exports of about $60.000.000, $43.000.000 to the United States, an increase of $11.000.000 in three years, mainly ours; but its imports had shrunk from $57.000.000 to $45.000.000, most of the reduction from this country, owing to unfavorable customs laws. The entrances and clearances of ocean vessels in that year were over 1,500.000, and of domestic vessels nearly 3.000, with an average tonnage of about 935. The exports are chiefly of sugar, tobacco, cigars, and cigarettes; the imports, flour, rice, lard, and other foods, cotton, and metals. Its manufactures are mainly tobacco products; its cigar factories, of which there are over 100 of the first rank, are the largest in the world, one covering an entire square. It also manufactures confectionery, perfumes, rum, etc. The new electric street railway system is one of the finest of its kind, with 36 miles of track.

Population.— In 1899 it was 242.055, 52.000 being foreign; in 1887 it was about 180.000. About one third were unable to read; and about one third from 5 to 17 attended school.

History.— Havana was founded here (transferred from an older site) by Diego de Velasquez in 1519, and called by him "the key of the

New World." Burnt by buccaneers in 1528, it was rebuilt and made the chief naval station of Spain in this hemisphere, twice sacked in 1555 and 1563, it was a storm centre of wars and piracies for two centuries. In 1762 the English captured it, but restored it to Spain the next year. In 1802 it was partly burnt, but under the famous Governor Tacon, its second founder, commemorated at every turn, it was rebuilt from a straw-thatched wooden town to a city of brick and stone. For its late history, see CUBA. Consult: Norton's 'Handbook of Havana and Cuba' (1900).

Havana, Ill., city, county-seat of Mason County; on the Illinois River, and on the Chicago, P. & St. L. and the Illinois C. R.R.'s; about 39 miles northwest of Springfield. It is situated in an agricultural region and is the trade centre for a large extent of country. The chief manufactures are flour, agricultural implements, drills, gasoline engines, and some factory supplies. Its trade is chiefly in grain, fruit, vegetables, and dairy products. The waterworks are owned and operated by the city. Pop. (1900) 3,268.

Havelock, hăv'ē-lŏk, SIR **Henry**, English soldier: b. Bishop-Wearmouth, near Sunderland, 5 April 1795; d. Dilkusha, India, 24 Nov. 1857. Entering the army, he served with distinction in the Burmese war (1824–6); in 1829 married, became a Baptist, and was distinguished during the remainder of his life by his earnest religious zeal. He participated in the Afghan war, and in the defeat of Mohammed Akbar, 1843. He took part in the Mahratta war, and distinguished himself in the Sikh war of 1845. He commanded a division in the Persian war (1856–7) and on the outbreak of the Indian mutiny was despatched to Allahabad in order to support Sir H. Lawrence at Lucknow and Sir H. Wheeler at Cawnpore. On arriving at Cawnpore he found that Nana Sahib had massacred the prisoners. Pursuing his march to Lucknow, he defeated the rebels at Bithoor, and finally won the battle of Alumbagh. Having captured Lucknow, Havelock and Outram were shut up there until relieved by Sir Colin Campbell 17 Nov. 1857. He was raised to the rank of major-general, made a K. C. B., and (before his death was known) created a baronet. Consult lives by Brock (1858); Marshman (1860); Forbes (1890).

Havemeyer, hăv-ē-mī'ėr, **William Frederick**, American banker: b. 31 March 1850. He received his education in private schools and entered into commercial business, and as a successful financier became vice-president and director of the National Bank of North America, and of the Queens County Bank of Long Island, and took a place in the board of directors of numerous railroad and banking corporations.

Ha'ven, Alice Bradley, American author: b. Hudson, N. Y., 1828; d. 1863. Her maiden name was Emily Bradley, and while a school girl she sent under the pseudonym of "ALICE G. LEE' many sketches to the Saturday 'Gazette,' then recently established by Joseph C. Neal in Philadelphia. She was married to Mr. Neal in 1846, and at his request assumed and retained the name of Alice. On the death of her husband in 1847, she conducted the 'Gazette' for several years. She published in 1850 'Gossips of Rivertown, with Sketches in Prose and Verse,' and became widely known by her series of juvenile stories, as 'Helen Morton,' 'Pictures from the Bible,' 'No such Word as Fail,' 'Patient Waiting no Loss,' 'Contentment Better than Wealth,' 'All's not Gold that Glitters,' 'Out of Debt Out of Danger,' etc. In 1853 she was married to Mr. Samuel L. Haven.

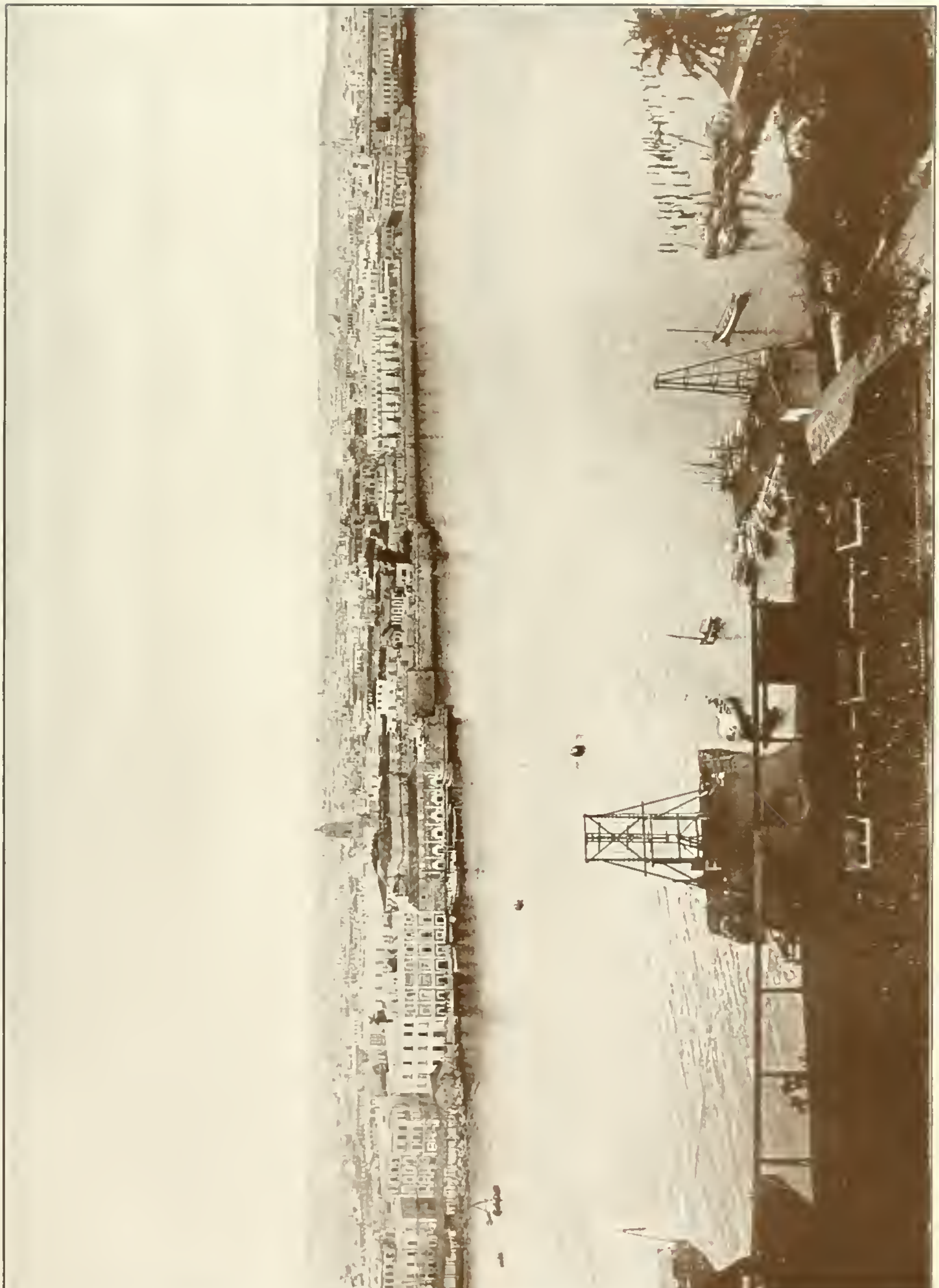
Haven, Erastus Otis, American Methodist bishop and educator: b. Boston, Mass., 1 Nov. 1820; d. Salem, Ore., 3 Aug. 1881. He was graduated at the Wesleyan University, Middletown, Conn., in 1842, soon after entered the ministry of the Methodist Episcopal Church, was appointed teacher of natural science in the Amenia Seminary, N. Y., and in 1845 was elected principal of that institution. He was professor of Latin and Greek in the University of Michigan 1854–6; editor of 'Zion's Herald' 1856–63, and sat in the Massachusetts Senate 1862–3. He was president of the University of Michigan 1863–7, and of Northwestern University, Evanston, Ill., 1869–72. He was subsequently chancellor of Syracuse University and was elected bishop in 1880. He published 'The Young Man Advised' (1855); 'Pillars of Truth' (1866); 'Rhetoric' (1869).

Haven, Gilbert, American Methodist bishop: b. Malden, Mass., 19 Sept. 1821; d. there 30 Jan. 1880. He was an able writer, and a forceful preacher. In the Civil War he was the first commissioned chaplain in the Federal army. He was editor of 'Zion's Herald' 1867–72, and was elected bishop in the latter year. He published 'The Pilgrim's Wallet, or Sketches of Travel in England, France, and Germany' (1865); 'National Sermons' (1869); 'Life of Father Taylor, the Sailor Preacher' (1871); 'Our Next-Door Neighbor, or a Winter in Mexico' (1875); etc.

Hav'erford College, under the auspices of the Society of Friends founded in 1833 in Haverford, Pa. It was first known as Haverford School, but in 1845 it was suspended for the purpose of collecting an endowment, and in 1856 it was made a college. It was the first collegiate institute in the United States which was founded and conducted entirely within the Society of Friends. Others besides the sons of Friends have been admitted as pupils since 1849. It is well equipped in laboratory requirements and in its library facilities. In 1903 the college reported 20 professors and instructors and 130 students. There were in the library about 37,100 volumes.

Havergal, hăv'ėr-gal, **Frances Ridley**, English hymn-writer: b. Astley, Worcestershire, 14 Dec. 1836; d. Swansea, Wales, 3 June 1879. She was a frequent contributor to 'Good Words,' and the chief English religious periodicals, and her musical harmonies were praised by the German composer Hiller. Her poems and hymns were collected in several volumes, 'The Ministry of Song' (1870) being the first. Her 'Poetical Works' (1884) appeared under the editorship of M. V. G. Havergal. Of her hymns, which contain her best work and are found in all collections, the most familiar is 'Take my Life and Let it Be.'

Haverhill, hā'vėr-il, **Mass.**, city in Essex County; on the Merrimac River at the head of navigation, and on the Boston &. M. railroad;



VIEW OF HAVANA FROM CABANAS.

capacious wet-docks, lined with fine quays and extensive warehouses. Havre commands the greater part of the import and export trade of Paris, and of the more important towns in the north of France; importing vast quantities of colonial and other produce, among which cotton holds a most important place; and exporting numerous articles of French manufacture. It is the second port in France. The manufactures consist of paper, starch, lace, oil, refined sugar, cables, and other marine cordage, sulphuric acid, earthen and stone-ware. There are also breweries, gun factories, and electrical works. A government tobacco factory employs 300 workmen; and from the building-yards a great number of sailing vessels and steamers are annually fitted out. In the 15th century Havre became of importance to form a new harbor in consequence of the silting up of that of Harfleur. The project was conceived, and some progress made in it, by Louis XII.; but Havre continued little more than a fishing village till the time of Francis I., who erected numerous works, and at immense expense gained the greater part of the present site of the town from the sea. A citadel was afterward built; and Havre, as a place of strength, became the object of repeated contests between French and English. Pop. (1901) 130,196.

Havre de Grace, hăv'ĕr dė gräs, Md., city in Harford County; on the Susquehanna River, near its entrance into Chesapeake Bay; and on the Philadelphia, W. & B. and the Baltimore & O. R. R.'s; about 36 miles east-northeast of Baltimore. It is the south terminus of the Tidewater canal. A small settlement was made here in about 1670. The chief manufactures are flour, sash, doors and blinds, lumber, and canned fruits. The fisheries, especially shad and herring, are important. The trade is principally in the manufactured articles, coal, and fish. A government fish hatchery is located on Battery Island. Pop. (1900) 3,423.

Haw, Battle of the, in the Revolution, 21 Feb. 1781. Henry Lee had been commissioned by Greene to prevent Tory reinforcements coming to Cornwallis, who had taken position at Hillsboro, and in the course of the movement attempted to surprise Tarleton. Tarleton had moved; but hearing that about 400 Tories under Col. Pyle were on their way to join him, Lee determined to pass off his own "legion" as Tarleton's and capture them all. Forcing two captured British officers to keep up the deception, he moved forward, with Pickens' and Oldham's companies following, and met two young men who had been sent by Pyle to find Tarleton's camp; he was presented to them as Tarleton, and directed them to have Pyle's men drawn up beside the road while his "weary veterans" passed,—his object being to capture and disarm them all. The plan succeeded perfectly till, just as he had taken Pyle's hand, part of the Tories discovered Pickens' militia and saw the trap, and at once fired on the American rear; the latter poured in a volley that killed 90 of the enemy at the first fire, and in the melée, despite appeals for quarter, a great number of the rest were killed and the majority wounded. Pyle escaped badly hurt, and the rest of the body dispersed unpursued.

Hawaii, a Territory of the United States; geographically, the HAWAIIAN (formerly SANDWICH) ISLANDS, the northeasternmost group of the Pacific, lying near the northern edge of the Tropics (lat. 18° 54′ to 22° 15′ N.; long. 154° 50′ to 160° 30′ W.), 2,100 miles southwest of San Francisco. It consists of eight inhabited islands, *viz.*, Hawaii, Maui, Kahoolawe, Lanai, Molokai, Oahu, Kauai, and Niihau besides several rocky islets. They extend from Hawaii on the southeast, 390 miles to Kauai on the northwest, and are continued in a chain of islets, sand banks, and shoals 1,200 miles farther to Midway Island. The total area of the group is 6,454 square miles, of which Hawaii contains nearly two-thirds or 4,015 square miles; the next island, Maui, 728; the third, Oahu (which takes the lead in wealth and population, and contains the capital and chief seaport), 598; and the fourth, Kauai, 547 square miles.

Topography.—The islands are entirely volcanic, consisting in fact of the summits of a gigantic submarine mountain chain rising from the bottom of the ocean, which is three miles deep within 30 to 50 miles from the shores. The volcanic action seems to have moved from northwest to southeast, Kauai being the oldest island.

The last but one, Maui, contains the vast extinct crater of Haleakala, which is at its highest point 10,032 feet above sea level, 20 miles in circumference, and 2,000 feet deep; while Hawaii is made up of four volcanic mountains, Mauna Kea (White Mountain), 13,805 feet high, the loftiest peak in the Pacific; Mauna Loa (Long Mountain), 12,675 feet; Hualalai, 8,273 feet; and Kohala, 5,490 feet high. Of these Hualalai has been dormant since 1801, but Mauna Loa is still active at intervals, having an oval summit crater, 9.5 miles in circumference, with nearly vertical inner walls 500 to 600 feet high. Twenty miles to the southwest is the famous crater of Kilauea, eight miles in circumference and 4,000 feet above the sea, which is almost constantly in action.

The windward sides of Oahu and Molokai, and the northwest side of Kauai, present precipices 2,000 feet in height, while the northeast slopes of Hawaii and Maui end in bluffs several hundred feet high, furrowed by deep and narrow canyons cut by the streams. "In West Maui and Kauai may be found valleys that almost rival Yosemite" (Dutton). Coral reefs line the greater part of the shores of Kauai, Oahu, and the southern shore of Molokai, but are nearly absent from Hawaii and Maui.

The best harbors are found in Oahu at Honolulu, and at Pearl Harbor, seven miles west, but Hilo Bay, Hawaii, only needs a breakwater to make a commodious harbor. The only rivers worthy of the name are found in the island of Kauai. Several of them were formerly crossed by ferries.

Climate and Rainfall.—The climate of the islands is much cooler than that of other countries in the same latitude. This is due not only to the northeast trade winds, which blow nine or ten months in the year, but also to the return ocean current from the region of Bering Straits. At sea level the mean temperature is 73° F., the maximum and minimum being 89° and 52°, respectively. The islands are entirely exempt from the cyclones which so often make havoc in the central and western Pacific. The contrast in climate between the windward and leeward sides of each island is very striking, the

HAWAII
SCALES.
Statute Miles, 21 = 1 Inch.
Kilometres, 34 = 1 Inch.
Rand, McNally & Co.'s New 11 x 14 Map of Hawaii
OAHU
MOLOKAI
MAUI
LANAI
KAHOOLAWE
HAWAII
KAUAI
NIIHAU
HONOLULU
Statute Mile.
WESTERN ISLANDS OF HAWAII
ON SAME SCALE AS MAIN MAP.
PACIFIC OCEAN
KAIWI CHANNEL
PAILOLO CHANNEL
KEALAIKAHIKE CHANNEL
ALALAKEIKI CHANNEL
ALENUIHAHA CHANNEL
KAI O KALOHI
KAUAI CHANNEL
KAUKAHI CHANNEL
KAIEIE WAHO CHANNEL
WIRELESS TELEGRAPH
PACIFIC CABLE
TO SAN FRANCISCO, 2,089 MILES
TO SAN PEDRO, 2,232 MILES
TO SAN DIEGO, 2,260 MILES
TO ACAPULCO, MEXICO, 3,310 MILES
TO SALINA CRUZ, MEXICO, 3,580 MILES
TO PANAMA, C. A., 4,665 MILES
TO YOKOHAMA, JAPAN, 3,445 MILES
TO MANILA, VIA GUAM, 4,890 MILES
TO TAHITI, 2,390 MILES
TO CHRISTMAS ISLAND, 1,075 MILES
KOHALA
HAMAKUA
NORTH KONA
SOUTH KONA
HILO
PUNA
KAU
Mauna Kea 13,805
Mauna Loa 13,675
Kilauea 4,000
HILO BAY
KANEOHE HARBOR
PEARL HARBOR
PUNCH BOWL
Royal Mausoleum
Oahu College
Capitol Building
Alexander Young Hotel
U. S. Naval Reservation
Honolulu Iron Works
U. S. Immigration Depot
Oahu Railway Sta.
Road to Waikiki

northwest slopes being rainy and heavily wooded, while the opposite coast has a warm and dry climate. From the differing elevations and exposures there is an extraordinary variety in the rainfall even within narrow limits. Thus the annual rainfall in the district of Hilo, Hawaii, averaged 136 inches in 20 years, from 1880 to 1900, while in Honolulu it averaged 30.9 inches, and at Luakaha, in the valley back of Honolulu, 128.9 inches.

Production and Industries.—The Hawaiian Islands, from the lack of coal and metals, are an agricultural country, and about the only manufacture is that of sugar. The Honolulu iron foundry in 1890-1900 turned out $1,107,030 worth of work, and is now making sugar mills for Mexico, Formosa, and the Philippines. One plantation, near Pearl Harbor, is refining its own sugar.

The soil of the islands in general is poor, with the exception of the valleys and some of the coast plains, which are of limited extent. The greater part of the interior consists of rugged, barren mountain sides, extensive tracts covered with lava, and forest land, which needs to be protected for the preservation of the water supply. Extensive tracts of formerly barren land, however, have been made productive by irrigation and the use of fertilizers. On Oahu there are over 200 artesian wells, yielding daily from 250 to 300 million gallons, and on some plantations pumps are employed which raise over 10,000,000 gallons of water a day, and in some places to an elevation of 350 feet.

In Kauai electricity generated by water-power in the Wainiha Valley is carried 30 miles by wire to run the pumps of the McBryde plantation. Extensive aqueducts have been made in western Kauai, Maui, and northern Hawaii, consisting largely of tunnels driven generally through solid rock. Numerous reservoirs have also been formed by damming the canyons. The Planters' Association employs a large staff of experts in chemistry, entomology, and scientific agriculture, with the result that the yield of sugar per acre is the highest in the world. The average annual yield is 4½ tons per acre, but the average for irrigated plantations is six tons to the acre. The total crop for 1906 was 429,213 tons. The value of the sugar exported to the United States for the year ending 30 June 1906, was $25,495,427. At the close of that year there were about 200,000 acres cultivated in cane. Only Java and Cuba have a greater gross product. The power for the sugar mills is obtained entirely from burning the bagasse or cane refuse. The sugar is so completely extracted from the juice that no molasses is made, the remainder being thrown into fertilizers. The total number of employees on the sugar plantations in 1905 amounted to 48,229, including: Japanese, 31,735; Koreans, 4,683; Chinese, 4,409; Portuguese, 3,005; other whites, 1,006; Hawaiians, 1,452; Porto Ricans, 1,907; Negroes, 32.

The first importation of Chinese took place in 1852. In 1878 their number had risen to 5,916, and in 1886 to 21,000, at which time a strict exclusion act was passed. In 1878 the first Portuguese immigrants arrived from the Azores, and during the next ten years about 7,000 of these people came to the islands, where they have given great satisfaction as industrious and law-abiding citizens. In 1886 a labor convention was concluded with Japan and a stream of immigrants set in, which increased the number of Japanese in the Islands from 116 in 1884, to 24,400 in 1886, and 61,111 in 1900. Porto Ricans were imported in 1901 to the number of about 2,500. Both as laborers and as citizens they have proved to be very unsatisfactory. Beginning with the year 1903, up to 31 Dec. 1905, about 7,000 Koreans arrived in the Territory, who have done well as laborers. In the spring of 1907 several thousand immigrants were imported from Spain and the Azores, with the understanding that they should be given small freeholds of their own by the planters.

The danger of depending upon a single crop has long been recognized, and persistent efforts have been made to develop minor industries. The culture of rice was commenced in 1860, and it soon became the second crop in importance, amounting in 1904 to 14,000 tons of cleaned rice, most of which is consumed in the Territory. The quality of Hawaiian coffee is equal to that of Mocha, but the industry is depressed by the competition of Brazilian and Central American low-grade coffees. The crop in 1903 amounted to 300,000 lbs. The amount exported in 1906 was valued at $248,618. There were four pineapple canneries that year, which put up 40,000 cases. There are several sisal plantations, and two promising rubber plantations. Experiments with tobacco have been successful. The castor oil bean grows wild, but the manufacture of the oil has not yet been profitable. Nearly all the fruits of the tropical and some of the temperate zone, grow well in the islands, and yet the total export in 1905 of fruit, not canned, was valued at only $131,806. The native staff of life is the taro root, or Colocasia, reduced to a paste called poi. There are about twenty stock and sheep ranches, which exported $45,883 worth of wool in 1906. The export of honey and wax amounts to about $40,000 a year.

Commerce.—The total exports in 1904 were $26,275,438, and in 1906, $26,994,824. The imports in 1904 were $15,481,034 and in 1906, $15,639,874. Nearly three-fourths of the imports are from the United States. In 1905, 452 vessels cleared from Hawaiian ports, aggregating 973,279 tons, five-sixths of which were under the American flag.

Transportation.—For steamship lines see article on Honolulu. There are 20 steamers and as many schooners engaged in the inter-island trade. There are about 150 miles of railroads on the islands, the principal line being on Oahu, and others on Maui and Hawaii. The principal islands are connected by wireless telegraph, each island being encircled by telephone lines. The trans-Pacific submarine cable laid in 1903 connects the islands with both continents.

Finances.—The bonded debt assumed by the United States on annexation was $4,000,000, leaving $951,000 to be paid by the Territory of Hawaii. The debt of the Territory had increased by 30 June 1904 to $2,185,000, and by 1 Jan. 1907 to $3,722,000. The assessed valuation of taxable property had increased by 1 Jan. 1906 to $131,175,015. The taxes are 1 per cent. on property, and 2 per cent. on incomes above $1,000 a year. The current receipts of the government aside from loans, during the year 1906, were $2,354,813. The receipts from customs and internal revenue, which are remitted to Washington, average about $1,200,000 a year.

Education.—There is a good free-school system, graded, with compulsory attendance from 6 to 15, with an excellent normal training school, besides industrial and high schools. The school law requires that the English language shall be the basis and medium of instruction in all schools.

The department is administered by a superintendent and six commissioners, aided by three travelling inspectors.

On 31 Dec. 1906 the numbers were as follows: Public schools, 151; 443 teachers; 16,051 pupils. Private schools, 62; 261 teachers; 5,230 pupils. Total: 213 schools; 704 teachers; 21,800 pupils.

The total cost of the government schools is about $350,000 per annum. The private schools are mostly endowed, as Oahu College and the Kamehameha Schools, founded by the late Mrs. Bernice Bishop; or managed by missionary boards or religious orders as Saint Louis College.

Charitable Institutions.—Among these may be mentioned the Lunalilo Home for aged and indigent Hawaiians, the Asylum for the Insane, the numerous hospitals, eight of which are under the Board of Health, but the most important is the leper settlement established in 1866 on a peninsula of Molokai, shut off from the rest of the island by a precipice 2,000 feet in height. The number of lepers has decreased from 1,200 to 833. The territorial government provides them comfortable homes, food, clothing, and medical attendance free of cost, aided by the devoted Franciscan sisters and the Brothers of the Sacred Heart.

Population.—The census of 1900 divides the population as follows: Hawaiians, 29,787; Part-Hawaiians, 7,848; Americans, 7,283; Portuguese, 15,675; other Caucasians, 3,294; Chinese, 25,762; Japanese, 61,115; Polynesians, 653; other foreigners, 2,584; total, 154,001. Of the islands, Hawaii had 46,843; Oahu (including the city of Honolulu, 39,306), 58,504; Maui, 25,416; Kauai and Niihau, 20,734; Molokai and Lanai, 2,504.

Government.—The new territorial government was inaugurated at Honolulu 14 June 1900, and the first territorial legislature began its sessions at Honolulu 20 Feb. 1901. The legislature is composed of two houses—the senate of 15 members, holding office four years; and the house of representatives of 30 members, holding office two years. The legislature meets biennially, and sessions are limited to 60 days.

The executive power is lodged in a governor, a secretary, both appointed by the President, and holding office four years, and the following officials appointed by the governor, by and with the consent of the senate of Hawaii: an attorney-general, treasurer, commissioner of public lands, commissioner of agriculture and forestry, superintendent of public works, superintendent of public instruction, auditor and deputy, surveyor, high sheriff, and members of the boards of health, public instruction, prison inspectors, etc. They hold office for four years, and must be citizens of Hawaii.

The judiciary of the Territory is composed of the supreme court with three judges, the circuit court, and such inferior courts as the legislature may establish. The judges are appointed by the President. The Territory is a federal judicial district, with a district judge, district attorney, and marshal, all appointed by the President. The district judge has all the powers of a circuit judge.

The Territory is represented in congress by a delegate, who is elected biennially by the people.

History.—According to documents in the Spanish archives, the islands were discovered in 1555 by Juan Gaetano, who named Hawaii "La Mesa." They were rediscovered by Capt. James Cook in 1778, and named the Sandwich Islands. In 1792 Capt. Vancouver visited the islands, and introduced the first cattle and sheep. Kamehameha I., a chief of northern Hawaii, after nine years of war, became master of the whole island in 1791. In 1795 he conquered Maui and Oahu, the decisive battle being fought in Nuuanu Valley back of Honolulu. Having united the group under one strong government, he died 8 May 1819. His son, Kamehameha II., abolished the ancient tabu system in the following September. The first American missionaries arrived at Kailua, Hawaii, 4 April 1820, and met with remarkable success. The first Catholic missionaries arrived 7 July 1827. In the same year the first written laws were printed. The first constitution was proclaimed 8 Oct. 1840. On 25 Feb. 1843, the native government was compelled by Lord Paulet to make a provisional cession to Great Britain, but its independence was restored 31 July of the same year by Admiral Thomas. The feudal tenure of land was abolished in 1848, and a liberal constitution was adopted in 1852. The Kamehameha dynasty ended with the death of Kamehameha V., 11 Dec. 1872. David Kalakaua was elected by the Legislature 12 Feb. 1874. In 1876 a reciprocity treaty was ratified with the United States, which assured prosperity to the islands. The King, however, labored to build up a reactionary party, and to restore autocratic government, until he was compelled by the civilized element to sign a revision of the constitution, which limited his powers, in 1887. A Royalist insurrection was put down in 1889. His sister, Liliuokalani, succeeded him in 1891, and in January 1893 undertook to abrogate the constitution, and establish an absolute monarchy. Upon this the constitutional party dethroned her, and established a provisional government. During the following year the Republic of Hawaii was organized with S. B. Dole as President. An annexation treaty was negotiated with President Harrison, which was withdrawn by President Cleveland in April 1893, but brought up again on the accession of President McKinley. After long delays, Hawaii was admitted into the Union by a joint resolution passed 7 July 1898. It was finally organized as a Territory 14 June 1900, with S. B. Dole as Governor, who was succeeded by Geo. R. Carter 23 Nov. 1903, and by Walter F. Frear in 1907. Consult Bishop, 'Hawaiian Archipelago' (New York 1894); Twombley, 'Hawaii and Its People' (London 1900); Musick, 'Our New Possessions' (New York 1897); Whitman, 'Hawaiian America' (New York 1899); Young, 'The Real Hawaii' (London 1899).

W. D. ALEXANDER,
Formerly Surveyor-General Hawaiian Islands.

Hawes' Shop, Cavalry Engagement Near. Gen. Grant had crossed to the south bank of the North Anna, in Virginia, and finding Gen. Lee too strongly posted to be attacked, and his own army in a false and critical position, he withdrew, on the night of 26 May 1864, to the north bank, and moved down the north bank of the Pamunkey to turn Lee's right. Torbert's and Gregg's divisions of cavalry, under Sheridan, together with the Sixth corps, led the advance. Torbert crossed the Pamunkey at Hanover Ferry on the 27th, after considerable skirmishing in which he took about 60 prisoners, and the two cavalry divisions, supported by Russell's division of infantry, pushed on to Hanover Town and bivouacked for the night. On the morning of the 28th Sheridan was directed to make a demonstration and discover the enemy's position. Gregg's division, advancing on the Mechanicsville road, encountered the two cavalry divisions of Wade Hampton and Fitzhugh Lee and Butler's South Carolina cavalry brigade about a mile beyond Hawes' Shop. The Confederate cavalry was dismounted and had thrown up a barricade of rails covering the road. Gregg attacked, and there ensued one of the most severe cavalry engagements of the War, which continued several hours, neither side yielding ground. Finally, late in the day, Custer's brigade of Torbert's division came up, dismounted, took position in the centre of Gregg's line, formed in close column of attack, the whole line charged and, after a hard struggle at close quarters, the Confederates were driven from position and retreated upon their infantry at the Totopotomoy. Gregg's loss was 256 killed and wounded; the entire Union loss was 44 killed and 306 wounded. The Confederate loss is not known. Consult: 'Official Records,' Vol. XXXVI.; Humphreys, 'The Virginia Campaign of 1864–5'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. Carman.

Hawesville, hâz'vĭl, Ky., city, county-seat of Hancock County; on the Ohio River, and on the Louisville, H. & S. T. L. railroad; about 65 miles above Evansville, Ind.: and 80 miles west by south from Louisville. It is situated in an agricultural and coal-mining region. Its chief manufactures are flour, lumber, and furniture. It has a number of tobacco factories or stemmeries, and its trade is chiefly in tobacco, coal, articles of home manufacture, and agricultural products. Pop. (1900) 1,041.

Haw'finch, one of the largest of European finches (*Coccothraustes vulgaris*), so called in England from the belief that it subsisted principally on the fruit of the hawthorn. It resembles the chaffinch in color, but is distinguished by its enormous beak and larger size. It feeds on all kinds of berries.

Hawk, a general name for diurnal birds of prey not eagles or vultures. See Falcon, and the names of various groups and species, as Hen-hawks, Sparrow-hawk and the like: also Falconry.

Hawk-moths, a family of large moths forming the family *Sphingidæ*. They have stout bodies, large heads with prominent eyes, and thick spindle-shaped antennæ, ending in a hook. The fore-wings are long, narrow, more or less pointed, and always much longer than the hind-wings. They are insects of rapid flight, and dart about in the twilight; some species also during the day. Their caterpillars are hairless, smooth, often green, with transverse stripes on the sides and nearly always a horn on the back of the second last segment, and always have ten prolegs. They are leaf-eaters and often greatly destructive to cultivated plants, the tomato-worm (q.v.) being a prominent example. They change to pupæ either on the surface of the ground or in a cell underground, but make no cocoon. Some of the South American species resemble humming-birds so closely, especially when poising before a flower on whirring wings and sucking its nectar, that they can hardly be distinguished, and popular belief asserts that the one is transmutable into the other. A great number of forms exist in all parts of the world, the United States having about 100 species. All are plainly dressed in grays and browns, and one of the most remarkable is the death's-head (q.v.).

Hawkbit, a genus (*Leontodon*) of composite plants closely related to the dandelion, from which they differ in having feathery pappus. The name is due to the peculiar shape of the lacerations of the leaves. Several species are natives of Europe and Russian Asia.

Hawke, Edward, Lord, English sailor: b. London 1705; d. Sunbury-on-Thames 17 Oct. 1781. Early in 1720 Hawke entered the navy and was appointed in 1733 to the command of the Wolf. Being promoted to the command of a squadron in 1847 he totally defeated the French fleet off Belle Isle. In 1759 he was sent in pursuit of the Brest fleet, which he came up with in Quiberon Bay, and signally defeated. He now received a pension of £2,000, and in 1768 became admiral of Great Britain and commander-in-chief of the fleet. From 1766 to 1771 he was first lord of the admiralty. In 1776 he was advanced to a seat in the House of Lords by the style of Baron Hawke of Towton.

Haw'ker, Mary Elizabeth, English novelist: b. 1865. Under the pseudonym of "Lanoe Falconer" she has written the well known novel 'Mademoiselle Ixe' (1890); which was followed by 'The Hotel d'Angleterre' (1891) and 'Cecilia de Noel' (1891).

Hawkesbury, hâks'ber-ĭ, Canada, village in Prescott County, Ontario; on the Ottawa River, and a terminus of a branch of the Canada Atlantic Railway, 50 miles west of Montreal. It has ferry communication with Grenville, across the river. Its chief industrial establishments are flour mills, a woolen factory, and large saw and planing mills. It has an extensive lumber trade. Pop. (1901) 4,150.

Hawk'eye State, Iowa — so named after a famous Indian warrior.

Hawking. See Falconry.

Haw'kins, Anthony Hope, English novelist, known by the pen-name "Anthony Hope": b. London 9 Feb. 1863. He was educated at Balliol College, Oxford, was admitted to the bar at the Middle Temple in 1887, and practised until 1894 on the London and Midland circuit. He contested South Bucks as a Liberal in 1892, but unsuccessfully. In 1894 he achieved a striking literary success with his 'Prisoner of Zenda,' with scene in an imaginary independent state of South Germany. Other books of his are: 'The Dolly Dialogues' (1894), cited as models of keen if somewhat shallow repartee;

'The Chronicles of Count Antonio' (1895); 'Rupert of Hentzau' (1898); and 'The Intrusions of Peggy' (1902).

Hawkins, Hamilton Smith, American military officer: b. South Carolina 1834. He entered the army in 1861, was made captain in the 6th infantry in 1863, and brevetted major in October 1865. In 1888 he became commandant at West Point, and in 1892 was promoted colonel. When war was declared against Spain (1898) he went to the front as a brigadier-general of volunteers. He led the desperate and now historic charge at San Juan, Cuba, 2 July 1898, and was made major-general of volunteers, 8 July 1898.

Hawkinsville, Ga., village, county-seat of Pulaski County; on the Ocmulgee River, at the head of navigation, and on a branch of the Macon & B. railroad; about 48 miles south of Macon. It is situated in a fertile agricultural region. It has a cotton factory, cotton compresses, cotton gins, cottonseed-oil mills, barrel factories, carriage and wagon works. Its trade is chiefly in cotton, lumber, fruits, and vegetables. Pop. (1900) 2,103.

Hawksbeard, a perennial composite plant allied to hawkweed, but of the genus *Crepis*, about 150 species of which are known in the northern hemisphere. Several are European weeds which have become naturalized in the United States, and there are several native species. The flowers are dandelion-like and yellow or orange.

Hawksbill, a great marine turtle (*Chelone imbricata*) allied to the green turtle, but which has the plates of the shell overlapping; and these plates form the tortoise-shell (q.v.) of commerce. The flesh is not good for eating, but the eggs are good. The animal inhabits the Indian Ocean, the Pacific, and the warmer parts of the Atlantic. This is one of the sea-turtles called "caret," but that term belongs more properly to the loggerhead. See TURTLE.

Hawkweed, or Rattlesnake Weed, a genus (*Hieracium*) of composite plants with mottled, radical leaves, tall hairy stems and yellow or orange flowers. One species, the European orange hawkweed (*H. aurantiacum*) is frequently cultivated for the sake of its fine orange flowers. The name "hawkweed" in English, and various similar names in use among the peasants of continental Europe, are based on an ancient belief that birds of prey used the juice of the species to strengthen their vision. Several species grow numerously in the United States, where they are called "rattlesnake weeds" and are believed to be of value in curing the poison of snakes.

Hawkwood, Sir John de, English soldier: b. Hedingham Sibil, Essex; d. Florence, Italy, 17 March 1304. He was styled by Hallam the first distinguished commander who had appeared in Europe since the destruction of the Roman Empire. It is said that he fought at Crécy and Poitiers, and for his bravery was knighted by Edward III. However that may be, in 1350 he was the leader of a troop of free lances, preying upon France and northern Italy. With this band, the "White Company," he served the Marquis of Montferrat, later the Republic of Pisa, and still later Florence, upon whose side he oftenest fought in the civil disturbances of Italy. As commander-in-chief he directed the successful war against Milan (1390-2). He was pensioned by the Florentines and entombed with great ceremony in the Duomo.

Hawley, Gideon, American missionary to the Indians: b. Stratfield, now Bridgeport, Conn., 5 Nov. 1727; d. Marshpee, Mass., 3 Oct. 1807. He was graduated at Yale College in 1749, and commenced his labors at Stockbridge in 1752, opening a school at that place, in which he instructed a number of Mohawk, Oneida, and Tuscarora families. In 1754, under the patronage of Sir William Johnson, he began a mission among the Iroquois, or Six Nations, on the Susquehanna River; but in 1756 was obliged by the disturbances of the French war to leave that region, when he became a chaplain in the army marching against Crown Point. The campaign being over, he re-engaged in his missionary work at Marshpee, where he was installed as pastor in 1758, and there passed the remainder of his life in his benevolent labors.

Hawley, Joseph, American statesman: b. Northampton, Mass., 1724; d. 10 March 1788. He was graduated at Yale College, and followed the profession of law at Northampton, in which he rose to eminence. At the time of the disputes between Great Britain and America, he took a prominent part in advocating the cause of the colonies. "We must fight," he wrote to the delegates of Massachusetts, "if we cannot otherwise rid ourselves of British taxation. The form of government enacted for us by the British parliament is evil against right, utterly intolerable to every man, who has any idea or feeling of right or liberty." He was several times elected a member of the council, but declined, preferring to enter the State legislature, of which he was a member 1764-6.

Hawley, Joseph Roswell, American politician and legislator: b. Stewartsville, N. C., 31 Oct. 1826; d. Washington, D. C., 17 March 1905. He was graduated at Hamilton College, Clinton, N. Y., 1847, and began the practice of law at Hartford, Conn., in 1850. The Republican party in Connecticut was organized in the office of the *Charter Oak*, of which he was the editor. He afterward became editor of the Hartford *Evening Post*, the new Republican paper. When the Civil War broke out he recruited the first company of volunteers raised in the State — Company A of the 1st Connecticut regiment — of which he took command. He saw service throughout the whole war and was mustered out in 1866 with the brevet rank of major-general. He was elected governor of Connecticut the same year. In 1872 he was elected to Congress, at the end of the term, 1875-81, was sent to the United States Senate, to which he was re-elected 1887, 1893, and 1899.

Hawley, Pa., borough in Wayne County; on the Lackawaxen River, and on the main line or branches of the Pennsylvania, the Delaware & H., and the Erie R. R.'s; about nine miles south-southeast of Honesdale. Its chief manufacturing establishments are a glass-factory, a glass-cutting factory and a silk-factory. In addition to its trade in home manufactures, it has an extensive coal trade, and ships a considerable quantity of farm products. Pop. 2,128.

Haworth, Adrian Hardy, English naturalist: b. at Hull in 1767; d. there 16 Jan. 1833. He was educated for the law, but did not practice, devoting his time to entomology and botany. He was the founder of the Entomological Society of London, a member of the Linnæan Society, and the Hull Botanical Gardens were planned by him, and laid out under his direction. His collections were large and important and his works are still standard. He wrote: 'Observations on the Genus Mesembryanthemum' (1794); 'Prodromus Lepidopterorum Britannicorum' (1802); and 'Synopsis Plantarum Succulentarum' (1812); and many minor papers.

Haworth, hâ'wėrth, **Joseph,** American actor: b. Providence, R. I., 1855; d. 29 Aug. 1903. His first appearance was as a member of Ellsler's stock company at Cleveland, Ohio, and subsequently he supported Edwin Booth, Lawrence Barrett, and John McCullough. From 1883 he toured for several years as a star in 'The Bells,' 'The Leavenworth Case,' 'Hamlet,' and other productions; in 1896–8 was Macbeth to Modjeska's Lady Macbeth, and later Storm in Caine's 'Christian,' Vinicius in Stange's adaptation of Sienkiewicz's 'Quo Vadis,' and Cassius in the Mansfield presentation of 'Julius Cæsar.'

Hawser, a manila or wire rope used in mooring or towing boats, etc., over four or three inches in circumference respectively. The name is now usually applied to all large ropes, though formerly it signified ropes "hawser-laid," that is, with three "plain-laid," three-stranded ropes laid up left-handed, now usually called a cable-laid rope.

Hawthorn, or **White Thorn** (*Cratægus oxyacantha*), a small spiny European tree, rising sometimes to the height of 20 to 25 feet, much admired for the beauty of its foliage. The leaves are smooth, shining, more or less deeply lobed, and of a beautiful green color; the flowers are white, sometimes with a reddish tinge, disposed in corymbs, and possess an agreeable perfume. The species of *Cratægus* are about 50 in number, all shrubs or small trees, spiny, with red fruit resembling in miniature that of the apple, from which plant they are distinguished chiefly by their seeds, and are arranged with it in the family *Rosaceæ*. Fifteen species are recognized in North America. When young the hawthorn springs up rapidly, a shoot of a single year being sufficient for a walking-stick. It thus, if well pruned and kept down, quickly grows into a thick and intricately woven hedge.

Hawthorne, hâ'thôrn, **Julian,** American novelist and journalist, son of Nathaniel Hawthorne (q.v.): b. Boston, Mass., 22 June 1846. He was graduated from Harvard University in 1867 and afterward studied civil engineering in Dresden, but soon forsook this occupation for literature. His first successful story was 'Bressant' (1872), the forerunner of a long list of novels, of which may be particularized 'Garth' (1875); 'Sebastian Strome' (1884); 'Archibald Malmaison' (1884); 'A Fool of Nature' (1896). He has also published 'Saxon Studies' (1876); and 'Nathaniel Hawthorne and His Wife' (1885). His best work suggests more than one element that distinguishes his father's stories. There is a psychologic accent, the touch of mystery, and the avoidance of the stock properties of romance.

Hawthorne, Nathaniel, American novelist: b. Salem, Mass., 4 July 1804; d. Plymouth, N. H., 19 May 1864. The founder of the family in America was William Hathorne (as the name was then spelled), a typical Puritan and a public man of importance. John, his son, was a judge, one of those presiding over the witchcraft trials. Of Joseph in the next generation little is said, but Daniel, next in descent, followed the sea and commanded a privateer in the Revolution, while his son Nathaniel, father of the romancer, was also a sea captain. This pure New England descent gave a personal character to Hawthorne's presentations of New England life; when he writes of the strictness of the early Puritans, of the forests haunted by Indians, of the magnificence of the provincial days, of men high in the opinion of their townspeople, of the reaching out to far lands and exotic splendors, he is expressing the stored-up experience of his race. His father died when Nathaniel was but four and the little family lived a secluded life with his mother. He was a handsome boy and quite devoted to reading, by an early accident which for a time prevented outdoor games. His first school was with Dr. Worcester, the lexicographer. In 1818 his mother moved to Raymond, Maine, where her brother had bought land, and Hawthorne went to Bowdoin College. He entered college at the age of seventeen in the same class with Longfellow. In the class above him was Franklin Pierce, afterward 12th President of the United States. On being graduated in 1825 Hawthorne determined upon literature as a profession, but his first efforts were without success. 'Fanshawe' was published anonymously in 1828, and shorter tales and sketches were without importance. Little need be said of these earlier years save to note that they were full of reading and observation. In 1836 he edited in Boston the 'American Magazine for Useful and Entertaining Knowledge,' but gained little from it save an introduction to 'The Token,' in which his tales first came to be known. Returning to Salem he lived a very secluded life, seeing almost no one (rather a family trait), and devoted to his thoughts and imaginations. He was a strong and powerful man, of excellent health and, though silent, cheerful, and a delightful companion when he chose. But intellectually he was of a separated and individual type, having his own extravagances and powers and submitting to no companionship in influence. In 1837 appeared 'Twice Told Tales' in book form: in a preface written afterwards Hawthorne says that he was at this time "the obscurest man of letters in America." Gradually he began to be more widely received. In 1839 he became engaged to Miss Sophia Peabody, but was not married for some years. In 1838 he was appointed to a place in the Boston custom house, but found that he could not easily save time enough for literature and was not very sorry when the change of administration put him out of office. In 1841 was founded the socialistic community at Brook Farm: it seemed to Hawthorne that here was a chance for a union of intellectual and physical work, whereby he might make a suitable home for his future wife. It failed to fulfill his expectations and Hawthorne withdrew from the experiment. In 1842 he was married and moved with his wife to the Old Manse at Concord just above the historic bridge. Here chiefly he wrote the 'Mosses of an Old Manse' (1846). In 1845 he published a second series of 'Twice Told Tales': in this year also the family moved to Salem, where he had received the appointment of surveyor at the custom house. As before, official work was a hindrance to literature; not till 1849 when he lost his position could he work seriously. He used his new-found leisure in carrying out a theme that had been long in his mind and produced 'The Scarlet Letter' in 1850. This, the first of his longer novels, was received with enthusiasm and at once gave him a distinct place in literature. He now moved to Lenox, Mass., where he began on 'The House of Seven Gables,' which was published in 1851. He also wrote 'A Wonder-Book' here, which in its way has become as famous as his more important work. In Dec. 1851 he moved to West Newton, and shortly to Concord again, this time to the Wayside. At Newton he wrote 'The Blithedale Romance.' Having settled himself at Concord in the summer of 1852, his first literary work was to write the life of his college friend, Franklin Pierce, just nominated for the Presidency. This done he turned to 'Tanglewood Tales,' a volume not unlike the 'Wonder-Book.' In 1853 he was named consul to Liverpool: at first he declined the position, but finally resolved to take this opportunity to see something of Europe. He spent four years in England, and then a year in Italy. As before, he could write nothing while an official, and resigned in 1857 to go to Rome, where he passed the winter, and to Florence, where he received suggestions and ideas which gave him stimulus for literary work. The summer of 1858 he passed at Redcar, in Yorkshire, where he wrote 'The Marble Faun.' In June 1860 he sailed for America, where he returned to the Wayside. For a time he did little literary work: in 1863 he published 'Our Old Home,' a series of sketches of English life and planned a new novel, 'The Dolliver Romance,' also called 'Pansie.' But though he suffered from no disease his vitality seemed relaxed: some unfortunate accidents had a depressing effect, and in the midst of a carriage trip into the White Mountains with his old friend, Franklin Pierce, he died suddenly at Plymouth, N. H., early in the morning, 19 May 1864.

The works of Hawthorne consist of novels, short stories, tales for children, sketches of life and travel, and some miscellaneous pieces of a biographical or descriptive character. Besides these there were published after his death extracts from his notebooks. Of his novels 'The Scarlet Letter' is a story of old New England: it has a powerful moral idea at bottom, but it is equally strong in its presentation of life and character in the early days of Massachusetts. 'The House of Seven Gables' presents New England life of a later date: there is more of careful analysis and presentation of character and more description of life and manners, but less moral intensity. 'The Blithedale Romance' is less strong: Hawthorne seems hardly to grasp his subject. It makes the third in what may be called a series of romances presenting the molding currents of New England life: the first showing the factors of religion and sin, the second the forces of hereditary good and evil, and the third giving a picture of intellectual and emotional ferment in a society which had come from very different beginnings. 'Septimius Felton,' finished in the main but not published by Hawthorne, is a fantastic story dealing with the idea of immortality. It was put aside by Hawthorne when he began to write 'The Dolliver Romance,' of which he completed only the first chapters. 'Dr. Grimshaw's Secret' (published in 1882) is also not entirely finished. These three books represent a purpose that Hawthorne never carried out. He had presented New England life, with which the life of himself and his ancestry was so indissolubly connected, in three characteristic phases. He had traced New England history to its source. He now looked back across the ocean to the England he had learned to know, and thought of a tale that should bridge the gulf between the old world and the new. But the stories are all incomplete and should be read only by the student. The same thing may be said of 'Fanshawe,' which was published anonymously early in Hawthorne's life and later withdrawn from circulation. 'The Marble Faun' presents to us a conception of the old world at its oldest point. It is Hawthorne's most elaborate work, and if every one were familiar with the scenes so discursively described, would probably be more generally considered his best. Like the other novels its motive is based on the problem of evil, but we have not precisely atonement nor retribution, as in his first two novels. The story is one of development, a transformation of the soul through the overcoming of evil. The four novels constitute the foundation of Hawthorne's literary fame and character, but the collections of short stories do much to develop and complete the structure. They are of various kinds, as follows: (1) Sketches of current life or of history, as 'Rills from the Town Pump,' 'The Village Uncle,' 'Main Street,' 'Old News.' These are chiefly descriptive and have little story; there are about twenty of them. (2) Stories of old New England, as 'The Gray Champion,' 'The Gentle Boy,' 'Tales of the Province House.' These stories are often illustrative of some idea and so might find place in the next set. (3) Stories based upon some idea, as 'Ethan Brand,' which presents the idea of the unpardonable sin: 'The Minister's Black Veil,' the idea of the separation of each soul from its fellows: 'Young Goodman Brown,' the power of doubt in good and evil. These are the most characteristic of Hawthorne's short stories: there are about a dozen of them. (4) Somewhat different are the allegories, as 'The Great Stone Face,' 'Rappacini's Daughter,' 'The Great Carbuncle.' Here the figures are not examples or types, but symbols, although in no story is the allegory consistent. (5) There are also purely fantastic developments of some idea, as 'The New Adam and Eve,' 'The Christmas Banquet,' 'The Celestial Railroad.' These differ from the others in that there is an almost logical development of some fancy, as in case of the first the idea of a perfectly natural pair being suddenly introduced to all the conventionalities of our civilization. There are perhaps twenty of these fantasies. Hawthorne's stories from classical mythology, the 'Wonder-Book' and 'Tanglewood Tales,' belong to a special class of books, those in which men of genius have retold stories of the past in forms suited to the present. The stories themselves are set in a piece of narrative and description which gives the atmosphere of the time of the writer, and the old legends are turned from stately myths not merely to children's stories, but to romantic fancies. Mr. Pringle in 'Tanglewood Fireside' comments on the idea: "Eustace," he says to the young college student who had been telling the stories to the children, "pray let me advise you never more to meddle with a classical myth. Your imagination is altogether Gothic and will inevitably Gothicize everything that you touch. The effect is like bedaubing a marble statue with paint. This giant, now! How can you have ventured to thrust his huge disproportioned mass among the seemly outlines of Grecian fable?" "I described the giant as he appeared to me," replied the student. "And, sir, if you would only bring your mind into such a relation to these fables as is necessary in order to remodel them, you would see at once that an old Greek has no more exclusive right to them than a modern Yankee has. They are the common property of the world and of all time" ('Wonder-Book,' p. 135). 'Grandfather's Chair' was also written primarily for children and gives narratives of New England history, joined together by a running comment and narrative from Grandfather, whose old chair had come to New England, not in the Mayflower, but with John Winthrop and the first settlers of Boston. 'Biographical Stories,' in a somewhat similar framework, tells of the lives of Franklin, Benjamin West and others. It should be noted of these books that Hawthorne's writings for children were always written with as much care and thought as his more serious work. 'Our Old Home' was the outcome of that less remembered side of Hawthorne's genius which was a master of the details of circumstance and surroundings. The notebooks give us this also, but the American notebook has also rather a peculiar interest in giving us many of Hawthorne's first ideas which were afterwards worked out into stories and sketches.

One element in Hawthorne's intellectual make-up was his interest in the observation of life and his power of description of scenes, manners and character. This is to be seen especially, as has been said, in his notebooks and in 'Our Old Home,' and in slightly modified form in the sketches noted above. These studies make up a considerable part of 'Twice Told Tales' and 'Mosses from an Old Manse,' and represent a side of Hawthorne's genius not always borne in mind. Had this interest been predominant in him we might have had in Hawthorne as great a novelist of our everyday life as James or Howells. In the 'House of Seven Gables' the power comes into full play: 100 pages hardly complete the descriptions of the simple occupations of a single uneventful day. In Hawthorne however, this interest in the life around him was mingled with a great interest in history, as we may see, not only in the stories of old New England noted above, but in the descriptive passages of 'The Scarlet Letter.' Still we have not, even here, the special quality for which we know Hawthorne. Many great realists have written historical novels, for the same curiosity that absorbs one in the affairs of everyday may readily absorb one in the recreation of the past. In Hawthorne, however, was another element very different. His imagination often furnished him with conceptions having little connection with the actual circumstances of life. The fanciful developments of an idea noted above (5) have almost no relation to fact: they are "made up out of his own head." They are fantastic enough, but generally they are developments of some moral idea and a still more ideal development of such conceptions was not uncommon in Hawthorne. 'Rappacini's Daughter' is an allegory in which the idea is given a wholly imaginary setting, not resembling anything that Hawthorne had ever known from observation. These two elements sometimes appear in Hawthorne's work separate and distinct just as they did in his life: sometimes he secluded himself in his room, going out only after nightfall; sometimes he wandered through the country observing life and meeting with everybody. But neither of these elements alone produced anything great, probably because for anything great we need the whole man. The true Hawthorne was a combination of these two elements, with various others of personal character, and artistic ability that cannot be specified here. The most obvious combination between these two elements, so far as literature is concerned, between the fact of external life and the idea of inward imagination, is by a symbol. The symbolist sees in everyday facts a presentation of ideas. Hawthorne wrote a number of tales that are practically allegories: 'The Great Stone Face' uses facts with which Hawthorne was familiar, persons and scenes that he knew, for the presentation of a conception of the ideal. His novels, too, are full of symbolism. 'The Scarlet Letter' itself is a symbol and the rich clothing of Little Pearl, Alice's posies among the Seven Gables, the old musty house itself, are symbols, Zenobia's flower, Hilda's doves. But this is not the highest synthesis of power, as Hawthorne sometimes felt himself, as when he said of 'The Great Stone Face,' that the moral was too plain and manifest for a work of art. However much we may delight in symbolism it must be admitted that a symbol that represents an idea only by a fanciful connection will not bear the seriousness of analysis of which a moral idea must be capable. A scarlet letter A has no real connection with adultery, which begins with A and is a scarlet sin only to such as know certain languages and certain metaphors. So Hawthorne aimed at a higher combination of the powers of which he was quite aware, and found it in figures and situations in which great ideas are implicit. In his finest work we have, not the circumstance before the conception or the conception before the circumstance, as in allegory. We have the idea in the fact, as it is in life the two inseparable. Hester Prynne's life does not merely present to us the idea that the breaking of a social law makes one a stranger to society with its advantages and disadvantages. Hester is the result of her breaking that law. The story of Donatello is not merely a way of conveying the idea that the soul which conquers evil, thereby grows strong in being and life. Donatello himself is such a soul growing and developing. We cannot get the idea without the fact, nor the fact without the idea

This is the especial power of Hawthorne, the power of presenting truth implicit in life. Add to this his profound preoccupation with the problem of evil in this world, with its appearance, its disappearance, its metamorphoses, and we have a clue to Hawthorne's greatest works. In 'The Scarlet Letter,' 'The House of Seven Gables,' 'The Marble Faun,' 'Ethan Brand,' 'The Gray Champion,' the ideas cannot be separated from the personalities which express them. It is this which constitutes Hawthorne's lasting power in literature. His observation is interesting to those that care for the things that he describes, his fancy amuses, or charms or often stimulates our ideas. His short stories are interesting to a student of literature because they did much to give a definite character to a literary form which has since become of great importance. His novels are exquisite specimens of what he himself called the romance, in which the figures and scenes are laid in a world a little more poetic than that which makes up our daily surrounding. But Hawthorne's really great power lay in his ability to depict life so that we are made keenly aware of the dominating influence of moral motive and moral law.

Bibliography.—Hawthorne's life has been written by G. P. Lathrop (library edition of his works), by Henry James ('English Men of Letters'), and by Moncure D. Conway ('Great Writers' Series'). Consult also: 'Memorials of Hawthorne,' by Rose Hawthorne Lathrop. Criticism will be found in G. W. Curtis, 'Literary and Social Studies'; T. W. Higginson, 'Short Studies of American Authors'; Leslie Stephen, 'Hours in a Library'; W. D. Howells, 'My Literary Passions'; J. T. Fields, 'Yesterdays With Authors'; R. H. Hutton, 'Essays in Literary Criticism.'

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Professor of English, Union College, Schenectady, N. Y.

Hawtrey, Charles Henry, English actor, playwright, and manager: b. Eton, 1858, son of Rev. John Hawtrey. He was educated at Rugby and Oxford, becoming an actor when he was twenty-three years old. His greatest success was in 'The Private Secretary,' adapted from Von Moser's 'Der Bibliothekar,' first produced in Cambridge in 1883, and played 844 consecutive times. Other plays in which he has been unusually successful are 'Jane,' 'Mr. Martin,' 'A Message from Mars,' and 'The Man from Blankley's.' With the last two plays he several times visited the United States. For several years he has controlled the Comedy and Avenue theaters in London.

Haxo's System, a style of fortification introduced by Baron François Nicolas Benoît Haxo, a French military engineer, employed by Napoleon and put in command at the siege of Antwerp in 1832. His casemated batteries have earthen parapets along their front, and their arches are mantled with earth. The apertures in front of the guns open into embrasures formed in an extension of the parapet at these points beyond its ordinary retired position. Being open in the rear the circulation of air obviates the inconvenience of confined smoke. This method of construction is now pretty generally adopted.

Hay, George, Scottish artist: b. Edinburgh. At 17 he entered the architectural profession, which he afterward abandoned for painting, and has been a prolific genre painter since he first attracted attention by his 'Barber's Shop in the Time of Elizabeth' (1863). Other works by him are: 'A Visit to the Spaewife' (1872); 'Caleb Balderston's Ruse' (1874); and 'A Scene at Chatsworth' (1899).

Hay, John, American statesman: b. Salem, Ind., 8 Oct. 1838; d. near Newbury, N. H., 1 July 1905. He was graduated from Brown University in 1858, and on leaving college entered the office of Abraham Lincoln in Springfield, Ill., to study law. In 1861 he was admitted to the bar, but did not practise, as in that same year he went with Lincoln to Washington as one of the President's private secretaries. During the Civil War period he was also Lincoln's adjutant and aide-de-camp, and served in the field for some time under Generals Hunter and Gillmore. He was brevetted lieutenant and lieutenant-colonel.

After the death of Lincoln he was made secretary of legation at Paris, remaining there till 1867, when he became *chargé d'affaires* at Vienna. After holding this post for a year he resigned and returned to the United States, but was sent almost immediately to Madrid as secretary of legation, where he remained till 1870.

During his service abroad he gained a valuable knowledge not only of the language and literature of the chief European nations, but also of foreign diplomacy and politics. On his return to the United States he took up journalism, was for a time on the editorial staff of the New York *Tribune,* and published, mostly in its columns, his 'Pike County Ballads.' After about five years of service on the *Tribune,* he married a daughter of Amasa Stone of Cleveland and went to that city to live. He devoted himself mainly to literary work, and occasionally took part in politics, writing and speaking in presidential campaigns. In 1879 he accepted an offer from President Hayes to become first assistant secretary of state under Mr. Evarts. He held this position till the end of the Hayes administration in March 1881; then he took charge of the *Tribune* during Whitelaw Reid's absence in Europe, and conducted it with marked success through the trying period of Garfield's assassination and death.

In March 1897 President McKinley appointed him United States minister to England, and the selection was declared by all without distinction of party, to be most suitable. In London he was well received, and did much to bring about friendly understanding between England and the United States. His London experience was also most valuable training for the important position to which he was appointed in August 1898, when he became secretary of state. Very few of those who had been at the head of the State Department had dealt with so many important questions as Secretary Hay, and probably none had been more thoroughly trained diplomats. At the time of the Boxer outbreak in China, he was successful in obtaining justice for the Chinese, and preserving the integrity of the Chinese Empire. in 1899 he directed the United States ambassadors at London, Berlin, St. Petersburg, and Paris to propose that each of these governments make a declaration in favor

JOHN HAY.

of the «open door» policy in China. They were invited to give assurances: first, that there would be no interference with any treaty port or vested interest; second, that the existing Chinese customs tariff would be continued without discrimination and administered by Chinese officials; third, that there would be no discrimination in harbor dues and railroad rates. Italy and Japan were afterward included in the negotiations. No treaties were exchanged, but all the governments approached pledged themselves by definite promises to the "open door" policy. He also negotiated and signed the Hay-Pauncefote treaty (q.v.), and several reciprocity treaties, including one with Cuba; gave support to The Hague Conference (q.v.), and induced the Powers demanding indemnity from Venezuela to refer the question to The Hague tribunal; and, in 1903, signed within forty-eight hours of each other a treaty with the Colombian government granting right of way for the Panama canal, and a treaty with Great Britain providing for the submission of the Alaskan boundary question to arbitration. During McKinley's first administration, also, Secretary Hay's position was of peculiar significance, because, owing to the death of Vice-President Hobart, Hay would have become McKinley's successor had the President died or resigned before the end of the term.

Secretary Hay was known as an author also, his publications including 'Pike County Ballads' (1871) and other poems; 'Castilian Days,' one of the best books on Spain in the English language, and 'Life of Abraham Lincoln' (1890), written in collaboration with J. G. Nicolay (q.v.), and ranking as the most comprehensive and authoritative biography of Lincoln.

Hay-Pauncefote Treaty, signed 18 Nov. 1901, which replaced the Clayton-Bulwer Treaty (q.v.) as an Anglo-American agreement of policy regarding an isthmian canal, then supposed to be fixed as across Nicaragua. It was drawn up by John Hay, secretary of state, and Sir Julian Pauncefote, ambassador from Great Britain. Public feeling for some years had been growing so sore over the Clayton-Bulwer Treaty's restriction on the independent action of the United States, that there was grave fear lest Congress might abrogate it by open violence, a great blow to future amicable action. President McKinley voiced the feeling by the declaration, in his annual message for 1898, that the canal had become a national necessity. Fresh negotiations were opened with Great Britain; that country had no wish beyond that of neutralizing the canal, and sent one of her best diplomats with very liberal instructions, to concede whatever did not nullify that essential principle. The draft treaty was sent to the Senate by the President 5 Feb. 1900. It provided that a canal might be constructed by the United States, or under its direction; should be permanently neutralized on the basis of the Suez Canal agreement — to be kept open at all times, either of war or peace, to all vessels, without discrimination, and no fortifications to be constructed commanding the canal or the waters adjacent, and that other powers should be invited to join in this guaranty of neutrality. The provisions excited intense hostility, and Senator Davis offered an amendment adopted by the committee on foreign affairs, canceling the very features for which it was drawn up, and which made the spirit of the previous one. It provided that the neutralization clause should not prevent the United States from any measures it thought needful for its own defense or the preservation of order, declared the Clayton-Bulwer Treaty specifically abrogated, and struck out the third clause inviting the concurrence of other powers. In this form it was ratified by the Senate 20 Dec. 1900, but Great Britain refused to accept the transformed treaty, and it expired by limitation on 5 March 1901. Undiscouraged, the two diplomats set to work on a compromise, which was signed by them 18 Nov. 1901, sent to the Senate by President Roosevelt, and ratified by them 16 December. The chief differences were in dropping as far as possible all specific guaranties, requirements, or prohibitions, leaving its interpretation and application to the chapter of fate and the certainty that the strong hand would decide in any event. The neutrality of the canal is not guaranteed at all except by the terms of the agreement, the Clayton-Bulwer Treaty is abrogated by name, and the United States is not forbidden to construct fortifications, nor required to keep the canal open in time of war.

Hay, or Forage, the stems and leaves of grasses and other plants cut for fodder and dried in the sun. In haymaking the object of the farmer is to preserve the hay for winter use in the condition most nearly resembling the grass in its natural state. Of the various ingredients which compose grass, those portions which are immediately soluble in water are the most fitted for the purposes of nutrition; and therefore the mowing should be done when the plants contain the largest amount of sugar and other soluble matter. During the latter part of the process of fructification, when the seeds have arrived at maturity, the stem and leaves begin to decay; so that if the grass is not cut when in flower, a great amount of nutriment will be wasted. On the third day after mowing, if the weather is fine, the newly-made hay will be ready for gathering into large windrows for carrying and stacking; but otherwise it will have to be put up into large cocks, and the carrying deferred until the next day. It is not desirable that grass should be too rapidly made into hay under a burning sun, as it is liable to scorch and lose its nutritive value. Great care must also be taken to preserve the hay from dew and rain, as water washes away the soluble salts and other matters, and when in the stack will cause fermentation, which, if excessive, destroys some of the most valuable properties of the hay. Some farmers salt their hay in stacking; others do not. Salt is generally commended. A good plan, when the hay harvest has been accompanied by wet weather, is to place a few layers of straw in the stack at intervals to absorb the moisture from the heating hay. On large farms the spreading out of the hay after it is cut down is performed by a haymaking machine drawn by a horse, which will do the work of twelve or fifteen haymakers, and distribute the grass more thinly and evenly as it crosses the field. It is only for the haymaking of the true grasses, however, that it is adapted, as clover must not be shaken so violently. To be transported to markets at a distance, hay is now compactly pressed into bales by presses worked by hand or power. In fact baled hay has increased the importance of haymaking, owing to the readiness with which it can be transported by rail or water. On the Pacific Coast, especially in California, hay cut from alfalfa grass is very productive and profitable, and as many as three crops a year are frequently obtained. In the United States 61,691,166 acres of land were utilized in cultivating hay and forage in 1900, the entire crop amounting to 84,011,299 tons, valued at $484,256,846.

The average value per acre of the hay and forage crop is $8. Included in the above estimate were 4,750,353 tons of cornstalks which were cut from fields cultivated mainly for the grain. These figures for 1900 show an increase in area since 1889 of 8,742,369 acres, or 16.5 per cent, and in production of 12,420,466 tons or 18.6 per cent.

Of this total area, 6.7 per cent was devoted to clover, 50.7 per cent to tame and cultivated grasses other than clover, 6.3 per cent to grains cut green for hay, 5.1 per cent to forage crops, 3.4 per cent to alfalfa or lucerne, 2.8 per cent to millet and Hungarian grasses, and 25.1 per cent to wild, salt, and prairie grasses.

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Haydn, hā'dn, **Hiram Collins**, American clergyman: b. Pompey, N. Y., 11 Dec. 1831. He was graduated from Amherst in 1856, from the Union Theological Seminary in 1859, held pastorates at Meriden, Conn., and Painesville, Ohio, was pastor of the First Congregational Church of Cleveland, Ohio, in 1874–80 and again from 1884. He was also president of Western Reserve University in 1888–90, and published 'Lay Effort'; 'Death and Beyond'; 'The Bible and Current Thought'; 'The Face Angelic,' and other works.

Haydon, hā'dǒn, **Benjamin Robert**, English painter: b. Plymouth 26 Jan. 1786; d. London 22 June 1846. He had a passion for great historical subjects, and covered immense areas of canvas, but seldom rose beyond mediocrity excepting by exaggeration. His work was, however, admired by many of his contemporaries, including the poet Keats. Among his pictures may be mentioned: 'Judgment of Solomon' (1814); 'Christ's Entry into Jerusalem' (1820), now in Philadelphia; 'The Raising of Lazarus'; 'The Mock Election in the King's Bench'; 'Napoleon at St. Helena'; 'Alexander and Bucephalus'; 'Alfred and the Trial by Jury'; 'Uriel and Satan'; 'The Burning of Rome.' See Life by Taylor (1853).

Hayes, Augustus Allen, American chemist: b. Windsor, Vt., 1806; d. Brookline, Mass., 21 June 1882. He began his studies under Dana, and was successful throughout his career in improving the resources of applied chemistry to a remarkable extent. He was the first to extract the alkaloid sanguinarin from the blood root, *Sanguinaria Canadensis*. He also improved the common method of reducing pig to malleable iron and discovered new processes in copper-smelting. His researches led him also to a new rail or water. On the Pacific Coast, especially in California, hay cut from alfalfa grass is very productive and profitable, and as many as three crops a year are frequently obtained. In the United States 61,691,166 acres of land were utilized in cultivating hay and forage in 1900, the entire crop amounting to 84,011,299 tons, valued at $484,256,846.

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Hay'den, Ferdinand Vendeveer, American geologist: b. Westfield, Mass., 7 Sept. 1829; d. 22 Dec 1887. He was graduated from Oberlin College, Ohio, studied at the Albany Medical College, and during the greater part of 1853–62 was employed in surveys in the northwest. He served as surgeon in the Union army during the Civil War, and was professor of mineralogy and geology in the University of Pennsylvania 1865–72. In 1867–9 he made a geological survey of Nebraska, and was afterward director of the geological survey of the Territories of the United States, until in 1879 the various national surveys were combined in the geological survey of the United States. Till 1886 he remained at the head of the Montana division. He published many papers, besides numerous and valuable government reports, and was a member of many scientific societies at home and abroad.

Haydn, hā'dn (Ger. hī'dn), **Franz Joseph**, Austrian musical composer: b. Rohau, on the borders of Hungary and Lower Austria, 31 March 1732; d. Vienna 31 May 1809. He was sent to school at Hamburg at 6, where he learned reading, writing, singing by note, and to play on such instruments as his childish strength would admit of his handling. His voice attracted the notice of the parish priest, who recommended him as a choir-boy to the chapel-master of St. Stephen's in Vienna, and at 8 Haydn was received into the choir. With exception of some Latin and much practical music he seems here to have been taught nothing: in the theory and science of the art he received but two lessons from his master in eight years. At last in his 16th year, his voice began to break, and he lost his place and took up his abode in an attic in the Austrian capital, intending to live by his art. At that time the first six sonatas of Emmanuel Bach fell into his hands. «I could not leave my instrument,» he said in his old age, «until I had played them through; and any one who knows me must perceive how much I owe to Emmanuel Bach, that I studied him carefully, and comprehended him.» After a time he became acquainted with Metastasio, the greatest operatic librettist of the time. The poet had charge of the education of a Signora Martinez, and Haydn was employed to give her elemenary instructions in music. This afforded him an opportunity for mastering Italian, and what was of more immediate importance, procured him board and lodging. Metastasio introduced the struggling young artist to Porpora, a celebrated Italian musician, then in Vienna. As Porpora's accompanist he attracted the attention of Gluck and other masters, and his prospects from this time onward grew steadily brighter. He was often engaged to play at the musical entertainments given by the Austrian nobles, was appointed organist of two churches, sang tenor parts in the choir of another, and pupils became rapidly more numerous. He wrote a short comic opera, 'Der hinkende Teufel' (The Limping Devil), which was given three nights with applause, but owing to the satirical character of the libretto was forbidden by the police. Having now the means, Haydn purchased and studied the theoretical works of Emmanuel Bach, Mattheson, and Fux. In 1759 Count Morzin engaged him as music composer and director at a salary of 200 florins, with free lodgings and table with his secretaries and other officials. In 1761 he was appointed «chapel-master» or musical director to Prince Nicholas Esterhazy, in whose service he remained 30 years. Anything like a catalogue of his compositions during this time is impossible; much was destroyed on three separate occasions when his house was burned down, and much was scattered; but we know of 163 pieces for the baryton, an obsolete instrument in size between the viola and the violoncello; about 120 symphonies for full orchestra; more than 100 works of chamber music of the higher forms; and 12 Italian operas performed in his patron's private theatre. On the death of Esterhazy, in 1790, Haydn visited London, where the musical world received him with the greatest enthusiasm, and where he stayed 18 months. Here he produced an opera, the 'Orfeo,' nine symphonies, six quartettes, 11 sonatas, several songs and canzonets, and the accompaniments to more than 100 Scotch songs. He visited London a second time in 1794, his stay lasting a like period, and on his return to Vienna set about composing the music of an oratorio, the 'Creation,' the words adapted by Linley from Milton's 'Paradise Lost.' Haydn thought the text too long, and being not thoroughly acquainted with English, had it translated and curtailed by Baron von Swieten. It was produced 19 March 1799, when its author was in his 66th year. It obtained a great success, and he was induced to undertake the music of another text prepared from Thomson's 'Seasons.' This work wants the freshness and vigor of the previous work; which may have resulted in some measure from the barren unpoetical text. Consult: Pohl, 'Joseph Haydn' (1875); 'Mozart and Haydn in London' (1867); Karajan, 'Joseph Haydn in London' (1861); Reissmann, 'Joseph Haydn' (1879).

Haydn, hā'dn, **Hiram Collins**, American clergyman: b. Pompey, N. Y., 11 Dec. 1831. He was graduated from Amherst in 1856, from the Union Theological Seminary in 1859, held pastorates at Meriden, Conn., and Painesville, Ohio, was pastor of the First Congregational Church of Cleveland, Ohio, in 1874–80 and again from 1884. He was also president of Western Reserve University in 1888–90, and published 'Lay Effort'; 'Death and Beyond'; 'The Bible and Current Thought'; 'The Face Angelic,' and other works.

Haydon, hā'dôn, **Benjamin Robert**, English painter: b. Plymouth 26 Jan. 1786; d. London 22 June 1846. He had a passion for great historical subjects, and covered immense areas of canvas, but seldom rose beyond mediocrity excepting by exaggeration. His work was, however, admired by many of his contemporaries, including the poet Keats. Among his pictures may be mentioned: 'Judgment of Solomon' (1814); 'Christ's Entry into Jerusalem' (1820), now in Philadelphia; 'The Raising of Lazarus'; 'The Mock Election in the King's Bench'; 'Napoleon at St. Helena'; 'Alexander and Bucephalus'; 'Alfred and the Trial by Jury'; 'Uriel and Satan'; 'The Burning of Rome.' See Life by Taylor (1853).

Hayes, **Augustus Allen**, American chemist: b. Windsor, Vt., 1806; d. Brookline, Mass., 21 June 1882. He began his studies under Dana, and was successful throughout his career in improving the resources of applied chemistry to a remarkable extent. He was the first to extract the alkaloid sanguinarin from the blood root, *Sanguinaria Canadensis*. He also improved the common method of reducing pig to malleable iron and discovered new processes in copper-smelting. His researches led him also to a new formula for the production of chloroform. He was for many years employed by the State of Massachusetts as assayer.

Hayes, Isaac Israel, American arctic explorer: b. Chester County, Pa., 5 March 1832; d. 17 Dec. 1881. He was graduated in medicine at the University of Pennsylvania in 1832, and began his arctic experiences as surgeon in the second Grinnell expedition sent out under Captain Kane in 1853, in search of Franklin. Becoming convinced of the existence of an open polar sea, he was enabled to obtain funds for the expedition on which he sailed in the ship United States from Boston in 1860. He had two astronomers on board and according to their observations reached lat. 81° 35′ N., lon. 70° 30′ W., the farthest point north hitherto recorded in any voyage. In 1869 he made a voyage to Greenland. He received gold medals from the geographical societies of Paris and London. His published works comprise 'An Arctic Boat Journey' (1860); 'The Open Polar Sea' (1867); 'Cast Away in the Cold' (1868); and 'The Land of Desolation' (1872).

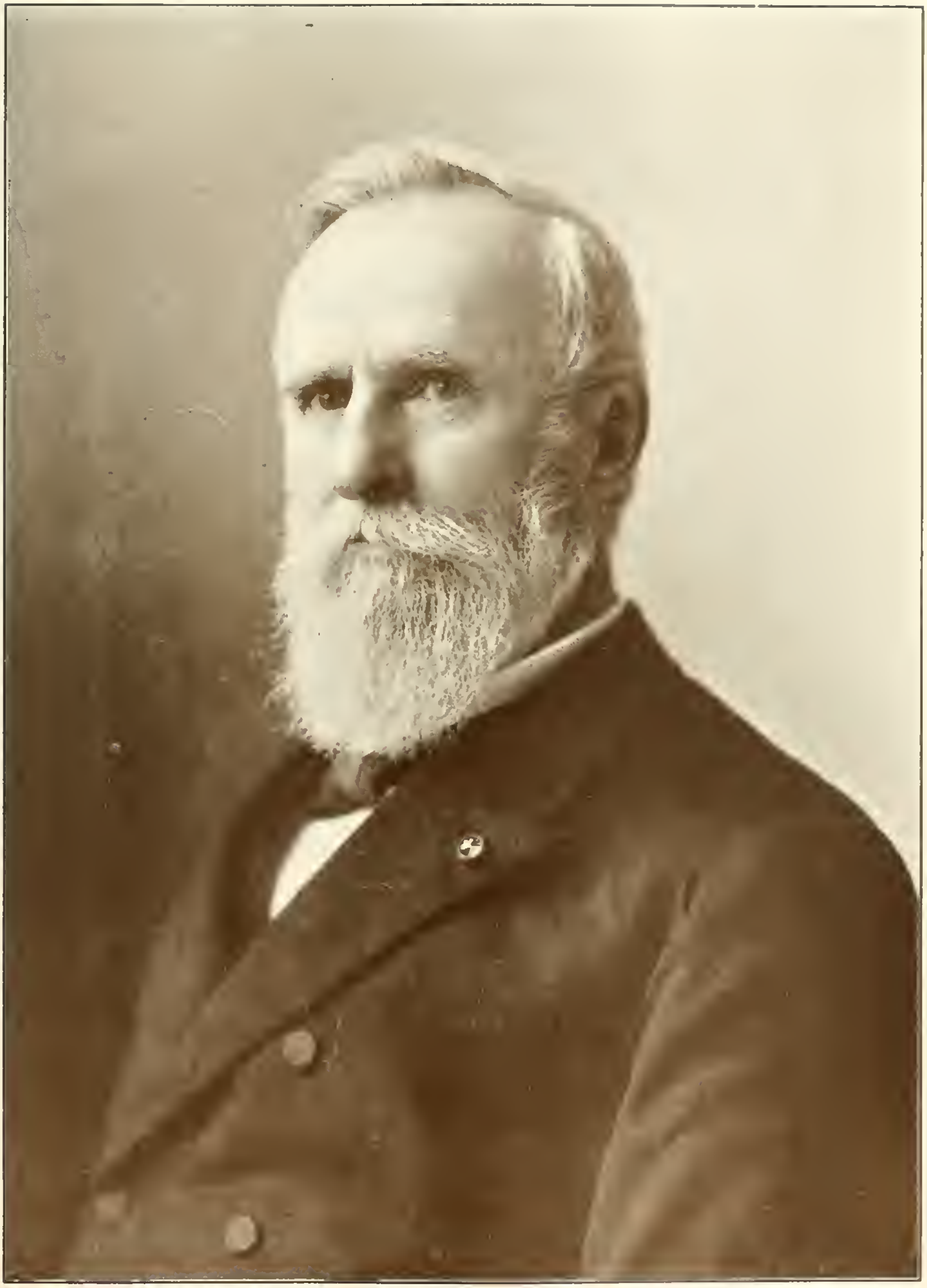
Hayes, Rutherford Birchard, 19th President of the United States: b. Delaware, Ohio, 4 Oct. 1822; d. Fremont, Ohio, 17 Jan. 1893. His early education was obtained in the common schools of Fremont and the academy at Norwalk, Ohio. At 16 he entered Kenyon College, from which he was graduated in 1842 as the valedictorian of his class. In 1843, he entered the law school of Harvard University and completed the course in 1845. He was admitted to the bar at Marietta, Ohio, and opened an office at Fremont; but, his health failing, he was compelled to go South, establishing himself later at Cincinnati (1849). His ability and industry soon gained recognition and secured him an excellent practice. He was city solicitor of Cincinnati from 1858 until April 1861, an office which brought him prominently before the people.

Hayes' military career began at the outbreak of the Civil War, when he was elected captain of a company formed from the old Literary Club of Cincinnati. A few months later, June 1861, he was appointed major in the 23d Ohio Volunteer Infantry, of which W. S. Rosecrans was colonel and Stanley Mathews, lieutenant-colonel. After the promotion and transfer of these two officers, the regiment was put under his command, and ordered at once to West Virginia; it took part in all of the important battles of Sheridan's campaign. In the battle of South Mountain he was severely wounded in the arm but soon recovered and returned to duty again. At the battle of Winchester, he made the famous charge across the swamp and saved the day. Many fell in that charge, but the day was won. He was no less courageous at Fisher's Hill and Cedar Creek. For meritorious service he was promoted to the rank of brigadier-general of volunteers and later brevetted major-general. He was nominated for Congress in his home district at Cincinnati, and in the fall of 1864, elected by a majority of 2,400; in 1866 he was re-elected. In 1867 he was nominated for governor of Ohio, by the Republicans; at that time a strong reaction against many of the policies of this party was felt in several States of the North, and the party itself in Ohio was divided into two factions. Hayes was one of the few men who could unite these factions, and he was elected by a small majority; and again chosen governor in 1869. At the close of his second term, he returned to Cincinnati determined to retire from public life; and in 1873 he moved to his old home at Fremont. In 1875, however, he was nominated for governor, and was with difficulty induced to accept the nomination. The great issue of the campaign was the money question, which though properly a national issue had been forced into State politics. There were those who believed and publicly contended that all that was needed to make money was the stamp of the government of the United States, that it was not necessary to have back of it any intrinsic value. Hayes, however, stood for "sound money," and after an active campaign won the election, thus becoming governor of Ohio for a third time.

When the National Republican Convention met at Cincinnati in 1876, a number of prominent leaders were candidates for the presidency. It soon became evident that none of the recognized candidates could be nominated and a "dark horse" was looked for. Thus it happened that Governor Hayes was nominated on the seventh ballot. The campaign which followed proved to be one of the most hotly contested in the history of the nation. The results were uncertain, and for the first time in our national life, a commission was created to pass upon the validity of the certificates which had been returned by the different States. This commission refused to go behind the returns of the different governors; and the votes of the Republican electors were therefore admitted from all of the doubtful States. This gave Mr. Hayes a majority of one in the electoral college, and he became the nineteenth President of the United States. (See ELECTORAL COMMISSION.) Two things were uppermost in his mind: the one, the improvement of the political condition of the South; the other, "the restoration of the civil service to the system established by Washington and followed by the early Presidents." In both of these, he was opposed by the machine politicians of his own party. In spite of this opposition, however, the troops were gradually withdrawn from the South and self-government re-established; the people were slow to see the need of civil service reform, and without effective support, the President could do little. He preserved his attitude in regard to sound money, and by his veto prevented dangerous financial legislation.

At the close of his administration, Mr. Hayes returned to private life. His interest in education was shown by the work done as a member of the boards of trustees of the Ohio Wesleyan University at Delaware and the Ohio State University at Columbus. Hayes' Hall at the latter institution bears his name because of his devotion to the cause of manual training. He was also president of the John F. Slater Educational Fund and gave much time to its proper distribution. As president of the National Prison Reform Association he did much to educate the public to a more humane way of thinking about the treatment of convicts, many of his public utterances have become maxims in prison management, and his work along these lines has been exceedingly valuable and permanent in its results.

Hayes River, called Hill River in the upper part of its course, rises near Lake Winnipeg, in Canada, and flows northeast through



RUTHERFORD BIRCHARD HAYES.

NINETEENTH PRESIDENT OF THE UNITED STATES

Oxford or Holy Lake, Knee Lake, and several other lakes, into James Bay, near the mouth of the Nelson River. The largest tributaries are the Shamattawa and the Fox. The length of the Hayes is about 300 miles.

Hayesine, hā'zīn, a hydrous borate of calcium, occurring as a sediment consisting of snowy-white, silky flakes, in the waters of hot springs in Chile. It is a somewhat uncertain species, and is perhaps to be referred in part to bechilite, and in part to ulexite. In the United States, specimens are reported from Bergen Hill, N. J. (Named in honor of A. A. Hayes (q.v.), an American chemist.)

Hay'good, Atticus Green, American Methodist bishop: b. Watkinsville, Ga., 19 Nov. 1839; d. Oxford, Ga., 19 Jan. 1896. He was educated at Emory College, Ga., of which he was president 1876–90, becoming in the last named year bishop of the Methodist Church South. He became bishop in 1890. He wrote: 'The Monk and the Prince,' a study of Savonarola and Lorenzo de Medici; 'Our Brother in Black' (1881); 'Pleas for Progress' (1889); etc.

Hay'market Square Massacre, the murder of several policemen in Chicago, 4 May 1886, by a bomb thrown by an anarchist. The labor troubles had long been exploited by the "practical" anarchists (with whom the philosophic anarchists disclaim connection), who denounced the efforts for shorter hours and better wages as tending merely to aggravate capitalistic slavery, and urged instead the general seizure of property and the murder of its owners. In February 1886 the McCormick Reaper Works had been closed on account of a demand for the expulsion of some non-union men, but had reopened. Meantime a great eight-hour strike had left some 50,000 unemployed workmen in the city, and in view of an almost certain conflict with the police, George Engel proposed at a meeting in Bohemian Hall on 2 May, and the meeting indorsed, a plan to blow up the police stations, shoot the emerging police, cut the telegraph wires, fire buildings to engross the service of the fire department, and make a general jail delivery, that the prisoners might aid in a social revolution. The next day August Spies and others incited a meeting of the Lumber-shovers' Union, 16,000 or more, principally Germans and Bohemians, to assail the McCormick Works in order to furnish an opportunity for carrying out this plan, though the works had no connection with this union. The mob attacked the works with stones and revolvers, but were driven off. No one was fatally injured, but Spies immediately issued a circular headed "Revenge!" asserting that six workingmen had been killed, and calling their brethren to arms. He also published a fierce article in his paper, the *Arbeiter Zeitung*, repeating the falsehood, and declaring that there had been a "massacre" to terrorize the workingmen, who should have had dynamite bombs instead of stones. In the evening a meeting was held at Greif's Hall, at which Engel's plan was adopted. Spies, Albert R. Parsons, Samuel Fielden, and Oscar W. Neebe spoke for a mass-meeting to further the plan above mentioned; at Adolf Fischer's suggestion it was fixed for next evening in Haymarket Square, that the dusk and the room for a great crowd might furnish more confusion and better means of escape. Rudolph Schnaubelt wished to have all socialists in other cities notified, so that there might be a general revolution. The signal was to be "Ruhe" (Peace), which was printed in next afternoon's *Arbeiter Zeitung*. Meantime Louis Lingg and others worked all day preparing bombs, of which the newspaper office was found to be an arsenal, along with firearms, and with a confederate carried a satchel of them to a place where others helped themselves. The air was full of rumors of intended violence, and the mayor (Carter Harrison, Sr.) ordered the police to mix with the meeting, and disperse it if incendiary language were used, and 176 were concentrated at the nearest station. Spies and Parsons spoke first, but the mayor was in the crowd, and they used mild language, till his suspicions were lulled and he left. Then Fielden began a frenzied and bloodthirsty harangue, calling for the "extermination" of the capitalists. The crowd grew so wild that shortly after 10 the police in four divisions appeared and covered the street, and while Fielden was speaking, Capt. Ward ordered the crowd to disperse. Fielden called out "We are peaceable" (curiously like "Peace"), and a bomb was at once thrown into the midst of the police, which exploded and caused frightful carnage, killing or mortally wounding eight policemen and injuring a great number more. The mob instantly followed it up with a volley from rifles and revolvers, proving that they had been expecting the signal, but the police, with a nerve as fine as that of trained soldiers, at once rallied and charged the mob, dispersing it in disorder. Most of the leaders who had been urging destruction either did not attend or ran away. Of the police, besides those killed, 68 were wounded by shot or bombs, many maimed for life. Spies, Parsons, Fischer, Engel, Lingg, Fielden, Michael Schwab, and Neebe were arrested and tried as accessories before the fact: the first four were hanged 11 Nov. 1887; Lingg shattered his jaw in prison with a bomb and died; Fielden and Schwab were sentenced to prison for life, and Neebe for 15 years. The last three were pardoned by Gov. Altgeld in 1893, many prominent men of Chicago and throughout the country having petitioned for their release on the ground that the evidence did not connect them with the actual throwing of the bomb, which was true, the evidence pointing strongly to Schnaubelt.

Hayne, Isaac, American patriot: b. South Carolina 23 Sept. 1745; d. Charleston, S. C., 4 Aug. 1781. He was a wealthy planter who took up arms after the invasion of the colony by the English forces, and after the capitulation of Charleston was paroled with the proviso that he might not be ordered to bear arms against his countrymen. He was summoned, however, to the English standard and refusing compliance as a violation of the compact, hastened to the American camp. Being shortly after taken prisoner by the English, he was tried and hanged.

Hayne, Paul Hamilton, American poet: b. Charleston, S. C., 1 Jan. 1830; d. Grovetown, Ga., 6 July 1886. He was a nephew of R. T. Hayne (q.v.) and was educated at the Charleston College, studied law and engaged in journalism. He served in the Confederate army till forced to resign on account of ill health, and lost nearly all his property through the bombardment of Charleston and the subsequent pillage. With the little left to him he retired to Copse

Hill, Grovetown, Ga., where he spent the rest of his life, a partial invalid. His verse is marked by grace and melody and he ranks almost the first among distinctively southern poets. He published 'Poems' (1855); 'Sonnets and Other Poems' (1857); 'Legends and Lyrics' (1872); etc. A complete edition of his poems appeared in 1882.

Hayne, Robert Young, American statesman: b. Colleton District, S. C., 10 Nov. 1791; d. Asheville, N. C., 24 Sept. 1839. After studying law he was admitted to the bar in 1812; and served in the second war with Great Britain, returning at its close to his practice in Charleston. He was a member of the State legislature 1814–18, and became Speaker, was attorney-general of the State in 1818–22, and a United States senator 1823–32. He vigorously opposed protection, and in 1832 boldly supported in Congress the doctrine of nullification. Daniel Webster's reply to Hayne upon this theme is classed among the former's ablest speeches. In November 1832 South Carolina adopted an ordinance of nullification, in December Hayne was elected governor, and the State prepared to resist the Federal power by force of arms. A compromise, however, was agreed to, and the ordinance was repealed. Hayne was mayor of Charleston in 1834.

Hayne, William Hamilton, American poet: b. Charleston, S. C., 11 March 1856. He is the son of Paul Hamilton Hayne (q.v.). He received a secondary education, from 1879 contributed extensively to various periodicals, and published 'Sylvan Lyrics and Other Verses' (1892).

Haynes, hānz, **Arthur Edwin**, American mathematician: b. Van Buren, N. Y., 23 May 1849. After graduation from Hillsdale College, Mich., in 1875 became instructor of mathematics and physics there in the same year: and was professor, 1877–90. He held the same position in Michigan Mining Schools in 1890–3, and was professor of mathematics at the University of Minnesota, 1893–6, and in its engineering department 1896–1901. He has published 'The Desirability of Uniformity in the Use of Mathematical Symbols and Terms': etc.

Haynes, John, American colonial governor: b. Old Holt, Essex, England: d. Hartford, Conn., 1 March 1654. He came with Hooker and his company to Boston in 1633, was soon after chosen assistant, and in 1635 governor of Massachusetts. In 1636 he removed to Connecticut, being one of the prominent founders of that colony. In 1639 he was chosen its first governor, and every alternate year afterward, which was as often as the constitution permitted, till his death. He was one of the five who in 1638 drew up a written constitution for the colony, which was finished in 1639, the first ever formed in America, and which embodies the main points of all our subsequent state constitutions, and of the Federal constitution.

Hays, Isaac, American physician and editor: b. Philadelphia 5 July 1790; d. there 12 April 1879. He was graduated from the University of Pennsylvania in 1816 and from its medical school in 1820. In addition to his long service as general practitioner he was for 52 years on the staff of the 'American Journal of the Medical Service.' In 1843 he established a monthly, the 'Medical News,' and in 1874 the 'Monthly Abstract of Medical Science.' He edited: 'Wilson's American Ornithology' (1828); 'Hoblyn's Dictionary of Medical Terms' (1846); 'Lawrence on Diseases of the Eye' (1847); and 'Arnott's Elements of Physics' (1848). He was president of the Philadelphia Academy of Natural Sciences (1865–9) and connected with many scientific societies at home and abroad.

Hays, William Jacob, American painter: b. New York 8 Aug. 1830; d. there 13 March 1875. He studied art under John Rubens Smith, and his 'Dogs in a Field,' exhibited in the Academy of Design in 1850, won him the reputation of an animal painter of remarkable fidelity to nature and spirit in design. He studied the bison in the upper waters of the Missouri and the deer in Nova Scotia. His 'Bison Bull at Bay' and 'Herd of Caribou in Nova Scotia' are characteristic pictures.

Hays, William Shakespeare, American song-writer and composer: b. Louisville, Ky., 19 July 1837; d. 23 July 1907. In 1857 he became a reporter for the Louisville *Democrat*, subsequently was clerk and captain of steamboats on the Ohio and Mississippi, and became marine editor of the Louisville *Courier Journal* and *Times*. He wrote and composed more than 300 songs, among them 'Nora O'Neil,' 'Write Me a Letter from Home,' and 'Shamus O'Brien'; and published 'Poems and Songs.' His songs sold very extensively.

Hays, Kan., city, county-seat of Ellis County; on Big Creek, and on the Union P. railroad; about 222 miles west of Topeka. It is in a fertile agricultural region. The chief manufactures are flour, dairy products, and machinery. It has grain-elevators, and there are large annual shipments of grain, flour, and live stock. It is the seat of a Normal school and of a State agricultural experiment station. The experiment station is connected with the State Agricultural College, which owns near Hays 2,000 acres of land. Pop. (1900) 1,136.

Hayti. See Haiti.

Hayward (properly "haw-ward," keeper of the haws or hedges, and still so pronounced, or rather as "howard," in country districts; the family name Howard as well as Hayward is from this), a town officer in old New England, whose duty was to keep the cattle on the roads from breaking through the hedges or fences into enclosed grounds and to impound them if they did so. The title came to be generic for a cattle-ward, and the hog-reeve was frequently known as a "hog howard."

Hayward, Wis., town, county-seat of Sawyer County; on the Namakagon River, and on the Chicago, St. P., M. & O. railroad; about 63 miles by rail southwest of Ashland. It is in the vicinity of the lumber region of the State, and the chief industry is lumbering. It has a government Indian school, a public library, and four churches. Pop. (1900) 2,720.

Hazard, hăz'ard, **Caroline**, American college president: b. Peacedale, R. I., 10 June 1856. She was educated in Providence and in Europe, and in 1899 was appointed president of Wellesley College, Mass., receiving the degrees of M. A. and Litt. D. from the University of Michigan and Brown University the same year. She is a granddaughter of R. G. Hazard (q.v.) and has published 'The Narragansett Friends' Meeting in the 18th Century' (1899); 'Thomas Hazard: a Study of Life in Narragansett in the 18th Century.'

Hazard, Ebenezer, American author: b. Philadelphia 15 Jan. 1744; d. there 13 June 1817. He was graduated from Princeton in 1762, in 1782–9 was postmaster-general, and from 1791 was in business in Philadelphia, where he assisted in the establishment of the North American Insurance Company. He published 'Historical Collections' (1792–4) and 'Remarks on a Report Concerning Western Indians.'

Hazard, Rowland Gibson, American manufacturer and philosopher: b. South Kingston, R. I., 9 Oct. 1801; d. Peacedale, R. I., 24 June 1888. He was a successful business man, being long engaged in the woolen manufacture in Peacedale. He also wrote on philosophical subjects; his works including 'Language, its Connection with the Constitution and Prospects of Man' (1836); 'Essays on the Resources of the United States' (1864); 'Causation and Freedom of Willing' (1869).

Haze, a condition of the atmosphere which deadens the blueness of the sky, and obscures the sharp outlines of distant objects. Haze is due to fine dust in the air or to extreme heat, the latter being known as heat-haze. In certain parts of China the haze is like a thin fog. Extensive forest fires create a smoke-haze, of a dense, blue color, which drifts like rain clouds hundreds of miles from the scene of the fire. Volcanic eruptions throw fine dust into the air in enormous quantities, forming a haze which is carried many hundreds of miles. See Dust.

Hazel-nut, or **Filbert,** a genus (*Corylus*) of shrubs and trees of the order *Cupuliferæ*, confined to the northern hemisphere. The male flowers are in long cylindrical aments or catkins; and the fruit, a nut, is marked at its base with a large cicatrix. The inflorescences of the hazel are developed in the year preceding their appearance; the male flowers last over the winter, naked; the female inflorescence is enclosed in a bud. In early spring the male catkins elongate and produce an abundance of dry pollen, while the female inflorescences are distinguishable from the leafbuds only by their larger size and projecting red stigmas. The nut is enveloped at the base by a sheath of succulent bracts.

The European hazel (*C. avellana*), from cultivation, has produced several varieties, differing in the size, shape, and flavor of the nuts, which are commonly known under the name of filberts. It grows in all situations, and is easily cultivated, but a light and tolerably dry soil is the most suitable. The best nuts come from Spain, where they are baked in large ovens before export, in order to ensure their preservation. Other species occur in southern Europe and Asia. The American hazel (*C. americana*) very much resembles the European, but is lower in stature. It is common in most parts of the eastern United States, but has not been cultivated. A second species (*C. rostrata*) occurs in California.

The oil which is obtained from hazel-nuts by pressure is little inferior in flavor to that of almonds, and chemists employ it as the basis of fragrant oils artificially prepared and used by perfumers, because it easily combines with and retains odors. In many parts of England hazels are planted in coppices and hedge-rows for several useful purposes, but particularly to be cut down periodically for charcoal, poles, fishing-rods, etc. In brewing, the dried twigs were used as a substitute for yeast when they were soaked in fermenting liquor. Being extremely tough and flexible, the branches are used for making hurdles, crates, and springles to fasten down thatch. They are formed into spars, handles for implements of husbandry, and when split are bent into hoops for casks. Charcoal made from hazel is much in request for forges, and when prepared in a particular manner is used by painters and engravers to draw their outlines. The roots are used by cabinet-makers for veneering; and in Italy the chips of hazel are sometimes put into turbid wine for the purpose of fining it. Finally forked twigs of the European hazel were formerly used by diviners to determine the position of water, gold, etc.

Hazeltine, hā'zĕl-tĭn, **Mayo Williamson,** American journalist and literary critic: b. Boston, Mass., 24 April 1841. He graduated from Harvard, studied also at Oxford, practised law until 1878, and was then appointed literary editor of the New York *Sun*. He became widely known as a critic for his reviews in the *Sun*, and has published in book-form: 'Chats about Books' (1883); 'British and American Education'; 'The American Woman in Europe.'

Ha'zen, Marshman Williams, American lawyer and author: b. Beverly, Mass., 1845. He was graduated from Dartmouth in 1866, from 1873 was a manager for the publishing firms successively of Ginn & Company and D. Appleton & Company, in 1882 was admitted to the Massachusetts bar, and in 1885 began the practice of law in New York. His publications include, besides a series of 21 school text-books: 'Observation, Thought, and Expression'; a 'History of the United States'; and 'Government.'

Hazen, William Babcock, American soldier: b. West Hartford, Vt., 27 Sept. 1830; d. Washington, D. C., 16 Jan. 1887. He was graduated at West Point in 1855, went to the front in the Civil War in command of 41st regiment of Ohio volunteers, which he himself had recruited in 1861, served actively in Ohio, Kentucky, and through the Atlanta campaign and in Sherman's march through Georgia, and in 1865, took command of the Fifteenth army corps. He observed the Franco-Prussian war on French territory, and was at Vienna as military attaché to the United States legation during the Turko-Russian war. Appointed chief signal officer in 1880, with the rank of brigadier general, he employed scientists as observers, introduced "cold wave" signals, and suggested the standard-time meridians at present in use. He published: 'The School and the Army in Germany and France, with a Diary of Siege Life at Versailles' (1872); 'Our Barren Lands' (1875); and 'A Narrative of Military Service' (1885).

Ha'zleton, Pa., a city situated in Luzerne County; on the Pennsylvania and the Lehigh Valley R.R.'s; about 24 miles south of Wilkes-Barre. The city was settled in 1820, incorporated as a borough in 1840, and chartered as a city in 1890. It is situated in the anthracite coal region, and its industrial interests are largely connected with the mining and shipping of coal. Its chief manufactures are foundry and machine-shop products, carriages, lumber, beer, baking-pans, cattle-powder, cigars, coffins and caskets. It has knitting mills, silk mills, three daily and eight weekly newspapers. It contains a State hospital for miners, 30 churches, three banks, a convent, high school, and Saint Gabriel's Academy. The government is vested in the mayor, who holds office three years, and in the council. The subordinate officials are appointed by the mayor, subject to the approval of the council. Some are elected by the council. Pop. (1890) 11,872; (1900) 14,230.

Hazlitt, hăz'lĭt, **William**, English critic and essayist: b. Maidstone, Kent, 10 April 1778; d. Westminster 18 Sept. 1830. In 1793 he became a student in the Unitarian College at Hackney. He devoted more time, however, to literature and art than to theology, and upon leaving college resolved to become a painter. He painted portraits with only tolerable success, and finally renounced art, and in 1805 opened his literary career with an essay 'On the Principles of Human Action,' in which much metaphysical acumen was displayed. In 1811 he settled in London, deriving his principal support from his contributions of political articles and theatrical and art criticisms to the newspapers, and his occasional lectures and publications. In 1813 he delivered at the Russell Institution a course of lectures on 'English Philosophy,' and subsequently delivered courses of lectures on the English poets generally, the comic poets, and the Elizabethan poets. Later in life he contributed to the 'Edinburgh Review' and some smaller magazines. He was a good art critic, but his tendency to prejudice and paradox, and his almost contemptuous regard for the productions of contemporary genius, render him a less safe authority than his knowledge and talents would lead us to expect. It is as a literary critic and essayist that Hazlitt achieved his chief success. Saintsbury has said that "long before Sainte-Beuve, Hazlitt had shown a genius for real criticism." He has probably not been surpassed by any English critic. Yet his recognition, in view of this fact, has been singularly inadequate to his merits. His judgment was, it is true, often marred by prejudice and by his paradoxes. But in the main it was discriminating and duly appreciative. His equipment might not now be thought adequate, but it was almost certainly in most respects superior to that of his Georgian contemporaries. He was able to write interestingly of a wide range of topics. He was bitterly attacked, after the custom of the times, by writers, particularly journalists, of adverse political views. But as a controversialist he was more than the equal of any of these, bold in epigram and invective. His style has been highly praised for its combination of vigor and ease, its rhythm, its clearness, and the aptness of its epithets. Not only in critical analysis, but as well in narrative and description it is excellent. Hazlitt also lectured in 1818–21 at the Surrey Institute. Northcote states that had he continued his art work he would have become a great painter. The best of his essays for the 'Examiner' appeared in 1817 under the title 'The Round Table.' The 'Spirit of the Age, or Contemporary Portraits,' also a significant work and by some critics considered his best, was published in 1825. Further essays are grouped in 'The Plain Dealer' and 'Sketches and Essays.' Among other well-known works of Hazlitt are: 'Characters of Shakspere's Plays' (1817); 'A View of the English Stage' (1818); 'Lectures on the English Poets' (1818); 'Lectures on the English Comic Writers' (1819); 'Lectures on the Elizabethan Age' (1821); 'Life of Napoleon Bonaparte' (4 vols. 1828). There is an edition of the 'Works' by Henley (1902); and a 'Life' by Berrell (1902).

Hazlitt, William Carew, English author: b. London 22 Aug. 1834. He is a grandson of William Hazlitt (q.v.). He was at first a civil engineer, relinquished that profession for journalism, and finally took up that of literature. Among his works are: 'History of the Venetian Republic' (1860); 'Bibliographical Collections and Notes' (1876–92); 'Memoirs of William Hazlitt' (1897); 'Four Generations of a Literary Family' (1897); 'Leisure Intervals,' poems (1897); 'Ourselves in Relation to a Deity and a Church' (1897); 'Coins of Europe' (1893–7).

Hazor, or **Chazor** (Heb., enclosure), the name of several places in ancient Palestine, the best known of which was the seat of Jabin, a Canaanitish king of considerable power, who, with his allies, was defeated by Joshua (Josh. xi. 1–13). Though it recovered and oppressed Israel, it was conquered a second time by Barak (Judges iv.) and remained in the possession of Israel until the invasion of Tiglath-pileser. Solomon made it a northern frontier fortress (1 Kings ix. 15). Its site has been variously placed, by many at Tell Hara, 2½ miles southeast of Kadesh. Consult the 'Journal of Sacred Literature' for 1866, p. 245.

Hazzard, David, American politician and jurist: b. Broadkiln Neck, Sussex County, Del., 18 May 1781; d. 8 July 1864. He served as an ensign in the War of 1812, was elected governor on the American Republican ticket in 1829, and subsequently was State senator and an associate judge. During his administration as governor, a constitutional convention was held at Dover, Del., by which among various revisions, the governor's term was changed from three to four years. Hazzard was a member of the constitutional convention of 1852.

Head, Barclay Vincent, English numismatic scholar: b. Ipswich, Suffolk, 2 Jan. 1844. In 1864 he became an assistant in the British Museum, where in 1893 he was made keeper of the department of coins and medals. He was also appointed joint-editor of the 'Numismatic Chronicle.' His chief work is the 'Historia Nummorum' (1887), a valuable study, and the standard one in its department. Among further publications by him are: 'History of the Coinage of Bœotia' (1881), and 'Guide to the Coins of the Ancients' (1881).

Head, Sir Edmund Walker, English colonial administrator and author: b. near Maidstone, Kent, 1805; d. London 28 Jan. 1868. He was educated at Oriel College, Oxford, became a fellow of Merton, studied law, was a poor-law commissioner in 1841, and in 1847–54 lieutenant-governor of New Brunswick. From 1854 to his retirement in 1861 he was governor-general of Canada. During his administration Ottawa was chosen as the capital of Canada, the Victoria bridge at Montreal was constructed, and the seigniorial tenures (see CANADA — SEIGNIORIAL TENURE) and the clergy reserves (see CANADA — THE CLERGY RESERVES) were abolished. In 1863 he was appointed a civil-service commissioner and in 1867 a privy councillor. He was an art critic of some importance, and published a 'Handbook of Painting of the German, Dutch, Spanish, and French Schools' (1848), and other works. His poetical contributions to 'Fraser's Magazine' appeared in 1868 in book-form.

Head, SIR Francis Bond, English colonial administrator and author: b. near Rochester, Kent, 1 Jan. 1793; d. Croydon, Surrey, 20 July 1875. Educated at Woolwich, he became first lieutenant of engineers in 1811, was at Waterloo and at Fleurus, retired from the army in 1825, and went to South America as a prospector in gold and silver mines. Of some of his experiences there he gave an account in 'Rough Notes of a Journey in the Pampas and Andes' (1828). In 1835 he was appointed lieutenant-governor of Upper Canada. His administration was a decidedly unfortunate one. Unfamiliar with the political status of the country, he opposed the union of the provinces, and endeavored to conduct the government without the assistance of a council. This state of affairs may be regarded as the chief cause for the part taken by Upper Canada in the insurrection of 1837. His numerous publications include: 'Bubbles from the Brunnen of Nassau' (1833); 'The Defenceless State of Great Britain' (1850); 'The Horse and His Rider' (1860); 'The Royal Engineer' (1869).

Head, SIR George, English writer of travels, etc.: b. Higham Parish, Kent, 1782; d. 1855. He held various posts in the army, and was present at most of the great battles of the Peninsular. In 1814 he proceeded to Canada to be chief of the commissariat of a proposed navy on the Canadian lakes, and subsequently published his experiences in 'Memoirs of an Assistant Commissary-General' and 'Forest Scenes and Incidents in the Wilds of North America.' He was knighted in 1831 by William IV. He also wrote 'Rome, a Tour of Many Days'; 'A Home Tour Through the Manufacturing Districts of England,' and 'A Tour Through Various Parts of the United Kingdom' and other works.

Head, Natt, American politician: b. Hookset, N. H., 20 May 1828; d. there 12 Nov. 1883. He became a railroad and general building contractor, sat in the State legislatures of 1861 and 1862, was adjutant-general of the State in 1864–70, and in that capacity published a four-volume military record of New Hampshire during the Civil War. In 1876 and 1877 he was elected to the State senate and in the latter year was its president. He was governor in 1879–80.

Head, the anterior part of the body of an animal when it is marked off by a difference in size, or by a constriction. The presence or absence of a head was formerly much used as a character in classification. But this line of classification is artificial. The mouth and principal nervous organs are the guides to the anterior end of the body, where the head, when recognizable, is situated. In the protozoa, infusoria, and cœlenterates, such as the hydra and corals, there is no nervous ganglion, and the mouth is not surrounded by special structures. In the inferior vermes the anterior end becomes marked by the presence of ganglia. The so-called head of parasitic animals, such as the tapeworms, is only the end of attachment, but neither mouth nor ganglia exist in it. In the polyzoa, lampshells, ascidians, and lamellibranch mollusks mouth and ganglia exist, but they are not surrounded by special structures. But in the worms proper, the articulated animals, the land and fresh-water gasteropods and the cuttlefishes a head proper is found. That is, the mouth and the anterior nervous ganglia are placed in a segment of the body which, by structure, is different from the rest. Thus in the worms and articulated animals some of the rings or articles of which the body is made up are fused together, the appendages being not walking limbs, but modified into jaws or jaw-like organs. Thus the common shoreworms possess a structural head, though it is not apparent. The head is best defined in the insects. The snail's head has its cavity shut off by a diaphragm from the rest of the body cavity. The cuttlefishes have, in addition, a remarkable cartilaginous box, which, like a skull, protects the ganglia and gives support to the muscles. The head of the vertebrated animals presents a regular series of increasing complexity from the amphioxus upward. In that fish the most anterior part of the nervous cord is lodged in a canal scarcely distinct from that which contains the rest of it. Ascending in the series, it becomes evident that as the anterior nervous mass enlarges, and its ganglia increase in complexity, the anterior vertebræ change their character; as the brain becomes specialized, so does the brain-case or skull. In man the brain attains its highest development and the head its greatest complexity, the difference between skull and face being now most pronounced. The vertebrate theory of the skull, first propounded by Goethe, is now accepted to this extent, that the skull or cranium consists of three vertebræ, which are recognizable in the fish, and that the facial bones are not vertebræ, but developed from cartilage which did not form an original part of the vertebral column. A vertebra consists of a body or centre, from which two processes arch upward and close in the spinal canal with its contents, the spinal cord. The posterior cranial vertebra is the occipital, consisting of a centre, two lateral pieces, and a superior, the next is the parietal, of which the basisphenoid is the centre, and the great wings of the sphenoid and the parietals the lateral arches; the most anterior is the frontal, with its centre, the presphenoid, and its arch, formed by the orbital plates of the sphenoid and the frontals. The centres of the spinal vertebræ are ossifications around a fibro-cartilaginous rod, the *chorda dorsalis*, which ends in the basisphenoid. So far spinal column and skull have a common base; but the spinal vertebræ were preceded by and are in fact modifications of primitive vertebræ, and no representatives of these appear in the development of the skull. It is therefore open to question whether the three divisions just mentioned are really vertebræ, or should not rather be called cranial segments. There is the more reason for this that in fishes the basisphenoid and presphenoid are represented by a single bone, the parasphenoid, which underlies the skull, but disappears in the higher vertebrates, and that the presphenoid is not properly connected with the chorda dorsalis, but rather belongs to the series of facial bones. The pituitary body which projects from the lower surface of the brain lies in front of the end of the chorda dorsalis: from this latter rod and its surroundings a plate of cartilage passes forward on either side of the pituitary body, and these (the *trabeculæ*) meeting in front of that body, form the cartilaginous axis around which the vomer, ethmoid, and other facial bones are developed, while the presphenoid is an ossification in this axis just where the two portions meet in front of the pituitary. The sense organs, the ear and the eye, are, so to speak, lodged in capsules of bone which are inserted, the ear between the occipital and parietal, the eye between the parietal and frontal segments. They are accidental, not essential parts of the cranium. The hyoid apparatus and the lower and upper jaws are developed from the cartilaginous walls of the embryonic skull, and the jaws come in a secondary manner to take part in the composition of the face. (See RESPIRATORY ORGANS.) The increasingly globular form of skull in the vertebrates is due to the greater increase of the cerebral hemispheres relatively to that of the base of the brain and axis of the skull; hence the brain comes in man to overhang the face. Of course it is to be remembered that while in the vertebrated animals the head is divided by its axis (commencing at the middle line of the upper jaw, and passing backward through the basisphenoid to the vertebral centres) into an upper chamber, lodging the brain, and a lower, lodging the first part of the alimentary canal; in the lower animals the cavity is a single one, the œsophagus piercing the nervous system so as to reach the surface of the body, and thus coming to be surrounded by a pair of ganglia above and a pair below, with the filaments connecting these ganglia. In the vertebrate the head is curved downward, the basisphenoid being the pivot point, so that the mouth is pushed to the lower surface: in the lower animals the under surface of the body curves upward, so as to carry a part of the nervous system past the mouth toward the upper surface. The eyes and feelers of a crab are in fact modified limbs which are thus carried upward: the jaws and sense organs of a vertebrate are entirely distinct from the limbs and other appendages of the trunk.

DIAGRAM, ILLUSTRATING GŒTHE'S THEORY OF THE VERTEBRATE HEAD.

NASAL.	FRONTAL.		PARIETAL.		OCCIPITAL.	
Nose.	Frontals.	EYE.	Parietals.	EAR.	Supraoccipital.	*Arches.*
Ethmoid and Prefrontal.	Orbitosphenoids.		Alisphenoids.		Exoccipitals.	
Vomer.	Presphenoid.	*Pituitary.*	Basisphenoid. Parasphenoid.		Basioccipital.	*Centra.*
Upper jaw. *Mouth.* Lower jaw.		Suspensorium.	Hyoid.			

Head-hunting. See DYAKS.

Head Money, an immigration tax of 50 cents levied by act of Congress 3 Aug. 1882 on every foreigner brought to the United States. Before the passage of this act the State of New York levied a "head tax" on all immigrants arriving at New York, the funds going to the support of the State board of immigration. A test of the legality of the tax being made in the courts, a decision was rendered that the New York statute was void because it infringed on the prerogatives of national government. Subsequently the act of Congress imposing the tax was questioned in the United States Supreme Court, and a decision affirming the constitutionality of the law was made. The national act provides that the tax shall be paid by the master or owner of the vessel bringing the immigrants, to the collector of the port, and by him turned over to the treasury of the United States, to be used by the secretary to defray the expenses of regulating immigration and to relieve immigrants in distress. See IMMIGRATION.

Headache, pain in the head, the result of a variety of causes. It may arise from overfulness of blood, from deficiency of blood or debility, from excited or inflammatory action, from the nerves, etc. If a person who suffers from headache is of full habit generally; if he is sleepy, dull, the vessels of his face full; overfulness is the probable cause, and reduction of the diet, with occasional doses of saline medicine, exercise, bathing the head with cold water, will be beneficial. If the urine is deficient, cream of tartar in some form may be taken with advantage. The above species of headache may also be occasioned by whatever impedes the circulation, such as affection of the heart or liver; when the latter is the case, the pain is frequently most severe at the back of the head. When, on the other hand, headache occurs in a person of weak constitution; when it is produced or aggravated by mental over-exertion; when there is listlessness both of mind and body rather than oppression — the face pale, the pulse weak — debility is the probable cause. This form of headache is often accompanied with indigestion, and is common in students and anxious men of business. Anything like abstraction of blood will certainly prove injurious. Exercise, attention to the state of the bowels, care in diet, rest, and change of scene and air, will be most useful. Headache from excitement or inflammatory causes is such as occurs in the first stages of inflammation of the brain and in some forms of fevers, or it follows violence to the head. Of all kinds of headache that arising from some disorder of the stomach is, however, the most common. The presence of indigestible food in the stomach almost certainly causes dull pain in the forehead; and too acid a condition of the contents of the organ produces the same effect. The various symptoms of indigestion will generally point to the cause. In the first some aperient, such as a saline draught, will probably remove the disorder. When acid eructations, heartburn, etc., indicate the presence of superabundant acid, a dose of soda, potash, or magnesia will correct the cause. There is a form of headache which consists in throbbing and pain of one part, or sometimes over one side of the head. This is called hemicrania (the migraine of French and the megrim of old English writers), and is often of a distinctly intermittent character. For its permanent cure quinine is in common use; a mustard poultice on the nape of the neck is also of service; and antipyrin has proved of value in affording relief. It should be well understood that the habitual use in headache of strong and swiftly working drugs is likely to undermine the nervous system, and increase liability to attack. Exercise, moderation and cheerfulness are the best preventives.

Headley, hĕd'lĭ, **Joel Tyler,** American historian: b. Walton, N. Y., 30 Dec. 1813; d. Newburg, N. Y., 16 Jan. 1897. Graduated from Union College in 1846, he took a course in theology at the Auburn Seminary, was pastor at Stockbridge, Mass., and in 1846 became assistant editor of the New York *Tribune*. In 1856–7 he was secretary of state for New York. His works, written in a popular vein, had great currency in their day, and include: 'Napoleon and his Marshals' (1846); 'Washington and his Generals' (1847); 'The Adirondacks' (1849), said to be the first book to advocate that region as a health-resort; 'Grant and Sherman, their Campaigns and Generals' (1865); and 'The Great Rebellion' (1864).

Headley, Phineas Camp, American Congregational clergyman: b. Walton, N. Y., 24 June 1819; d. Lexington, Mass., 1903. He was a brother of J. T. Headley, the historian (q.v.). He was admitted to practice at the bar in 1847, but studied theology at Auburn Seminary, held pastorates in various Presbyterian and Congregational churches, and contributed to the New York 'Observer' and *Tribune*, and many other newspapers and magazines. Among his works are: 'Women of the Bible' (1850); biographies of the Empress Josephine (1851), Kossuth (1852), Lafayette (1853), Mary, Queen of Scots (1856), Ericsson (1863), Farragut (1864), and others; 'Half-Hours in Bible Lands' (1867); 'Court and Camp of David' (1868); and 'Public Men of To-day' (1882).

Healy, George Peter Alexander, American painter: b. Boston 15 July 1808; d. Chicago 24 June 1894. He went to Paris about 1836, where he remained several years, alternating his residence there with occasional visits to the United States. Among works executed by him abroad are portraits of Louis Philippe, Marshal Soult, and Gen. Cass. At home he painted Calhoun, Webster, Pierce, and other prominent American statesmen. He occasionally produced large historical pictures, of which 'Webster's Reply to Hayne,' illustrating a well known scene in American legislative history, completed in 1851, now hangs in Faneuil Hall in Boston. At the exhibition of Paris in 1855 he exhibited a series of 13 portraits and a large picture representing Franklin urging the claims of the American colonies before Louis XVI., for which he received a medal of the 2d class. Portraits by him of Buchanan and Lincoln are in the Corcoran Gallery at Washington.

Healy, Timothy Michael, Irish political leader: b. Bantry, County Cork, Ireland, 17 May 1855. He was elected to Parliament for Wexford in 1880, County Monaghan in 1883, South Londonderry in 1885, North Longford in 1887, and County Louth, North, in 1895. In 1884 he was called to the Irish bar. He became known as a leader of the Irish Nationalist party, was a founder of the Dublin 'National Press' (later combined with the 'Freeman's Journal'), and was repeatedly in difficulties because of his public utterances on political matters. He made a lecture tour of the United States with Dillon and Parnell in 1880, and in 1881 participated in the Land League convention at Chicago, when $250,000 were contributed to the Irish cause. The 'Healy Clause' of the Land Act of 1881, providing that no tenant should pay rent on improvements made by him, was introduced by him. He wrote 'A Word for Ireland' (1886).

Heap, David Porter, American engineer: b. San Stefano, Turkey, 24 March 1843. He studied at Georgetown (D. C.) College, was graduated from the United States Military Academy in 1864, served in the Civil War with the engineer corps of the Army of the Potomac, and was brevetted captain for his services. In 1895 he attained the grade of lieutenant-colonel of engineers. He was for years employed in the construction of fortifications and the improvement of harbors, and in 1881 was military representative of the United States at the Paris congress of electricians. In addition to a 'Report on the International Exhibition of Electricity at Paris' (1884), he published: 'Ancient and Modern Light-Houses' (1889); 'Electrical Appliances of the Present Day'; 'Engineer Exhibit, Centennial Exhibition' (1882); and 'History of the Application of Electricity to Lighting the Coasts of France' (1885).

Heard, Franklin Fiske, American jurist: b. Wayland, Mass., 17 Jan. 1825. He was graduated at Harvard in 1848; was admitted to the bar in 1850; and practised in Middlesex County and later in Boston. He attained a reputation as an authority on pleading, and in 1861–6 was an editor of the 'Monthly Law Reporter.' His publications include: 'Libel and Slander' (1860); an edition of 'Stephen on Pleading' (1867); standard books on 'Criminal Pleading' (1879) and 'Civil Pleading' (1880); 'Heard on Criminal Law' (2d. ed 1882); 'Shakespeare as a Lawyer' (1883); 'Precedents of Equity Pleadings' (1884); 'Precedents of Pleadings in Personal Actions in the Superior Courts of Common Law' (1886).

Hearing, one of the five senses, the physical organ of which is the ear. (See Ear, Acoustics.)

Hearn, hėrn, **David William,** American Roman Catholic clergyman and educator: b. Boston, Mass., 21 Nov. 1861. He was graduated at Boston College in 1880; took post-graduate courses in literature, science and philosophy for five years, and theological courses for four; entered the Society of Jesus, and was ordained priest of the Roman Catholic Church. He was successively professor in Georgetown University, vice-president of Boston College, and vice-president of the College of Saint Francis Xavier, New York. In 1900 he became president of Saint Francis Xavier.

Hearn, Lafcadio, American author: b. Santa Maura (Leucadia), Ionian Islands, 27 June 1850; d. Tokio, Japan, 26 September 1904. Educated in England and France, he came to the United States in 1869, was a journalist in Cincinnati and New Orleans, in 1887–9 was at Saint Pierre, Martinique, French West Indies, and in 1890 went to Japan. He became a Japanese subject with the name Yakumo Koizumi, and was appointed lecturer in English literature at the Imperial University of Tokio. His 'Stray Leaves from Strange Literature' (1884), and 'Some Chinese Ghosts' (1887), were succeeded by 'Chita: A Memory of Lost Island' (1889), story of the destruction of "L'Ile Dernière," once the watering-place of Louisiana fashion, which attracted attention by its descriptive powers; and 'Two Years in the French West Indies' (1890), which gained new interest through the Martinique disaster of 1902. Among his further works, dealing almost exclusively with things Japanese and revealing a thorough comprehension of and sympathy with the art, myth, tradition, and philosophy of the Orient, are: 'Out of the East' (1894); 'Glimpses of Unfamiliar Japan' (1895); 'Kokoro' (1896); 'Gleanings in Buddha-Fields' (1897); 'Exotics and Retrospections' (1898); and 'Kottō, or Japanese Curios' (1902).

Hearst, Phoebe Appersin, American philanthropist: b. 1840. She was for a time a teacher, and in 1861 married George F. Hearst of California. She has been active in charitable and philanthropic enterprises and has given largely, especially to educational institutions. In San Francisco she has established kindergarten classes for the children of the poor, and a manual training school, and has organized a number of working girl's clubs. She has also given money to build a National Cathedral School for girls; has made donations to the American University at Washington; has established and given largely to public libraries in the mining towns of the West; and maintained a school for mining engineers at the University of California. In 1896 she offered to pay the expenses of an international competition of architects to obtain a suitable plan for a campus and buildings for the University of California, and to erect two buildings in accordance with this plan. See CALIFORNIA, UNIVERSITY OF.

Hearst, William Randolph, American newspaper publisher: b. San Francisco. He was graduated from Harvard, and on leaving college took charge of the publishing of the San Francisco *Examiner*, formerly owned by his father, Senator Hearst of California. In 1895 he bought the New York *Journal*, the name of the morning edition of which he later changed to the *American*; in 1900 he started the Chicago *American*; in 1904 the Boston *American* and the Los Angeles *Examiner*. In 1902 he presented the Greek Theatre to the University of California. He represented the 11th Congressional District (New York) in the 58th and 59th Congresses. In 1905 he was defeated for the office of Mayor of New York City and in 1906 for Governor.

Heart, The. The heart and the blood-vessels constitute the mechanical means for maintaining the circulation of the blood. In many respects this system is the most readily understood of any in the body, in that it is largely mechanical. There are, however, certain factors not existing in an ordinary system of hydraulics which, while essential to the proper performance of the function in the human body, render the understanding of the subject more difficult. The heart is merely a pump, or rather two pumps fused, for convenience, into one. It derives its power through contraction of the red muscle which forms its wall. It is hollow, alternately filling and emptying, receiving blood from one set of tubes filling its cavities, then emptying its contents into other tubes by contraction of its walls and momentary obliteration of its cavities. The action is analagous to that of the ordinary bulb syringe. The proper direction of the flow of the blood is maintained by valves, similar in structure and like in function to the valves in an ordinary pump.

The heart is about the size of the closed fist. The average dimensions of the adult organ are: length 85–90 millimetres in the male, 80–85 mm. in the female; breadth, 92–105 mm. in the male, 85–92 mm. in the female; thickness, 35–36 mm. in the male, 30–35 mm. in the female. The average weight in men is 300 grams; in women 250 grams. The heart is cone-shaped with the base uppermost. It lies within the cavity of the bony chest, a small portion of its anterior surface being in contact with the chest-wall, the rest covered by the overlapping lungs. The apex of the cone, or "apex," as it is technically called, is in the space between the fifth and sixth ribs on the left side, about 2 centimetres to the inside of a vertical line drawn through the left nipple. The heart reaches no lower and no farther to the left than this. From this point it reaches upward to the second rib, two thirds of its mass being to the left of the middle line of the body, one third to the right. Its long axis is neither vertical nor horizontal but is inclined to an angle of about 30 degrees to the horizontal, hence 60 degrees to the vertical. Therefore it is nearer horizontal than vertical. The position of the apex of the heart can be readily determined by placing the finger in the interspace mentioned and feeling the beat. In the healthy individual when not under excitement of the emotions or exercise no motion of the heart can be felt by the finger upon the chest-wall except at the apex.

Of secondary importance only to the heart is the system of tubes conveying the blood: arteries, capillaries, veins. The arteries are thick-walled, elastic tubes, dividing and subdividing into smaller tubes, but the total sectional area increases as the vessels become smaller in diameter. These end in a fine network of very small, thin-walled tubes called from their resemblance in size to hairs, capillaries. These in turn become veins, enlarging their diameter and diminishing their number, thus reversing the process in the arteries. Veins have very thin walls in proportion to the diameter of the bore and are provided with valves to prevent a back flow of blood.

This arrangement of the blood-vessels may be likened to two cones, base to base, one apex representing the largest artery leaving the heart, the other apex the largest vein entering the heart, and the bases of the cones the wide capillary system. The flow of blood will be naturally fastest in the larger arteries and veins, slower in the smaller arteries and veins, and slowest in the capillaries, due to the fact already mentioned that as vessels divide although the branches are smaller in diameter the combined sectional area is larger. The condition is quite like that of the flow of water in a river, the current being swiftest where the banks approach each other, slowest where the river widens into a lake or pond, again to become swifter as the width of the stream lessens.

The two pumps which compose the heart as a single whole are called the right heart and left heart. This designation takes its origin from the fact that one is more to the right side of the body, the other to the left side. Ordinarily the two parts are spoken of as the right side and the left side. The left side is by far the more powerful pump, having a very thick wall, its function being to force the blood under considerable pressure through most of the body, the so-called systemic circulation. The right heart has merely to force the blood through the lungs, a relatively short distance and under low pressure.

Each half of the heart has two cavities, a thin-walled one called the auricle for receiving the returning blood poured into it from the veins, and a thick-walled one called the ventricle which receives the blood from the auricle through an orifice guarded by a valve. The function of the ventricle is to force the blood by contraction of its muscular wall into the arteries through a connecting orifice also guarded by a valve. These four chambers are called the right auricle, right ventricle, left auricle and left ventricle. The walls of the auricles are composed of red muscle and are quite thin, the work required of them being but slight, that is, they force the blood under slight resistance. The walls of the ventricles are also made up of red muscle fibres, the outer surface being smooth, the inner surface crossed by a network of beams of muscle called the trabeculæ. The thickness of the wall of the right ventricle between the trabeculæ is from 2 to 3 millimetres; of the left ventricle 7 to 10 millimetres. The capacity of each ventricle is about 100 cubic centimetres, that is, it forces out about this amount at each contraction.

The function of the valves is to permit the flow of liquid in one direction and to prevent its flow in the opposite direction; in other words, their presence enables a pump to maintain a flow of liquid in one direction with little or no back flow.

The heart has four valves, one between each auricle and ventricle, and one in each ventricle at its point of connection with its outgoing artery. The valve between the auricle and ventricle of the left heart is called the mitral, from its resemblance to a bishop's mitre; that between the right auricle and right ventricle is called the tricuspid from its having three folds or cusps. The left ventricle is connected with the systemic circulation by the great artery called the aorta, its guarding valve is called the aortic valve. The right ventricle is connected with the circulation through the lungs by the pulmonary artery, its valve is called the pulmonic valve. The aortic and pulmonic valves are each composed of three cups of thin, flexible tissue fastened to the inner wall of the blood-vessel, their edges hanging free, and capacious enough to meet in the middle of the orifice they guard. When the ventricles contract, the blood within them under pressure tends to escape through any orifice, it presses upon these cups, forcing them against the walls of the orifice leading to the aorta and pulmonary artery respectively, leaving an opening of full size. In other words they offer no obstruction to the flow of blood in this direction. When, however, the muscle-wall by its contraction has emptied itself of blood through the orifices just mentioned it begins to relax, thus enlarging the cavity of the ventricle. Were there nothing to prevent, the blood just forced into the aorta and pulmonary artery under considerable pressure would flow back again into the relaxing ventricle, and so it does to a very slight degree, but this very back flow fills these three cups with blood, causing them to meet in the middle of the orifice, thus completely blocking it so far as any return of blood is concerned, and what blood has been forced into the aorta and pulmonary artery remains there to be carried on still further with the next contraction of the heart.

The mitral and tricuspid valves are simply flat folds or curtains attached to the edges of the orifices between auricles and ventricles. They are thrown back upon the inner walls of the ventricles while the blood is flowing from the auricles into the ventricles, offering little or no resistance to the flow, but when the flow of blood is in the opposite direction, that is, when the ventricles contract, they are floated upward till the free edges come in contact, thus blocking the orifice. The flaps are prevented from going too far by delicate tendinous cords attached to the free edge of the valves at one end and to the inside of the heart wall at the other end. They play the same part that sheets do for a sail. It will thus be seen that while one set of valves — mitral and tricuspid — is closed, the other set — aortic and pulmonic — will be open, and vice versa.

The period of active contraction of the ventricles is called the systole, and its time is often spoken of as the systolic period. The period of dilatation of the ventricles, the time during which they fill with blood from the auricles, is called the diastole or diastolic period. In time the two are nearly equal, the diastole being somewhat longer.

The cause of the heart beat is a matter of great interest. Inasmuch as the skeletal muscles require for contraction a stimulus carried to them through nerves, it was thought that heart muscle required a similar nerve impulse. It was known to physiologists that the heart of a frog severed from its connections went on beating in spite of there being no nerves attached to it to convey an impulse from without. Then certain nerve ganglia were found in portions of the heart wall and it was inferred that these gave out the necessary stimulus. But finally it was found that isolated portions of the heart wall in which there were no nerve ganglia continued to beat if they had a blood supply. Hence it was concluded by Gaskell that the beat of the heart must be due to an inherent rythmical power of the ventricle; the stimulus to the muscle probably residing in some chemical substance in the blood coming to the part. At any rate the ganglion theory is no longer held, while the latter is considered the probable one.

The sounds associated with the periods previously described are readily heard by anyone placing the ear over the heart of another person, or with a stethoscope the individual may hear his own heart sounds. The contraction of the ventricles occurs at the time the impulse is seen and felt over the apex of the heart in the fifth interspace. It is associated with a booming sound, loud and distinct. Then comes a short period of silence corresponding to the time when the heart muscle ceases its contraction and begins to relax. Then comes a very short, sharp, flapping sound due to the closure of the valves which prevent the return of the blood from the aorta and pulmonary artery to the ventricles. Then follows a longer period of silence and again a repetition of the same set of sounds. The time from the beginning of the first sound to the beginning of the second sound, that is, the time of the "boom" and its short silence, is the systole of the ventricle. The time from the beginning of the second or short, sharp sound through the period of silence following it is the diastole of the ventricle. The whole period occupied from the beginning of the first of the sounds described to its repetition is called a cycle of the heart. Of these there are on an average in an adult 72 per minute. When the successive cycles occupy the same length of time the rhythm is said to be "regular." When the times are unequal the term "irregular" is used. When a beat is dropped the term "intermittent" is applied.

If, when the ear is placed over the heart, the finger be placed over the artery in the wrist, an impulse or beat will be felt in the latter, occurring at a slightly later time, about one sixth of a second, than the apex beat. This is the pulse wave corresponding to that individual heart beat. It varies in frequency, in volume and in tension according to the number of heart beats, the volume of blood thrown into the arteries from the heart, and the tension or tone of the arterial wall. The latter point will be explained later.

The course of the blood after leaving the left ventricle is through the aorta and its branching arteries to the arms and legs and to all the organs of the body, except the main supply to the lungs, through capillaries; thence it is returned by the veins to the right auricle, from there it goes to the right ventricle, from which it is pumped through the lungs for purification to the left auricle and thence to the left ventricle again. The length of time required for any portion of blood to make the complete circuit in the human being is not known with absolute accuracy, but it is probably not less than 15 seconds nor more than 30 seconds.

The work done by the heart may be expressed in units. Assuming the pressure in the left ventricle during contraction to be 130 millimetres of mercury, each square centimetre will receive a pressure of 175.5 grams. Assuming further that the left ventricle forces 100 cubic centimetres of blood at each contraction, the work done will equal 17,880 gram centimetres. The right ventricle does a third as much work as the left, giving a total of 23,840 gram centimetres. The total work of the heart per diem equals 24,000 kilogram metres, equivalent to 50.6 kilo-calories.

The relatively high pressure required of the heart in maintaining the circulation is due to the fact that it has to force the blood into arteries having elastic walls that offer a considerable resistance to stretching. The stream from the heart into the arteries is intermittent, the elastic arterial walls are stretched by the incoming blood absorbing the force during systole and tending to again give out this force when the heart ceases during diastole to supply fresh blood. Even during diastole the pressure within the arteries remains considerable. Hence the heart has to force the blood against the elastic tension of the arterial wall and against the blood already in the vessel from previous heart beats. This force stored up in the arterial wall tends to drive the blood along to the capillaries and veins, making in the capillaries and veins a constant flow, just as a single-cylinder pump provided with an air-chamber delivers a constant stream. The circulation, then, in the arteries is intermittent, in the capillaries and veins constant.

An element of much interest as well as of great importance to the proper maintenance of the circulation in the arteries and to the nutrition of the organs supplied by them with blood is what is called "vascular tonicity," by which is meant the peculiar property inherent in the arterial walls of maintaining a relatively constant blood pressure with varying amounts of blood contents. In an ordinary system of hydraulics maintained through elastic tubes the walls of which are stretched by the circulating contents, the pressure falls if some of the contents escape. In animals, on the contrary, a considerable quantity of blood may be withdrawn from the blood-vessels, yet the blood pressure, after a fall of very short duration, returns to the normal. This tonicity is due to the fact that the walls of the arteries have circular muscle fibres, under control of nerves, that contract down upon the blood remaining in the vessel and so maintain the pressure, a matter of great importance, as an equal pressure in organs is necessary for the proper physiological function.

The muscle in the arterial walls is supplied with two sets of nerves called vasomotor nerves, having opposite actions. One set called vasoconstrictors has the power when stimulated of contracting the vessel, the other set called vasodilators enlarges the vessel. Under normal conditions a certain equilibrium is established between the two sets of nerves and the artery is said to possess "tone." Increased action of one over the other will produce increased amount of blood in the part, as in the familiar example of blushing, or on the other hand pallor as seen in fright. Certain drugs have a powerful effect upon these nerves.

Before considering the diseases of the heart a word may be said of the historical development of the subject. That the blood circulated was not known until Harvey demonstrated it in 1628. Auenbrugger, a Viennese physician, in 1761 invented percussion, the method by which the position, size, and in a measure the changes in organs may be determined by the sound produced when the surface of the body over them is struck or "percussed," as it is technically called. His invention remained unheeded until 1806, when Corvisart, body physician to Napoleon, used it in mapping out the heart in healthy and in diseased conditions. Laennec, the founder of auscultation as used to-day, by means of his newly invented stethoscope, gave to the world in 1819 the first accurate description of the characteristics of the heart sounds and the significance of changes in the sounds in the diagnosis of diseases of the heart. Bouillaud in France and Hope in England were also pioneers in this work, practically all that has been done since then being an elaboration along lines laid down by them.

By percussion the size and position of the heart can be accurately determined, and by auscultation variations from the normal sounds and the presence of abnormal sounds enable one to determine what special derangement of the heart exists.

To understand the abnormalities of the heart it should be borne in mind that the work of this organ is done by the muscle of which it is composed; that the nerve stimulus for the muscular contraction comes from within the heart wall, and that the regulatory action, that is, whether it beats faster or slower, depends upon two nerves of opposing action, the vagus and the sympathetic; stimulation of the former slowing the heart, stimulation of the latter increasing the rapidity of action. Under ordinary conditions an equilibrium is established between them, somewhat analagous to the equilibrium in a balance when equal weights are placed in the scale-pans; an equilibrium that is at once disturbed if weights are added to or taken from either pan. Furthermore intact valves are necessary for the proper function of the heart.

Hence changes in the action of the heart are due to changes in the nerve stimulation; changes in the muscle; changes in the valves. They may exist alone or in combination. Changes affecting the nerves are more commonly functional or temporary; while those affecting muscles and valves are organic and usually, though not always, permanent.

Diseases of the valves are the most frequent, the most important and of the greatest interest. A valve to perform its duty properly must be so flexible that it is readily thrown back against the walls of the heart so as not to hinder the passage of the blood through the orifice it should go. It should also quickly fall back into place and meet its fellows, so as to block the passage and prevent the flow of blood in the direction it should not go. Unfortunately these delicate valve segments are prone to inflammation, rheumatic fever being the commonest cause. This inflammation is associated with the formation of new tissue much like that formed in the scar of a wound. It leads to thickening, rigidity, retraction and deformity of the valves, and also frequently to adhesion of the cups along the edges of closure.

These changes affect the function of the valve, causing on the one hand narrowing of the orifice so that the passage of the blood is obstructed, hence the technical use of the term "obstruction," or "stenosis"; on the other hand the segments of valves may be so shortened and puckered that they do not meet each other, and so leakage results. To this condition the term "insufficiency" or "regurgitation" is applied. Either obstruction of a valve orifice or leakage through a valve calls upon the muscle of the heart for more work. In the former case the blood is forced under a greater resistance; in the latter more blood must be forced to make up for the leakage. The muscular wall thickens and the cavity of the heart behind the leaky valve enlarges to "compensate," as the expression is for the valvular defect. This compensation may remain effective for years, the patient having but little inconvenience from the disease.

Sooner or later the heart muscle feels the effect of the prolonged overwork, it weakens, becomes stretched, the cavity enclosed by it enlarges, and the condition known as "broken compensation" follows. The heart can no longer supply a sufficient amount of blood for the needs of the body, the circulation is slowed, stagnation results with the associated symptoms of distress in breathing and frequently dropsy. There is marked impairment in the functions of the organs of the body due to imperfect blood supply. Valvular disease is very common and may occur at any age, but it usually involves the valves of the left heart, mitral and aortic.

With care on the part of the patient life may often be prolonged with comfort for many years. Apart from the benefit derived from rest, the drug digitalis by prolonging diastole and stimulating the heart muscle to better contraction gives the best results. When properly used it is a great boon to the patient.

The muscle of the heart undergoes a degenerative change in acute infective diseases associated with fever, like typhoid fever, pneumonia, and diphtheria, by which its contractile power is lessened. It may reach such a degree as to lead to death from paralysis of the heart wall. If the patient recovers from the disease the heart muscle in time recovers its normal tone.

An important disease of the heart muscle is one occurring usually in males after middle life, frequently associated with the symptom known as angina pectoris. It is a degeneration of the heart wall due to partial occlusion, by thickening of the walls, of the two coronary arteries which supply the heart muscle with blood, thus disturbing the nutrition of the muscle and the nerve ganglia. Angina pectoris is characterized by the sensation of great constriction and pressure and often of a violent tearing of the heart, with intense anxiety and a feeling of impending death. The suffering is often very great, and while the attack may be of short duration the prostration following one is marked.

Fatty degeneration of the heart muscle occurs, but it cannot be diagnosticated with exactness during life. Although the term is often heard its use should be reserved as an anatomical and not as a clinical diagnosis. That is, one can be sure of it only when one sees the exposed heart. On the other hand, collection of fat between the muscle-fibres and around the heart such as occurs in fat people may seriously embarrass the heart by not allowing enough space for it to move freely.

Extreme muscular effort as in lifting or carrying a heavy load or a prolonged march or climbing a mountain may overstrain the heart and lead to feeble action. Rest usually repairs the damage, although sometimes it is permanent.

Prolonged overwork and certain forms of disease of the kidney may lead to marked enlargement of the heart, due mainly to thickening of muscle wall of the left ventricle, to which the term "hypertrophy" is applied.

Disturbances of the heart function, due to some action through its nerves, are of great importance. Such may be physiological or functional, or they may be due to diseased conditions. Among the former are examples familiar to all. The increased frequency and force of the heart beat due to the emotions, to alcohol, to tea, to coffee, to tobacco, belong in this category. If not used to excess the effect of the above may be merely temporary, the heart resuming its usual frequency and quiet action when the effect of the stimulation has ceased. Prolonged abuse of such substances or long continued nerve worry or excitement may lead to a more permanent disturbance of the heart functions, indicated by palpitation, either permanent or after a trivial cause, or by irregularity in the rhythm. The "tobacco heart" of the milder form is an irritable one, with increased frequency of the beat; in the severer grade marked irregularity is characteristic. In the nervously tired person palpitation is common, while the uncomfortable sensations about the heart due to disturbed digestion with fermentation in the stomach often lead the individual to consult a physician feeling that heart disease exists.

A nervous disorder of the heart of considerable interest is one associated with greatly increased frequency of its beat, but with a regular rhythm, combined with a marked prominence of the eyeballs, enlarged neck (goitre) and tremor of the hands. This complex has received the name of exophthalmic goitre, a neuropathic disturbance associated with irritation of the sympathetic nerve leading to the rapid heart action.

Still more uncommon and as yet unexplained is the condition called Tachycardia (rapid heart) characterized by paroxysmal attacks of very rapid beating of the heart, lasting but a short time and followed by normal frequency. During an attack it may be impossible to count the heart or pulse beats, owing to the rapidity.

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Heart of Midlothian, The, a romance by Sir Walter Scott, published anonymously in 1818. It takes its name from the Tolbooth or old jail of Edinburgh (pulled down in 1815), where Scott imagined Effie Deans, his heroine, to have been imprisoned. The book is notable for having fewer characters than any others of Scott's novels. It has also a smaller variety of incidents, and less description of scenery.

Heart-urchin. One of a group of sea-urchins (see Echinoidea) of elongated form and cordate outline from a lateral point of view. The group is best represented by the genus *Spatangus*, common in Europe, but heart-urchins occur elsewhere, and are known as fossils.

Hearts-ease, a violet (q.v.), especially the common yellow violet of Europe, or a pansy.

Heat. Until the early part of the 19th century, it was generally believed that heat was a substance devoid of weight (imponderable), and diffused through the mass of bodies. This hypothetical substance was called *caloric*. Many phenomena seemed to be explained by the assumption of the existence of caloric, but finally, through the experiments of Davy and Rumford, in which heat was actually created from mechanical energy, the old caloric theory was abandoned. In its place we now have the molecular motion theory. According to this theory heat is nothing but a violent agitation of the molecules of matter. These molecules are extremely minute, but have a definite size and weight for each definite substance. It has been estimated that a molecule of water has a diameter of about one fifty-millionth of an inch. Though molecules are small in size, their velocity, even at ordinary temperatures, is very great. In air, where the molecules dart about in straight lines until they encounter other molecules, they attain a speed of 1,470 feet a second at the freezing temperature. The average length of their path between two encounters — the *mean free path* — is about 1-277,000 inch, and the number of molecules in a cubic inch of air is about 10 raised to the 21st power. Each molecule experiences about 5,000,000,000 collisions a second.

Expansion of Solids, Liquids, and Gases.— The molecules of every substance attract one another with a force called cohesion. It is cohesion that prevents a wire from breaking when it supports a heavy weight. The pressure of the atmosphere also helps to hold the molecules of a body together. Opposed to both of these forces is heat. The effect of the agitation of the molecules is to make them jostle one another apart. Thus it is that in general an increase of temperature results in expansion. In solids, where the cohesion is enormous, the expansion for a given increase of temperature is very slight, especially when the test is made at low temperatures. At higher temperatures, when the molecules have somewhat weakened their mutual hold through having moved further apart, an increase of temperature equal to the previous increase generally results in a somewhat greater expansion. To express such ideas technically we employ the expression *coefficient of linear expansion*, which means the fraction of its length that a bar expands when heated one degree centigrade. As the length varies with the temperature, the length at the freezing point, 0° C., is taken as the standard length. Using then this expression we may say that the coefficient of expansion of a solid generally increases with the temperature. The coefficient of linear expansion of a number of substances will be found in the following table:

COEFFICIENTS OF LINEAR EXPANSION OF SOLIDS.

Aluminium	0.0000233	Wood (soft)	0.000003
Gold	0.0000144	Wood (hard)	0.000006
Iron	0.0000121	Vulcanite	0.000067
Lead	0.0000293	Paraffin	0.00034
Platinum	0.0000090	Quartz	0.0000013
Copper	0.0000168	Rock salt	0.00003
Zinc	0.0000292	Ice	0.00005
Silver	0.0000193	Glass	0.0000083
Steel	0.0000123	Granite	0.0000087
Guillaume's nickel steel (36 per cent nickel)	0.00000087	Porcelain	0.0000025

Two notable cases may be remarked. It is seen from the table that the coefficient for glass is very close to that for platinum. This fact is taken advantage of in the construction of incandescent electric lamps, and of those scientific instruments where it is necessary to have a wire pass through glass and leave an air-tight joint. In making the joint, the glass around the hole is softened by heat until it gathers closely around the hot platinum wire. In cooling, if the coefficient for platinum were higher than that for glass, the platinum would contract more rapidly than the glass and leave a leaky joint. The second case to be noted is that of Guillaume's nickel steel. The coefficient of expansion of this metal is so extremely small that it is eminently suited to the construction of clock pendulum rods, of surveying instruments, and of standard scales of length, and to many other purposes where much expansion now proves an annoyance. Unfortunately the high cost of nickel will preclude the employment of this wonderful alloy in some cases.

The influence of expansion is seen in railroad tracks. On a cold day 60-foot rails may contract so as to draw apart one half of an inch. The cables of the Brooklyn Bridge support the slightly arched roadway. When they sag down in hot weather through expansion, they tend to make the roadway buckle. This tendency is increased by the expansion of the roadway itself. However, both tendencies were overcome through the foresight of the engineers, who provided a telescoping joint in the roadway at the middle of the span. The parts of this joint play in and out about a foot. On hot days clock pendulums grow longer, and so the clocks lose time. Glass when suddenly and hence unevenly heated, expands more at one point than at another, thus introducing internal strains that cause fracture, but vessels made of vitrified quartz are strong enough to resist this tendency to crack; they will endure without injury the sudden application of a blowpipe flame.

In liquids the molecules are so far freed from cohesion that they are able to roll around one another and to wander from one position to another. The small remaining cohesion is assisted by the pressure of the atmosphere or by any other pressure to which the liquid may be subjected and so the molecules in the body of the liquid are prevented from flying directly apart. It is on account of this small resistance to expansion that we find liquids very much more expansible than solids. The term *coefficient of cubical expansion* is employed to express the degree of expansibility of a liquid. It means the fraction of its volume that a liquid expands when its temperature is raised one degree centigrade. The cubical coefficient of a substance is three times as great as its linear coefficient, because we measure the effect of expansion in length, breadth, and thickness, instead of merely noting the expansion in length. Of course a liquid confined in a tube of unchanging dimension could only expand in length, but the effect in this one direction would be three times as much as it would be if the liquid were allowed to expand proportionally in all three dimensions.

COEFFICIENTS OF CUBICAL EXPANSION, LIQUIDS.

Ethyl alcohol	0.00106	Petroleum (heavy)	0.00090
Methyl alcohol	0.00114	Mercury	0.00018153
Acetone	0.00135	Aniline	0.00118
Ether	0.00148		
Olive oil	0.00080		

The expansibility of water is strikingly irregular. Starting at the freezing point, water contracts as the temperature rises until at about 4° C. it has assumed its maximum density. A further increase of temperature now causes the water to expand, which it does at an increasing rate until it begins to boil at 100° C.

Gases surpass even liquids in their expansibility. Because in gases the molecules are relatively very far apart, cohesion counts for nearly nothing, leaving external pressure as almost the sole force restraining expansion. It appears that the coefficient of expansion of a gas is nearly independent of the external pressure, for though a greater pressure tends to restrain expansion more, the greater crowding of the molecules resulting from this pressure causes more frequent blows among the molecules, and makes the expansive force increase in nearly the same proportion as the external pressure. This law is not perfectly complied with because the molecules in a gas are not quite free from cohesion, especially when much compressed, and because the diameter of the molecule is an appreciable fraction of the distance between two molecules. Another law, fulfilled only approximately for the same reasons, is that all gases have the same coefficient of expansion, as will be seen in the following table, which gives the cubical coefficient referred as a standard to the volume the gas has at 0° C.

COEFFICIENTS OF CUBICAL EXPANSION, GASES AT A PRESSURE OF FROM 300 TO 500 MM.

Air	0.003667	Carbon dioxide	0.003710
Hydrogen	0.003661	Nitrous oxide	0.003719
Nitrogen	0.003661	Cyanogen	0.003877
Carbon monoxide	0.003667	Sulphur dioxide	0.003903

The Convection of Heat.—When the air in contact with a hot stove becomes warmed, it expands and grows lighter than the other air. Owing to unbalanced forces the hot air rises to the ceiling and then spreads out to the walls. It there becomes cooled, and therefore contracts and becomes dense. As a result it descends at the walls and finally returns to the stove only to start again on the journey. During this process, called *convection,* heat is carried by the air from the stove to the most distant parts of the room. Winds consist of convection currents in the atmosphere. Some parts of the earth's surface become more highly heated by the sun than others. The air over the hot areas expands and becomes specifically lighter than the surrounding air. The general result is that the hot air is forced to rise giving place to the surrounding cooler air which blows toward the hot area as a surface wind. The hot air risen aloft spreads away toward the cool regions as an upper wind. Corresponding to the ascent of air over the hot areas is a descent of air over the cool areas. Much heat is brought from the tropical regions to temperate regions by regular winds.

Convection phenomena also occur in liquids. A large vessel of water supplied with heat at one side of the bottom becomes through the action of convection currents uniformly heated throughout. Much heat is conveyed from the equator toward the poles by means of the Gulf Stream and other ocean currents. It is probable, however, that with ocean currents differences of temperature have little to do with the motion of the water, but that the motion is caused chiefly by the action of winds that blow with great steadiness in a westerly direction across the equatorial portions of the great oceans. Difference in salinity of the ocean at different latitudes may possibly be a partial cause of the phenomenon.

Thermometry.—Before proceeding further in the discussion of heat phenomena, it will be necessary to describe some of the methods employed for measuring temperature or the degree of hotness of a body. Most commonly the methods depend upon the property of expansion. In ordinary thermometers the expanding body is either mercury or colored alcohol. The liquid, say mercury, is held in a glass tube having a fine bore and at one end a spherical or cylindrical bulb, the other end being simply closed. Above the mercury, which fills the bulb and part of the stem, is a space that is free from air and contains only a small amount of mercury vapor. When the thermometer is warmed, the mercury rises in the tube because the cubical expansion of mercury is greater than the cubical expansion of glass. The glass tube is provided with a scale, sometimes engraved directly on the tube, and sometimes engraved on some other material and mounted at the back of the tube. For a Fahrenheit scale division number 32 is placed opposite the mercury level when the thermometer is placed in pure crushed melting ice, and division number 212 is placed opposite the mercury level when the thermometer is placed in saturated steam over boiling water. As the temperature of the boiling point depends upon the atmospheric pressure, which is ever varying, the standard boiling point is taken to correspond to the average atmospheric pressure, which is measured by a barometric column of 760 millimetres. The space between these marks, the freezing and boiling points, is divided into 180 equal divisions, and then divisions equal to these are extended above the boiling point and below the freezing point. For the centigrade scale, which is generally employed in scientific work, the freezing point on the thermometer is marked 0° and the boiling point 100°. For the Réaumur scale, much used for household purposes in Germany, these points are marked 0° and 80° respectively, and finally for the De Lisle scale, which is used in Russia, the direction of the graduation is reversed, the boiling point being marked 0° and the freezing point + 150°. With this last thermometer, the greater the intensity of the *cold* the higher the number representing the temperature. Mercury thermometers permit of the measurement of rather high temperatures, mercury not boiling until the temperature of about 357° C. (674.3 F.) is reached. Still higher temperatures with mercury thermometers may be reached by checking the vaporization of the mercury through the introduction into the upper part of the tube of a compressed gas such as nitrogen. With such a thermometer the only limitation is the softening of the glass at high heats, and even this trouble is largely lessened by the use of vitrified quartz for the material of the bulb. On the other hand, mercury freezes at about —39° C. (—38.2° F.) and so becomes useless for indicating temperatures lower than this. For these lower temperatures alcohol may be employed as the thermometric substance because it resists freezing until temperatures far below any met with in nature are encountered. In addition to this advantage alcohol expands much more rapidly than mercury, thus permitting a much larger bore for the same length of degree. However, for very high temperatures alcohol is not available, as it boils at the moderate temperature of 78.3° C. (173° F.).

In practical work thermometry fairly bristles with errors. For several months after a thermometer is made the bulb gradually shrinks, probably owing to some molecular instability in the glass caused by the excessive heating employed in the process of blowing the bulb. This causes the thermometer to read too high. After each time a thermometer is used for a very high temperature the bulb on cooling fails to contract promptly to the volume proper to the new temperature, and so now the thermometer for a while reads too low; however, prolonged heating at the temperature of boiling mercury tends to put the glass into a more stable state. Also such troubles are much reduced by the use of hard glass instead of soft glass for the bulbs. Errors also arise from the following causes: non-uniformity of the bore; variations of atmospheric pressure, which cause a yielding of the bulb; failure to have the stem of the thermometer at the same temperature as the bulb; the hydrostatic pressure on the bulb due to the liquid being tested, especially when the thermometer is sunk to great depths; a variation in the internal pressure of the mercury itself on the bulb when the thermometer is inclined from the vertical position to the horizontal; a peculiar jerking motion of the mercury when it ascends a very fine bore; the fact that equal volumes of the bore marked off on the tube do not represent equal expansions of the mercury, since at high temperatures the volume of the bore indicating a degree has increased (this is quite distinct from the matter of the relative expansion of glass and mercury); irregularities in the expansion of the glass of the thermometer; and lastly irregularities in the expansion of the fluid itself, be it mercury, alcohol, air, or any other substance. This last source of error is worth much consideration because two thermometers otherwise perfect but containing different liquids, as alcohol and mercury, fail to agree in their indications. Further, we have no right arbitrarily to select any particular fluid as a standard and yet feel that our temperature scale has anything more than an empirical value. It will, however, be explained in the last section how a theoretical definition for temperature measurement can be formulated (the thermodynamic scale), agreeing fairly with ordinary thermometers, very closely with the hydrogen or nitrogen thermometer, and perfectly free from ambiguity.

In the hydrogen thermometer advantage is taken of the increase of pressure of a gas attending an increase of temperature, the volume of the gas being kept constant. The hydrogen is confined in a glass bulb about two inches in diameter which is connected by a thick-walled capillary tube with the top of one side of a U-shaped apparatus consisting of two vertical glass tubes connected by a rubber hose at their lower ends and partly filled with mercury. When the hydrogen in the bulb is warmed it tends to expand and push the mercury down its side of the U and to cause it to rise on the other side, which is open to the atmosphere. This effect is counteracted by raising the glass tube on the open side, the rubber tubing allowing this to be done The extra back pressure of the mercury forces the hydrogen back to its former volume. In measuring the pressure to which the hydrogen at any time is subjected, the difference in level of the mercury columns must have added to it the length of the barometric column measured at the time. For each degree centigrade added to the temperature, the hydrogen is found to increase in pressure about 1/273 of its pressure measured at 0° C. Similarly for each degree subtracted, the pressure decreases 1/273 of the pressure at 0° C.

If this law held to the limit, we would conclude that at —273° C. the hydrogen would lose all its pressure, thus indicating the cessation of all molecular motion — a veritable absolute zero of temperature. However, at extremely low temperatures the perfect working of this law is interfered with through the dominance of cohesion which reduces unduly the pressure of the hydrogen, and may cause it to assume the liquid or even the solid state. Nevertheless, this limiting temperature as predicted by the hydrogen thermometer agrees almost exactly with the true absolute zero of the thermodynamic scale referred to above. On this absolute scale the temperature of freezing water is approximately + 273° Abs., and temperature of boiling, + 373° Abs.

Other methods of measuring temperature depend upon change in the electrical resistance of platinum, and upon the electromotive force created when the juncture of two dissimilar metals as platinum and rhodium is heated. Very high and very low temperatures may be measured by such methods.

Conduction of Heat.—When a sterling silver spoon is placed in a cup of hot tea, the handle of the spoon soon becomes uncomfortably warm to the hand. Heat has been conducted through the silver. The molecules in the bowl of the spoon are the first to have their motion accelerated by contact with the tea. This extra motion is communicated to their neighbors which in turn pass it on until, step by step, the motion reaches the molecules in the handle. It appears that in some substances the character of connection between the molecules is more favorable to conduction than in others. As we might have expected, from the mutual grip of the molecules found in solids, that class of bodies furnishes the best conductors; but in gases, where the molecules are very loosely distributed, we naturally find the poorest conductors. Liquids as conductors occupy a position intermediate between solids and gases. Metals surpass all other materials in conducting power, silver standing at the very head of the list, while near the foot of the list of solids are found organic materials and mineral substances especially when in the porous or fibrous state, such as horn, leather, magnesia brick, asbestos fibre, sand, cotton wool, cowhair felt, and down. Great value is attached to poor conductors of heat. They are called insulators. Bone is used in joining the handles to silver tea pots. Our clothes are made of organic material woven so as to leave a multitude of fine pores, a condition favorable to insulation and met with in the fur of animals and in the feathers of birds. Saw dust and mineral wool for the same reason are made to serve as insulators of heat in the outer casing of ice boxes.

In the following table of conductivities the better conductors have the higher numbers. These numbers, called the *coefficient of conductivity*, indicate the amount of heat energy measured in calories (a *calorie* is the amount of heat energy required to raise the temperature of a gram of water one degree centigrade) conducted from one face to the opposite face of a centimetre cube of the substance when one of the faces is maintained one degree hotter than the other. The amount of heat energy conducted is proportional to the difference in temperature between the opposite faces.

COEFFICIENTS OF CONDUCTIVITY.

	Degrees Cent.			
Aluminium	at 0	0.343	Slate	0.00272
Aluminium	at 100	0.362	Granite	0.0053
Bismuth	at 0	0.0177	Marble	0.0050
Bismuth	at 100	0.0164	Sand, white	0.00093
Brass	at 0	0.2041	Snow, compact	0.00051
Brass	at 100	0.2540	Vulcanite	0.0004
Copper	at 0	0.7189	Wood, fir —	
Copper	at 100	0.7226	Along grain	0.0003
Iron	at 0	0.166	Across grain	0.00009
Iron	at 100	0.163	Bees'-wax	0.00009
Lead	at 0	0.0836	Ether	0.0003
Lead	at 100	0.0764	Water	0.002
Silver	at 0	0.960	Air	0.000056
Zinc	at 0	0.303	Hydrogen	0.00039
Mercury		0.0152		

Specific Heat.— In the last section the expression "heat energy" was employed, and the "calorie," its unit, was defined. If thin glass vessels containing equal weights at equal temperatures of different materials, mercury and water for example, be placed over equal gas flames so as to receive in a given time equal amounts of heat energy (equal numbers of calories), it will be found that the water will require nearly 30 minutes to get as hot as the mercury does in one minute. The water is said to have a greater capacity for heat than the mercury has. Making allowance for the heat capacity of the glass vessels and for radiation and conduction it is found that the heat capacity of mercury is 0.034 that of water. We say that the *specific heat* of the mercury is 0.034, for water is taken as the standard and its heat capacity is assigned the value 1.0. The value of the specific heat of a number of solids and liquids is given in the following tables:

SPECIFIC HEAT OF SOLIDS.

Substance	A Atomic Weight	B Specific Heat	$C = A \times B$ Atomic Heat
Aluminum	27.04	0.2022	5.45
Bismuth	207.5	0.0298	6.17
Copper	63.18	0.09232	5.82
Gold	195.74	0.03035	5.94
Iron	55.88	0.10983	6.13
Lead	206.39	0.0315	6.50
Nickel	58.24	0.10842	6.31
Platinum	194.3	0.03147	6.09
Silver	107.66	0.0559	6.10
Sulphur	31.98	0.1844	6.02
Tin	117.35	0.0559	6.65
Zinc	64.88	0.0935	6.05
Ice	......	0.502	......
Paraffin	......	0.694	......
Glass	......	0.19	......
Wood	......	0.6	......
Quartz	......	0.186	......
Rock Salt	......	0.219	......
Gypsum	......	0.26	......
Ruby	......	0.22	......
Brass	......	0.093	......

SPECIFIC HEAT OF LIQUIDS.

Acetone	.53	Glycerine	.55
Alcohol, Ethyl	.65	Mercury	.034
Benzol	.44	Carbon disulphide	.24
Bromine	.46	Turpentine	.46
Ether	.54		

In the first table the atomic weights (the weight of the atom as compared with the weight of an atom of hydrogen) of some of the elements in the solid state are also given. The product obtained by multiplying the specific heat by the atomic weight is given in the last column. It will be observed that these products are approximately equal. This equality indicates that if we took as our standard of comparison equal numbers of atoms of a solid instead of equal weights, all elements in the solid state would have the same heat capacity. It takes about as much heat energy to raise the temperature of an atom of gold one degree as it does for one atom of aluminium. This law of Dulong and Petit also applies with some degree of approximation to compounds in the solid state — not equal heat capacity for the molecules, but for the atoms.

In the cases of gases we have two specific heats according as on the one hand the gas is confined to constant volume while being heated, or as on the other hand the gas is allowed to expand so as to keep the pressure constant. This is shown in the accompanying table where it will be seen that the specific heat at constant pressure is greater than the specific heat at constant volume.

SPECIFIC HEATS OF GASES.

Substance	Symbol	Constant volume equal weights	Constant pressure		Ratio of specific heats, equals col. 4 ÷ col. 3
			Equal weights	Equal volumes	
Air	......	.1692	.2374	.2374	1.403
Mercury vapor	Hg	......	......	......	1.666
Argon	Ar	......	......	......	1.63
Carb. monoxide	Co	.1746	.2450	.2370	1.403
Oxygen	O_2	.1542	.2174	.2405	1.41
Hydrogen	H_2	2.417	3.4000	.2359	1.41
Nitrogen	N_2	.1729	.2438	.2370	1.41
Chlorine	Cl_2	.0913	.1210	.2962	1.336
Carbon dioxide	CO_2	.1654	.2169	.3307	1.311
Ether	C_4H_4O	.467	.4810	1.2296	1.03

This difference in specific heat in the same gas is due to two causes. When the gas expands not only do the molecules acquire greater kinetic energy, but in pushing each other farther apart against the attractive force of cohesion, they require a further amount of energy of the potential sort, and in pushing back the restraining pressure of the atmosphere still another large supply of energy is needed. It appears from several independent considerations that in gases far removed from their liquefying points the cohesion effect is exceedingly small, and so we conclude that the excess of specific heat of an expanding gas is almost entirely due to work done on the external pressure applied to the gas.

In the last column of the table the ratio of the two specific heats of the gases is given. This ratio is found to vary, decreasing from simple gases like mercury vapor, the molecules of which have single atoms, to complex gases like ether vapor, the molecules of which have 15 atoms. With complex molecules a large part of the energy is internal, much being stored up in the rotating motion of the individual molecules, and in the relative motion of their atoms, leaving the energy of translation of the molecules and the energy due to the pushing back of the external pressure about the same as before. It follows then that the energy associated with the external pressure is a smaller fraction of the whole energy, and that therefore, as observed, the ratio between the heat energy imparted to an expanding gas and the energy imparted to a non-expanding gas must be smaller for such complex molecules. The value of this ratio is the principal means of judging of the number of atoms in a molecule of an element in the gaseous state.

Before leaving this subject it should be remarked that the specific heat of water varies slightly with the temperature, and so it is convenient to take as the value of the calorie one hundredth the heat required to raise the temperature of a gram of water from 0° C. to 100° C.

Latent Heat.—If heat energy be imparted to a mass of ice at the point of melting, the ice will proceed to melt, but will not grow any warmer as it does so. The heat energy thus added without increasing temperature is called *latent heat*. Latent heat is devoted only to shaking the molecules of ice asunder, not to increasing their speed. Temperature depends upon the energy of motion (kinetic energy) of the molecules; latent heat only stores up energy of position (potential energy) of the molecules, and so does not produce an increase of temperature. Again, when water is being boiled, a large amount of heat energy becomes latent. The latent heat of vaporization and of melting for a variety of substances is given below.

LATENT HEAT OF VAPORIZATION.

	Calories		Calories
Water	536	Mercury	62
Acetone	126	Carbon disulphide	90
Ethyl alcohol	206	Sulphur	362
Methyl alcohol	264	Ether	91
Liquid air	47		

LATENT HEAT OF MELTING.

	Calories		Calories
Ice	80	Silver	21.07
Sulphur	9.37	Mercury	2.82
Paraffin	35.10	Iron	35.
Phosphorus	5.	Platinum	27.
Bees'-wax	42.	Tin	14.
Zinc	28.13	Bismuth	13.
Lead	5.86	Copper	30.

It should be remarked that the latent heat devoted to converting a liquid into vapor besides increasing the internal potential energy of the molecules also does work in pushing back the atmosphere, but with water this external work bears a very small ratio to the internal work against cohesion, namely, a little more than one twelfth.

Heretofore we have supposed the energy for melting or for vaporization to be derived from some external source of heat. It is, however, possible to secure a change of state through the consumption of the heat energy of the body itself. If water be left in an open vessel it will presently have evaporated entirely away. During the progress of this vaporization a thermometer placed either in the water or in the moist air above the water will show a temperature lower than that of the surrounding air. The reason of this is as follows: At the surface of the liquid, with all the irregularities of position and velocity possessed by the molecules, some of them find opportunity to fly off from the liquid surface. On the average it will be the faster going molecules that spring away first, thus leaving the more slowly going ones behind, which is the same as saying that the remaining liquid is cooler. Also in going away, the molecules fly against the back pull of cohesion, and so their velocity is checked. Indeed many are entirely stopped and drawn back into the liquid, though others escape quite beyond the range of cohesion of the liquid and diffuse among the molecules of the air. The reduced motion of these escaping molecules causes the low temperature referred to above of the vapor. Common illustrations of cold by evaporation are frequently met with. The function of perspiration is a means of regulating the temperature of the human body. In the healthy state when we are overheated the skin becomes very moist and the evaporation of this moisture, assisted by a breeze or by fanning, cools the surface. In disease the proper action of the skin may be interfered with, and becoming dry, may fail through lack of evaporation to provide the normal cooling effect. An exalted temperature of the body ensues; in other words, a fever. Certain drugs tend to promote perspiration and thus reduce the temperature of the patient. Another large factor in the temperature regulation of the body is in the water evaporated from the lungs in the process of breathing. The evaporation of ammonia that has been liquefied by pressure furnishes the cold employed in some ice machines. In the case of liquefaction the necessary latent heat may be derived from the body itself. This occurs when a salt is dissolved in water, a process that is generally accompanied by a fall of temperature, though occasionally a rise in temperature is noted. The factors governing the result in such cases are rather complicated. We have to take account of the work done by the solvent in tearing molecules away from the solid lump and in some cases the tearing of these molecules apart into electrically charged parts called ions. On the other hand a certain amount of kinetic energy is furnished by the attraction of the molecules of the dissolving substance by the molecules of the solvent. According as the back pulls or the forward pulls predominate, will the temperature of the solution be lowered or raised. If much chemical action takes place between the substance and the solvent, the solution is almost always warmed.

The temperature at which melting takes place depends upon external pressure. When a solid like paraffin expands on liquefying high pressure, which resists expansion, stops melting until a temperature slightly higher than the ordinary melting point is reached. Paraffin that under ordinary conditions melts at 46.3° C. melts at 49.9° C. when subjected to the additional pressure of 100 atmospheres. In the case of ice, which contracts on melting, melting is favored by pressure. The addition of one atmosphere of pressure lowers the melting point of ice by 0.0072° C. This fact accounts for the slipperiness of ice especially when being skated upon. The sharp edge of the skate exerts great pressure on the ice below it, which melts and furnishes a lubricating film of water. This film of water is cooler than the ice furnishing it, some of the heat of the ice having become latent, and as soon as the skate has passed over, the water immediately resumes the solid state. This process of freezing again is called regelation. Regelation is an important factor in glacier motion. The ice as it follows down a tortuous valley is continually being cracked. After the settling following this cracking, the great pressure from the upper ice fields melts the ice at the points of contact of opposite sides of a fracture, and the escaping undercooled water freezes again, thus healing the fracture. In this way the glacier appears to follow down the irregularities of a valley as would a very viscous mass.

MELTING POINTS.

	Degrees Centigrade		Degrees Centigrade
Paraffin	55	Bismuth	270
Ice	0	Cadmium	318
Silver chloride	450	Copper, pure in air	1065
Fluor spar	900	Copper, pure, air excluded	1084
Potassium nitrate	340	Iron	1600
Salt, common	800	Lead	330
Spermaceti	44	Mercury	—39
Sugar, crystals	170	Nickel	1500
Bees'-wax	63	Palladium	1700
Brass	900	Platinum	900
Glass, crown	400	Rhodium	2000
Gold	1064	Selenium	216
Cast iron, gray	1200	Silver	1000
Cast iron, white	1100	Sulphur	114
Silver, sterling	900	Tin	230
Steel, cast	1400	Zinc, pure	419
Hydrogen	—255	Manganese (99%)	1245
Oxygen	—191	Chromium (99% free from carbon)	1515
Aluminium, pure	657		
Antimony	440		

Saturated and Unsaturated Vapors.—When a liquid, water for example, is placed in a vacuous enclosure kept at constant temperature by artificial means, it immediately begins to evaporate, the vapor presently attaining a maximum density and pressure. The vapor as well as the space occupied by it is then said to be *saturated.* Before this maximum pressure was reached the vapor was unsaturated. If the temperature of the whole apparatus be now raised, more water will commence to evaporate, and the vapor will increase in density and pressure before it is again saturated. Had the saturated vapor formed in the first place been shut off from the water surface before raising the temperature, it would not become as dense as when it had the water evaporating into it, and so we would then pronounce the heated saturated vapor as unsaturated. On the other hand if a mass of unsaturated water vapor be cooled, the density of the vapor will at a certain temperature be sufficient to cause saturation. Below this particular temperature, called the *dew-point,* some of the moisture will condense. In some cases, however, when there are no nuclei in the form of dust particles, free ions, etc., the vapor may cool appreciably below the dew-point without immediate condensation. The vapor is then said to be supersaturated. The presence of air has only a very small influence on the density and pressure of saturated water vapor in contact with water, especially when the temperature is not high.

When the temperature of water or other volatile liquid is raised so high that the pressure of the saturated vapor becomes as great as that of the atmosphere, bubbles of the vapor begin to form in the body of the liquid. This constitutes the process of boiling. The temperature at which a liquid boils is much influenced by the external pressure. The boiling point is the same as the temperature at which the pressure of the saturated vapor equals the external pressure on the bubble. In the following table these temperatures with their corresponding pressures are given for water.

PRESSURE OF WATER VAPOR.

Temperature degrees centigrade	Pressure in millimetres of mercury	Temperature degrees centigrade	Pressure in millimetres of mercury
—10	2.08	50	91.98
— 5	3.14	55	117.48
0	4.60	60	148.79
+ 5	6.53	65	186.94
10	9.16	70	233.09
15	12.70	75	288.52
20	17.39	80	354.64
25	23.55	85	433.41
30	31.55	90	525.45
35	41.83	95	633.78
40	54.91	100	760.00
45	71.39	101	787.63

Degrees centigrade	Pressure in atmospheres	Degrees centigrade	Pressure in atmospheres
100.	1	198.8	15
112.2	1½	201.9	16
120.6	2	204.9	17
133.9	3	207.7	18
144.0	4	210.4	19
152.2	5	213.0	20
156.2	6	215.5	21
165.3	7	217.9	22
170.8	8	220.3	23
175.8	9	222.5	24
180.3	10	224.7	25
184.5	11	226.8	26
188.4	12	228.9	27
192.1	13	230.9	28
195.5	14		

BOILING POINTS OF LIQUIDS.

	Degrees Centigrade		Degrees Centigrade
Hydrogen	—246.	Sulphur dioxide..	— 10.1
Helium	—240.?	Ether	+ 34.6
Nitrogen	—196.5	Carbon disulphide	+ 46.2
Air		Acetone	+ 57.
Argon	—186.1	Chloroform	+ 60.2
Oxygen	—182.7	Methyl alcohol...	+ 64.9
Fluorine	—187.	Ethyl alcohol.....	+ 78.3
Krypton	—152.7	Benzol	+ 80.2
Xenon	—109.9	Water	+ 100.0
Ethylene	—102.	Amyl acetate.....	+ 150.0
Nitrous oxide....	— 89.	Aniline	+ 184.4
Carbon dioxide (sub-limes)....	— 80.	Sulphuric acid...	+ 330.?
Chlorine	— 33.6	Sulphur	+ 448.4
Ammonia	— 32.9	Mercury	+ 356.8
		Zinc	+ 958.

A saturated vapor in contact with its liquid offers a beautiful instance of dynamic equilibrium. We conceive that molecules are ever leaving the surface of the water, adding themselves to the vapor. At the same time molecules of the vapor coming near to the liquid surface or plunging into it are caught by the cohesion of the liquid, thus subtracting themselves from the vapor. A less dense vapor would lessen the latter process and would allow the vapor to grow denser; a denser vapor would increase it and allow the vapor to fall to a state — the saturated state — when the rate of evaporation is just equal to the rate of condensation.

The degree of moistness of air is expressed by the phrase *hygrometric state*. The hygrometric state does not express the density of the water vapor present, but instead expresses the quotient obtained by dividing the density of the vapor present by the density of the vapor required to saturate the air. If pressures were employed instead of densities in getting the quotient, substantially the same result would be obtained. Still another common way of defining hygrometric state is to take the quotient obtained by dividing the pressure of the vapor corresponding to the dew-point by the pressure of vapor saturated at the temperature of the air, a method closely agreeing with the former ones.

The Critical State.—When the temperature rises, the density of a saturated vapor in contact with its liquid becomes denser, while the liquid itself expands and becomes less dense. If the heating of the liquid and vapor takes place in a strong closed vessel containing not too much or too little of the liquid, after a while a temperature is reached at which the saturated vapor becomes as dense as the liquid. At this point they become identical in their physical properties; the line of demarkation of liquid and vapor fades away, and the two fluids begin to mix. The temperature at which this phenomenon occurs is called the *critical temperature*, the corresponding pressure is called the *critical pressure*, and the liquid is said to be at the *critical state*. Above the critical temperature it is impossible to distinguish between a liquid and its vapor. No matter how great the pressure, a gas or vapor cannot be forced into the state of a liquid that is obviously distinct from the vapor unless the vapor be cooled below the critical temperature.

CRITICAL TEMPERATURES AND PRESSURES.

Substance	Critical Temperature Degrees Centigrade	Critical Pressure Atmospheres
Hydrogen	—225.	15.
Oxygen	—118.8	50.8
Nitrogen	—146.	35.
Carbon monoxide.........	—141.	36.
Argon	—120.	40.
Fluorine	—121.	50.6
Methane	— 95.5	50.
Carbon dioxide...........	+ 31.	75.
Ammonia	+ 130.0	115.
Sulphur dioxide..........	+ 155.4	80.
Chlorine	+ 144.0	83.9
Nitrous oxide............	+ 35.	75.
Water	+ 365.	200.
Ethane	+ 34.	50.2
Ethylene	+ 10.	51.7

Radiation.—We have described two methods by which heat energy may be transferred from one place to another — by conduction and by convection. A third method remains to be studied. How does the heat of the sun reach us? By means of waves in the luminiferous ether. Go to a quiet pond in which a piece of wood may be floating. Standing on the shore, vibrate your hand up and down in the water. Waves run from your hand over the surface of the water to the wood and cause it to vibrate up and down. Energy from the hand has been transferred to the wood by means of waves. These waves consist of the successive vibration of successive particles of water, each particle receiving energy from behind and passing it on to the front. It is much the same with heat waves. The ether, which fills all space, is capable of being set into vibration by vibrating molecules and of handing this vibration on step by step in the form of waves. Molecules acted upon by these waves are themselves set into vibration. The vibrating molecules of the sun generate ether waves, and the ether waves generate vibration of the molecules of bodies on the earth. These ether waves are called *radiant heat*. We now have a very wide range of ether waves under experimental control. From the large waves generated by electrical oscillations used in wireless telegraphy and sometimes a quarter of a mile long we may pass by insensible gradations with only two breaks to the extremely minute waves supposed to constitute Roentgen's X rays. Dark heat waves or infra-red rays, ordinary light, and ultra-violet light belong to the middle of the series. Quite recently Blondot has discovered a peculiar radiation which he designates as *n rays*. There are indications that n rays are ether waves about one fifth of a millimetre in length. All of these waves behave very much like light. They all have the same velocity as light, namely, 186,300 miles a second (n rays not tested yet). All except Roentgen rays may be reflected, refracted, polarized, and absorbed by transmission to a degree depending upon the substance used for transmission and the particular wave-length of the rays.

Thermodynamics.—The most cogent reason for discarding the caloric theory of heat is that heat may be generated from that which is not in any sense substance — heat may be derived from mechanical energy. Heat is generated when a brass button is rubbed on the carpet, when a bullet is struck with a hammer, and when two pieces of ice are rubbed together, a process resulting in their melting. The relation between mechanical energy and the heat energy generated by its consumption was first carefully investigated by J. P. Joule before 1850. One pound-calorie of heat energy is obtained from 1,400 foot-pounds of mechanical energy. That is to say, the energy due to the fall of 1,400 pounds through the distance of a foot is sufficient if transformed into heat to raise the temperature of a pound of water through one degree centigrade. This number of foot-pounds is called the *mechanical equivalent of heat*, for it has been found that the process is reversible. When by means of an air-engine or a steam-engine one pound-calorie of heat is consumed in generating mechanical energy, 1,400 foot-pounds of the latter are obtained. *The first law of thermodynamics* states that when mechanical energy is converted into heat, or when heat is converted into mechanical energy, the quantity of mechanical energy is equivalent to the quantity of heat energy. *The second law of thermodynamics* states that it is impossible for a machine without the consumption of external energy to make heat pass from a body at a low temperature to one at a high temperature. When external energy is supplied, the transfer of heat becomes possible through the use of a reversible engine. A reversible engine is one that while it may on the one hand take heat from a high temperature source and transfer it to a low temperature escape with a conversion of a definite portion of the heat into mechanical energy, may, on the other hand, when its operation is reversed by the application of external mechanical energy equal in amount to that generated in the first operation, take back the same heat from the low temperature escape and transfer it together with an amount of heat equal to that lost in the first operation to the high temperature source. The fraction of the heat leaving the high temperature source converted into mechanical energy, or when the engine is reversed, the fraction of the heat entering the high temperature source obtained from the mechanical energy applied has been shown by Carnot to be the same for all reversible engines of whatever nature and working with any substance whatsoever, provided they work between the same temperatures. This fraction may be called the *thermodynamic efficiency* of the engine. The thermodynamic efficiency of good steam-engines occasionally exceeds 20 per cent. This means that 20 per cent of the heat energy supplied to engine is transformed into mechanical energy, the remaining 80 per cent escaping unused at the condenser or exhaust.

Using the provisional absolute scale as indicated by a hydrogen thermometer experiment shows that the efficiency, W/H, is roughly represented by the following equation in which W stands for the mechanical energy realized, H for the heat (measured in the equivalent foot-pounds) leaving the high temperature source, T for the temperature of the source, and T^1 for the temperature of the cooler escape.

$$\frac{W}{H} = \frac{T - T^1}{T}$$

This suggests a new definition for a temperature scale, namely that numerical values of temperatures be so adjusted as to fulfil exactly the above formula. Since the formula only fixes a ratio between the temperatures T and T^1 corresponding to a given efficiency, an infinite number of sets of numerical values for these temperatures could be found to satisfy the formula. But if it be decided that a definite numerical range, say one hundred degrees, be comprised between the freezing and boiling points of water, only one set of values becomes possible. This decision makes the value of the freezing point very nearly $+273°$ Abs., and the value of the boiling point $+370°$ Abs. Lord Kelvin was the first to propose this *thermodynamic scale*. Theory shows that its indications would correspond exactly to a thermometer containing a perfect gas. Hydrogen is not quite a perfect gas, for its molecules attract each other slightly and they occupy an appreciable fraction of the space holding the gas. Hence there are small deviations of the hydrogen thermometer from the thermodynamic scale, especially at low temperatures. It should be added that the practical realization of the thermodynamic scale, though much aided by very ingenious mathematical considerations relating to careful experiments made by Regnault on the expansion and the increase of pressure observed when hydrogen and other gases are heated, and by Joule and Kelvin on the temperature changes suffered by gases in expanding through a porous plug, still that realization is far from complete. Nevertheless, the thermodynamic scale offers us a theoretical ideal which is absolutely independent of the thermal properties of any particular substance, but is only related in a definite way to a fixed universal law.

When a *small* amount of heat is transferred from or to a gram of a substance, the heat transferred (measured in calories), divided by the average absolute temperature of the substance at the time of the transference is called the *change of entropy* of the substance. For convenience, the zero of entropy is generally taken to correspond to water at the freezing point and under the normal atmospheric pressure. It may be shown that when two bodies at different temperatures are placed in contact and their temperatures become equalized, the average entropy rises, for from the above definition of entropy, the heat leaving the hotter body must reduce its entropy less than it increases the entropy of the cooler body into which the heat enters. Consequently the average entropy of the universe is constantly rising and tending toward a maximum. At the same time the availability of the energy of the universe is tending toward zero.

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Heath, Daniel Collamore, American publisher: b. Salem, Maine, 19 Jan. 1857. He was graduated from Amherst in 1868, became junior member of the firm of Ginn and Heath, publishers of Boston, and in 1886 established in Boston the house of D. C. Heath & Company, publishers of text-books for schools and colleges, with branch offices in New York, Chicago and London.

Heath, Francis George, English writer: b. Totnes, Devon, 15 Jan. 1843. He entered the civil service as a clerk of the higher division in the customs department in 1862, and was transferred as surveyor to the outdoor division of that department in 1882. In 1896 he founded and in 1897 became editor of the Imperial Press, in connection with which he directed from 1896 the publication of the Imperial library. He was for several years prominent in his activity for the preservation and extension of open spaces in and about London; and published: 'The «Romance» of Peasant Life' (1872); 'The Fern World' (1877; 10th ed. 1902); 'Our Woodland Trees' (1878); 'Where to Find Ferns' (1881), and other volumes.

Heath, Perry Sanford, American journalist and politician: b. Muncie, Ind., 31 Aug. 1857. He learned the printer's trade, in 1877 became a newspaper reporter, in 1878–80 was editor of the Muncie *Times,* and in 1881 established the *Pioneer* at Aberdeen, S. D. In 1881–93 he was a correspondent at Washington, D. C., in 1894–6 president and general-manager of the Cincinnati *Commercial-Gazette* (now the *Commercial-Tribune*), and in 1897–1900 was first assistant postmaster-general of the United States. In 1900 he was elected secretary of the Republican National committee.

Heath, William, American soldier: b. Roxbury, Mass., 7 March 1737; d. there 24 Jan. 1814. When the Massachusetts congress in 1774 voted to enroll 12,000 minute men, volunteers from among the militia, Heath, then a farmer in Roxbury, was commissioned as one of the generals. In June 1775 he received the appointment of brigadier in the Continental army, and in August 1776 was created major-general. When the troops moved to New York Heath was stationed in the highlands near King's Bridge, with orders to throw up fortifications for the defense of that important pass. In 1777 he was transferred to Boston, and the prisoners of Saratoga were entrusted to him. In June 1779 he was again in New York, at the Highlands, with four regiments, and was stationed near the Hudson till the close of the war. He was the last surviving major-general of the war. Consult: 'Memoirs of Maj.-Gen. Heath, containing Anecdotes, Details of Skirmishes, Battles, etc., during the American War' (1798).

Heathcock, Heath-hen. See BLACKCOCK.

Heath'cote, Caleb, American merchant: b. Chesterfield, Derbyshire, England, 6 March 1665; d. New York 28 Feb. 1721. He was successful in a mercantile career in New York from 1692, save for the years 1698–1701, was a councillor of the province, was a petitioner for a license to build Old Trinity, was mayor of New York in 1711-14, and held other posts, among them those of judge of Westchester County; commander-in-chief of the military of the colony; surveyor-general; and receiver-general of customs for North America. His letters and despatches afford interesting glimpses of the history of his time.

Heaths, or Heather, a group (*Ericoideæ*) of the order *Ericaceæ.* The leaves of the heaths are simple and entire; their flowers oval, cylindrical, or even swelled at the base; the anthers of many with horn-like appendages. From 400 to 500 species are known, 12 or 15 of which inhabit Europe, and have small flowers, while all the remainder are natives of South Africa, many of them bearing brilliantly colored flowers, and forming one of the most characteristic genera of that region of dry plains. The common heath of Europe (*Calluna vulgaris*), a low shrub, often covers exclusively extensive tracts of dry land, and is used in domestic economy; mixed with oak-bark it is employed in tanning; and also, when tender, for fodder. This species forms the «heather» of British moorlands; but in Scotland are two other species, whose flowers are the «heather-bells» of Scottish song and story. Many South African species, remarkable for the size and beauty of their flowers, are much cultivated in greenhouses, and have been so improved and hybridized that they exhibit a wonderful richness of color.

Heating and Ventilation. Generally speaking, the methods of heating buildings may be divided into two general classes — the direct and the indirect system, or a combination of the two. Heating by means of an open fire, by a stove, and by radiators placed in the rooms to be warmed are examples of the former method, while furnace-heating and heating by means of a current of air warmed by indirect steam or hot-water coils are examples of the latter method. When a direct radiator is fitted with a connection to the outer air, it is said to be arranged on the direct-indirect principle. Hot water, steam, or electricity may be the vehicle used for conveying heat to radiators. Ventilation is only obtained by supplying air, and in some systems of heating and ventilation the air is made so hot that part of it is available for heating purposes. This is the case in furnace-heating.

It is well known that when two bodies of different temperature exist, heat passes from the warmer to the cooler body until their temperatures are equal. If a building be of a temperature of 70° F. and the outer air of a lower temperature, heat will be transmitted by the walls, windows, and other exposed surfaces, and the temperature of the air in the building will be lowered. It is only by supplying to the building an amount of heat equivalent to that transmitted by the walls and windows that it is possible to maintain the building at constant temperature. If we supply more heat than is transmitted by the walls, the temperature of the room rises.

Heat is measured in units which have as exact a value as a ton of coal or a pound of sugar. British physicists have selected as the unit of heat that quantity which will raise the temperature of one pound of water one degree on the Fahrenheit scale when the water's temperature is near 39° F. This unit is designated as the British thermal unit. It is known with reasonable accuracy just how many heat-units are transmitted by each square foot of wall, window, and other exposed surfaces of the various materials used in building construction, under such extreme conditions as to building and outside temperature as may exist. With these data and the plans of a building, calculation will show the heat-loss from a building or a room, and the heating-apparatus should be proportioned to supply this amount of heat. Allowances are made for various conditions that may exist, depending upon the judgment and experience of the designer. The heat required can be supplied by radiation from an open fire or from a stove, but this is an unsatisfactory method. Direct radiators supplied with steam or hot water can be placed in a room to furnish the heat necessary, or the heat may be supplied by hot air from a furnace, or by air heated by indirect radiators supplied with steam or hot water.

Heating by hot air is a slightly more expensive method than heating by direct radiation, for to be effective the air must be taken in from outdoors, sometimes at very low temperature, and heated above the temperature of the room to be warmed. If cold air at 40° F. is heated to 100° F., and is supplied to a room at this temperature, it is evident that as soon as this air is cooled from 100° to 70° no more heat can pass from the air to the room if the temperature of the latter remains at 70°. Under these conditions only one-half of the heat that has been supplied to the air is available for heating the room. This will tend to show why heating by hot air is more expensive, estimated from the cost of fuel, than the direct system. When the advantages of the air supply that accompanies indirect heating are taken into account the increased fuel cost becomes insignificant.

Direct heating is usually obtained by steam and hot-water radiators. Although manufacturers have greatly improved the appearance of direct radiators, at best they are unsightly and objectionable from an artistic point of view. This objection may be overcome by concealing the radiators in boxing beneath windows, when the walls of the building are thick enough to permit the boxing to be built in without projecting into the room. A screened opening is provided in the front of the boxing near the floor, and one at the top over the radiator, to permit a circulation of air, so that the radiators can be effective.

In residence-heating it is frequently the custom to heat the first floor by the indirect method and the upper stories by the direct. When an owner will pay for it, the indirect method is used throughout the building. Such a system is much to be preferred to the direct.

The simplest method of connecting steam-radiators is by the gravity system, and it is usually employed unless steam exhausted by engines is available for heating. This system comprises distributing-mains connecting with the top of the boiler, and with vertical riser-pipes from which horizontal branches lead to the radiators. Usually a return pipe is connected to the opposite end of the radiators from that at which steam is admitted, this return connecting, through return risers and mains, with the boiler at a point below the water-line. As the steam in the radiators condenses, the resulting condensation flows back by gravity through the return pipes to the boiler. The flow and return pipes are made sufficiently large to insure a practically uniform pressure throughout the system. The system is simplicity itself, as the fire only needs attention. When the boiler is once filled, no more water is required.

It is only recently that the steam exhausted by engines and pumps has been used for heating. Before this time steam direct from the boilers was used in direct radiators for heating mills and factories. The radiators consisted of coils of pipe suspended from the walls or ceilings. Sometimes the condensation was returned to the boilers by a pump or other device; sometimes it was allowed to go to waste. As the steam exhausted by engines, pumps, etc., contains a very large percentage of the heat that it contained upon entering the engine, someone conceived the idea of utilizing this steam for heating buildings, thereby saving the steam direct from the boilers that would otherwise have to be used. This practice is now almost universal where exhaust-steam is available, and the saving that it has occasioned is very great. By placing what is known as a back-pressure valve in the exhaust-pipe, sufficient pressure is maintained to cause the exhaust-steam to circulate through the pipes and radiators of the heating-system, the latter being connected to the exhaust-pipe between the engine and the back-pressure valve. The condensation that occurs in the heating system can be collected and returned to the boilers by various methods. Usually a pump or similarly acting device is employed.

A hot-water system arranged on the gravity-principle has flow and return pipes similar to the gravity-system of steam-heating described. The entire system is filled with water. As the water is warmed in the boilers it becomes lighter in weight per cubic foot, making a difference in pressure between the flow and return pipes and causing a circulation to begin. The water rises in the flow pipes to the radiators and is there cooled. On its return to the boiler the water is again heated, and so the circulation is maintained. As the difference in weight between the water in the flow and return pipes is very slight, the motive power producing the circulation is very slight also. Hence the pipes have to be relatively larger than for steam-heating and very carefully connected to avoid excessive friction, which would stop or retard the circulation. As large pipes are costly, in some large plants heated by hot water, a circulation is brought about by pumps.

Direct steam-radiators emit about 250 British thermal units per square foot of radiating surface per hour, and hot-water radiators about 180 heat-units per square foot. Consequently about one third more radiating surface is necessary with hot water than with steam. The pipes also must be larger, hence the hot-water system is the most expensive in first cost. Hot water, however, is cheaper to operate, for water will circulate with a very low fire and supply the small amount of heat required to warm a building in mild weather.

With direct steam-heat, operating on the gravity-system, it is impossible to vary to any appreciable extent the temperature of steam in a radiator; hence with this system the alternative is, all the heat the radiator will supply or none at all. This is the principal objection to heating by means of direct steam. Air warmed by the relatively cooler hot-water radiators is thought by some to be more agreeable than air heated by steam-radiators.

With indirect heating the lack of means of regulating the steam-temperature is not of so much moment, for the air-supply can be partly shut off by partly closing a register in mild weather; or else, if the full air-supply is required at all times, arrangements can be made for passing part of the air-supply around the indirect radiators, which is called "by-passing" them. Another method is to divide the indirect radiator into independent sections and place some of the sections under the control of a regulator that automatically shuts off the supply of steam when the room becomes too warm. The method of "by-passing" the radiator, or subdividing it, is used mainly with the fan-system of supplying air.

The cost of indirect hot-water heating is greater than that of indirect heating by steam, as the radiators and pipes must be larger, the same as in direct heating. Hot water is, however, cheaper to operate. The principal objection to its use in indirect heating is the possibility of damage to the indirect radiators through the freezing of the water in them in severe weather, if the circulation should from any cause be arrested.

The direct-indirect system consists of direct radiators connected with the outer air by means of an opening in the building-walls beneath the window-sill, the radiator being set under the window opposite the opening. With this system there is always the possibility of getting too much air when the wind blows strongly. Furthermore, in situations where the air is smoke-laden or dusty, it is not easy to keep the smoke and dust from entering a building supplied with air by this means.

As has been said, a supply of air may be brought about by the gravity-method or by means of fans. In the gravity-method the heated column of air in the flue is lighter than the outdoor air; hence it rises. As in the case of hot-water heating, the motive power is very slight, and it becomes less as the outdoor temperature increases. For this reason the gravity system is not a positive one, and it cannot be depended upon to supply much air in mild weather. Its use for schoolhouse ventilation is therefore to be deprecated. An important advantage of this system is its simplicity, as no machinery is required with it.

With the fan-system some type of fan is employed, to give a positive supply of air. The air is blown over coils, usually steam, and delivered to the room at a temperature slightly above that of the room, if the air-supply is intended to ventilate only, or at a higher temperature if the air-supply is to carry with it the heat necessary to balance that transmitted by the walls and windows. In the former event the indirect coils act as tempering-coils, being sufficient only to raise the air to about 70° F. If the air-supply is to furnish heat for warming the rooms, additional coils, known as supplementary coils, are provided. These raise the air-temperature from 70° to from 100° to 120° F. Sometimes the supplementary coils are combined with the tempering coils, the whole being divided into several independently controlled sections. In some instances the supplementary coils are divided into a number of small coils, one being placed at the base of each air-supply flue, and so arranged that, by adjusting dampers controlled by hand or automatically, the temperature of the air supplied to any room can be regulated independently of that supplied to other rooms. If all of the air is passed through one group of coils, independent regulation of the temperature of the air in the branch ducts and flues is impossible. This independent regulation can be obtained, however, by the double-duct system. The coils are divided into two groups, one for tempering and one for supplying additional heat. All of the air is passed through the tempering coils, but only part of it through the supplementary coils, the balance "by-passing" the latter coils and flowing through a system of ducts, usually located below the system conveying the air of higher temperature, to the base of the flues. At the junction of the two ducts a mixing-damper is provided, so arranged as to open in one duct as it closes in the other. By adjusting this damper the air can be mixed to give the resultant temperature required.

In situations where direct radiators can be used, either exposed or concealed, it is becoming the practice to provide sufficient heat by means of direct radiation to balance the heat transmitted by walls, windows, etc., also a supply of tempered air for ventilation only. As previously explained, when heat is supplied by means of air, the fuel-cost is greater than with direct heating; so that a building can be warmed with less coal with the direct than with the indirect system. Furthermore, with the combined system, heating can be done at night, and at other times when air-supply is not required, at minimum cost. This system is particularly adapted for schoolhouse heating and ventilation.

The withdrawal of impure air from rooms is effected by fans connected to a system of vent-flues extending upward to an attic space, or downward to a cellar or basement, if the latter is more convenient. Another method of accelerating the outflow of air through flues rising to the roof of a building is by the use of aspirating coils. These are simply coils of pipe, or radiators, placed in the vent-flues as low down as possible, the coil heating the air and thus causing it to rise. Theoretically the aspirating-coil is a more expensive method of moving air than the mechanical method, as far as fuel-cost is concerned. It is simpler, however, than the fan-system.

Fans are of two general types — the disk or propeller fan, and the centrifugal blower. The former is constructed somewhat like a ship's propeller, and the current of air that it produces is mainly in a direction parallel with the shaft of the fan. The centrifugal blower, as usually designed, consists of a wheel with blades, something like a ship's paddle-wheel, enclosed in a casing. The air enters at the axis of the fan, and when the fan-wheel is revolved the air is discharged radially to the casing by the action of centrifugal force. Relatively speaking, the propeller-fan will move a large volume of air with small expenditure of power, but the pressure at which it will deliver air is limited. The centrifugal fan will deliver air under a greater pressure and the power required is therefore greater. In some buildings, where the system is of ducts and flues, is long, and the cross-sections are comparatively small, to save space, quite a pressure is required to force the necessary amount of air through them. For such situations the centrifugal blower is best adapted. When the ducts are short and of ample area, it is best to use the propeller type of fan.

Fans are driven usually by small steam-engines or by electric motors. Sometimes gas-engines have been used with success. Where an engine is used, it is necessary for the boilers to operate under a sufficient pressure to drive the engine, or at least under a higher pressure than is commonly used with the gravity-system of connecting radiators. If the steam exhausted by the engine is condensed in the heating-system, as it usually is, a pump is necessary to return the condensation to the boilers. In large office buildings, public buildings, theatres, etc., where a skilled engineman is employed to care for the plant, the use of a pump, an engine, etc., does not present an objection. On the other hand, in the case of schoolhouses, large residences, churches, etc., which are apt to be looked after by less skilled attendants, an engine, pump, and other apparatus that must go with them are open to objection. In such cases electric motors can be used if current can be obtained from an electric-supply company. The entire heating system can then be operated on the simpler gravity-system. Of course the current must be paid for, but in many locations its cost will be more than offset by the greater simplicity of the motor-driven system.

Heating by electricity is not done to any great extent, on account of the excessive cost. When coal is burned under a steam-boiler, it is not uncommon for 60 per cent of the heat in the fuel to be realized in the steam which can be used for heating. If the heat in coal be transformed into electrical energy, and this again transformed into heat, less than 10 per cent of the heat in the fuel will be realized for heating.

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Consulting Engineer.

Hea'ton, Augustus George, American artist: b. Philadelphia, Pa., 28 April 1844. He was the first pupil from the United States to study at the Paris Beaux-Arts, where he was trained by Cabanel. Later (1878–80) he was in the studio of Léon Bonnat, and exhibited considerably at the Salon. Among his paintings are: 'Washington at Fort Duquesne'; 'The Recall of Columbus,' engraved on the 50-cent Columbian Exposition stamp of 1893; a portrait of Bishop Bowman; and 'Hardships of Emigration,' engraved on the 10-cent Omaha Fair stamp. He wrote 'The Heart of David — the Psalmist King' (1900).

Heaton, John Henniker, English publicist: b. Rochester, Kent, England, 1848. He was for some time prominent in Australian journalism and has sat in the House of Commons for Canterbury from 1885. He carried the Imperial Penny Postage Scheme in July 1898, introduced telegraph money orders into England, the parcel-post to France, and has been connected with other progressive schemes. He has published: 'Manners and Customs of the Aborigines of Australia'; 'Australian Men of the Time'; etc.

Heaton, John Langdon, American journalist: b. Canton, N. Y., 29 Jan. 1860. He was graduated from St. Lawrence University in 1880, entered journalism as a member of the Brooklyn *Times* staff in 1881, and in 1897 became assistant editor of the New York *World*. His publications are: 'The Story of Vermont' (1889); 'Stories of Napoleon' (1895); 'The Book of Lies' (1896); 'The Quilting Bee' (1896).

Heaven, in a physical sense, is the azure vault which spreads above us like a hollow hemisphere, and appears to rest on the limits of the horizon. Modern astronomy has taught that this blue vault is, in fact, the immeasurable space in which earth, sun, and planets, with the countless host of fixed stars, revolve. The blue color of the heavens is due to the action of minute particles in the air upon the blue rays in sunlight.

In ancient astronomy, heaven denoted a sphere or circular region of the ethereal heaven. The ancient astronomers assumed as many different heavens as they observed different celestial motions. These they supposed to be all solid, thinking they could not otherwise sustain the bodies fixed in them; and spherical, that being the most proper form for motion. Thus they had seven heavens for the seven planets: the moon, Mercury, Venus, the sun, Mars, Jupiter, and Saturn. The eighth was that of the fixed stars, which was particularly denominated the firmament. Ptolemy adds a ninth heaven, which he calls the *primum mobile*. But others admitted many more heavens, according as their different views and hypotheses required: Eudoxus supposed 23; Regiomontanus 33; and Fracastoro no less than 70.

In theology, this word denotes the upper and nobler region of God's universe, in contrast with the earth, the lower part assigned to men for their habitation. Of the belief in the existence of some special scene of the presence of Deity, the majority of the known religions of the world bear ample evidence. According to Aristotle all men, whether Greeks or barbarians, had a conception of God; and all united in placing the residence of the gods in the most elevated regions of the universe. This idea runs through the Persian, Egyptian, German, Scandinavian, and indeed of all the ancient religions in which the belief in a supreme being assumes any other form than the pantheistic; and even though the pantheistic philosophers may have denied that any peculiar locality could be regarded as the peculiar habitation of the Deity, we find that the popular belief and worship of the sect is evidently grounded upon a contrary opinion. In addition, however, to its being the special seat of the Deity, heaven also denotes the place, or the state or condition of blessed spirits, and of the souls of just men either immediately after physical death or at some certain period subsequent to it. All the religious systems which include the immortality of the soul involve, at least in substance, the idea of a future state of happiness as a reward for a virtuous life. The delights of the heavens of the various creeds differ greatly in kind. The pleasures of the classical Elysian fields were to a great extent pleasures of sense; the German warrior believed he would be transferred to a region where he would be able to pursue his old fierce enjoyments, and the American Indian cherishes the notion that he quits this world for a happier hunting-ground. Among Christians the general opinion is that heaven is the residence of the Most High, the holy angels, and the spirits of just men made perfect, that this abode is eternal, its joys entirely spiritual; it is believed also by many that the just who are free from sin are admitted into heaven immediately after death; also that the souls of the patriarchs, prophets, and in general the good, were detained, before the new dispensation, in a temporary abode till the coming of the Redeemer. See IMMORTALITY.

Heaves, or Broken Wind, a disease of the horse generally described as unsoundness of the respiratory organs. The disease is not well understood by veterinarians and the treatment is unsatisfactory. It is generally conceded that the disease is incurable. The characteristic symptoms are labored breathing, dilated nostrils, bloodshot eyes and dependent belly. Horses with this disease often drop down while at work and succumb to congestion of the lungs, hemorrhage or suffocation, the direct result of the heaves. Upon post-mortem examination the stomach is found distended and to have thinner walls than in the normal horse.

Hebe, hē'bē, according to Greek mythology, the goddess of youth, and the cup-bearer on Olympus until replaced by Ganymede. She was a daughter of Zeus and Hera, who gave her as a wife to Heracles, in reward of his achievements. At Rome she was worshipped as Juventas. She is described by some authorities as a divinity who had it in her power to make old persons young again. In the arts she is represented with the cup in which she presents the nectar, under the figure of a charming young girl, her dress adorned with roses and wearing a wreath of flowers. An eagle often stands beside her, which she is caressing.

Heber, hē'bėr, **Reginald,** English Anglican bishop and poet: b. Malpas, Cheshire, 21 April 1783; d. Trichinopoli, India, 1 April 1826. He was educated at Brasenose College, Oxford, distinguished himself by the English prize poem —'Palestine,' was elected to a fellowship in All Souls' College, traveled in Germany, Russia, and the Crimea, entered holy orders in 1807, and became the incumbent of Hodnet, Shropshire. In 1812 he was appointed prebendary of St. Asaph, in 1815 Bampton lecturer at Oxford, in 1822 preacher at Lincoln's Inn. From 1822 until his death he was bishop of Calcutta, at that time constituting one very extensive diocese, in all parts of which he traveled to the furtherance of the mission work in progress. He completed the establishment of Bishop's College, Calcutta, begun by Bishop Middleton. Heber is best known for his hymns, 58 of which, including the familiar 'From Greenland's Icy Mountains,' 'Brightest and Best,' and 'Holy, Holy, Holy!' appear in 'Hymns Written and Adapted to the Weekly Church Service of the Year.' In prose he wrote 'A Life of Bishop Jeremy Taylor' (1822), and 'A Journey Through India' (1828). Consult the 'Life' by Smith (1895).

Hébert, Jacques René, zhāk rē-nā ā-bār, French journalist and politician: b. Alençon, Orne, 15 Nov. 1755; d. Paris 24 March 1794. At the beginning of the French Revolution Lemaire published a journal supporting constitutional principles under the title 'Père Duchesne.' The Jacobins soon established a rival 'Père Duchesne,' of which Hébert became editor. The journal owed its success to the cynical virulence with which it advocated the popular cause, and abused the court and the monarchy, and soon had the field to itself. He was a member of the Revolutionary Commune that approved the massacres in the prisons in September 1792, was soon after substitute attorney of the commune, and employed all his influence in forwarding a project to establish the authority of the commune on the ruins of the national representation. The Girondists, who were at that period contending against the Mountain, had credit enough to procure the arrest of Hébert 24 May 1793. Again restored to liberty, he assisted with all his power and influence in the proscription of the Brissotins. Their downfall hastened his own. With Chaumette he established the 'Feast of Reason,' and afterward accused Danton of having violated the nature of liberty and the rights of mankind. This terrified both Danton and Robespierre, who suspended their mutual jealousies to accomplish his destruction; and Hébert, with the greater part of his associates, was arrested and guillotined.

Hébert, Louis Philippe, Canadian sculptor: b. Sainte Sophie d'Halifax, Quebec, 27 Jan. 1850. He studied for several years in Canada, and later in Paris, where he established his studio. In 1894 he won the Confederation medal awarded by the Canadian government. Among his works are historical subjects executed for public buildings in Quebec, Ottawa, and Montreal.

Hebrew Language and Literature, the tongue in which the ancient Jews spoke and wrote, and the books produced by that people during their settlement in Palestine as an independent nation; these latter constitute the Hebrew Scriptures and are looked upon by the Hebrews as containing the inspired word of God. See JUDAISM—HEBREW LANGUAGE; JEWISH LITERATURE; JEWISH PHILOSOPHICAL WRITERS; THE JEW IN ART, SCIENCE, AND LITERATURE; THE TALMUD; THE MASORAH; THE CABALA.

Hebrews. See Jews in America; Jewish Sects; Jewish Charities; Judaism—Its Principles; Jewish History; Reformed Judaism; Zionism; Anti-Semitism; The Karaites; Status of the Jew throughout the World; Rabbinic Legislation; Jewish Emancipation.

Hebrews, one of the canonical books of the New Testament, usually spoken of as "The Epistle to the Hebrews." The fact that it lacks the introductory formula naming author and recipients, to be expected in every ancient letter, has led some to deny that this writing is a letter. But this form may in this case, as often, have been placed on a separate sheet and become lost, or for some other reason have failed to be copied. At any rate many expressions show that it really was a letter addressed by some individual to a definite group of early Christians. In the King James version it was styled "The Epistle of Paul the Apostle," and thus has been perpetuated an early Alexandrian tradition, which later became the universal opinion for many centuries. But this view was at first unknown in Rome and the West, where are the earliest traces of the use of this writing, and it differs from the acknowledged epistles of Paul in both style and thought. The language is here more idiomatic and choice; clauses and sentences are connected by an array of conjunctions largely different from those used by Paul; instead of his abrupt, almost disconnected course of expression, earnest to vehemence, we find in Hebrews a series of balanced periods, flowing smoothly even when most emphatic, and a style abounding in almost artificial devices of rhetoric. There is no less difference in the theological conceptions and their presentation. While not antagonistic to Paul's doctrines, being rather complementary, the doctrinal teachings here are yet variant, as, for example, the teachings as to the divine Sonship of Christ; the nature of faith, and the value of the law of Moses.

While the Pauline authorship is now set aside as out of the question by the practically unanimous judgment of critics of every school, there is no general agreement as to who did write the book. Clement of Rome and Luke have been urged for no reasons except valueless suggestions made by Clement of Alexandria and his pupil Origen. Harnack has conjectured that it may have been written by Priscilla in association with her husband Aquila, but this view can satisfy only such as regard it as addressed to Roman Christians. The conjecture of Luther that Apollos was the author has been widely accepted, while the later suggestion that it was written by Barnabas has met with the approval of many scholars of the highest rank. The latter view has in its favor, to be sure, the only ancient testimony of real weight, that of Tertullian, but it must be allowed that either Barnabas or Apollos would meet all the requirements of the case so far as they are now known, and consequently that the authorship cannot be positively decided.

There is no less uncertainty in naming the persons to whom it was originally addressed. The title prefixed very early, though in all probability not originally, was "To Hebrews," and the view that it was addressed to Jewish Christians is nearly universal. Not a few scholars, however, have lately declared in favor of the view that it was written rather to Gentile Christians. The decision hinges on the answer to the question whether the danger against which the author warns his readers is relapse into heathenism or relapse into Judaism. On the one side it is urged that relapse into Judaism could not properly be designated "apostasy from the living God," while on the other side it is urged that, while Judaism was in the author's mind good as compared with heathenism, yet its acceptance at cost of a surrender of all that was distinctively Christian might reasonably be styled apostasy. It has certainly seemed to most that the fact that the whole thought of the book is the superiority of Christianity over Judaism proves that the danger against which the first readers were warned was relapse into what the author regarded as relatively worthless because an outgrown and outworn stage of divine revelation, and that the opinion that apostasy into heathenism was the readers' danger is only "an ingenious parodox," even though "an amount of ingenuity has been expended in support of this hypothesis, sufficient to render it plausible."

To some extent the questions as to place and date depend for their answer upon the conclusion as to the character of the first readers. If addressed to Hebrew Christians, it is scarcely possible that its date can be later than 68, just before the Jewish war which resulted in the destruction of Jerusalem, and the final removal of the danger of relapse into Judaism, while the fact that it is addressed to a second generation of believers and the references to the lapse of considerable time make it necessary to set the date as late as possible. If addressed to Gentile Christians, it might be dated as late as 85 or even 90. But that in any case it is a first-century production is guaranteed by the use made of it by Clement of Rome before the year 100.

Where the first readers are to be looked for hangs as completely on their character as does the question of date. If Gentile, most would think it probable that they were to be found at Rome, where they may have constituted only a single group of many among the Christians in the city. If, however, they were really Hebrews, it is, if not impossible, at any rate less likely that they were at Rome. The reference to "those from Italy" is ambiguous, but it would seem plausible that Timothy had been imprisoned at Rome rather than that on release he should hasten hither. If the core of the book is a warning against Judaism, it would be natural to look for those needing such a warning nearer the Temple than was Rome. While it is generally regarded as improbable that the letter was addressed to the church at Jerusalem, there may have been many communities within easy reach of that city where such a group of Christians as these "Hebrews" could have been found. Syrian Antioch and Jamnia have been named among other places.

The author very fitly styled his work "a message of appeal." Such it is throughout. To be sure, the first ten chapters consist largely of argument skilfully marshaled and stated, but all is to strengthen appeal, and exhortation is constantly inwoven with demonstration. The great theme is the superiority of Christianity over Judaism. While this is developed in many phases, it may be briefly summed up in saying that in chapters i-vi the stress is laid on the personal superiority of Christ, as compared with angels, Moses, Aaron, and then (vii. 1-x. 18) the superiority of the work of Christ is set forth. But the whole is one plea for persistence in the Christian profession and life, and while the changes of the centuries have made much in this book peculiarly hard to understand and have robbed other arguments of some of their original force, yet, when understood, this plea for the value of Christianity remains cogent as well as earnest. DAVID FOSTER ESTES,

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Hebrides, hĕb'rĭ-dēz, **The**, or **Western Islands**, Scotland, an archipelago off the west coast, extending from lat. 55° 35′ to 58° 32′ N.; the most southern island being Islay, and the most northern, Lewis. The group is politically divided between the shires of Ross and Cromarty, Inverness, and Argyll, very nearly in the line of their coincidence with the coasts of the respective counties. They number about 400 in all, but many are inconsiderable islets and rocks, and only about 90 are inhabited; area, about 2,800 square miles; pop. (1901) 79,159. They are usually divided into the Outer Hebrides, of which the principal are Lewis and Harris (forming a single island), North Uist, Benbecula, South Uist, and Barra; and the Inner Hebrides — Skye, Mull, Islay, Jura, Coll, Rum, Tiree, Colonsay, etc. The Outer are separated from the Inner, and from the mainland, by a strait or channel called the Minch, which at its narrowest part, between Harris and Skye, is about 12 miles broad.

The climate is mild and salubrious, but variable, tempestuous, and humid. Snow and frost are almost unknown in the smaller islands, and are but little felt in the larger. There is comparatively little wood in the Hebrides, and on many of the islands none at all. In Lewis, Skye, Islay, Mull, and several of the other islands, however, both forest and fruit trees have been planted to a considerable extent, with great success. Oats and barley are almost the only cereal crops raised. Potatoes are extensively cultivated. Cattle constitute the staple product. The native breed are small but handsome. Cheese and butter of good quality are produced. The breed of horses is also small, but hardy and docile. The native breed of sheep is very small, but Cheviots have been introduced with success. The productive land is partly occupied as sheep-farms; much of it is held by "crofters," who occupy holdings usually of a very few acres, sometimes with a right of pasturage in common attached. There are also "cotters" who occupy houses, with or without a patch of ground, on the land of the crofter, the farmer, or the landlord, and who are often mere squatters paying no rent. Grouse-moors and deer ranges cover a considerable area. Owing to the minute division of the arable land there is in many places an excess of population. The condition of the crofters and cotters, especially in the Outer Hebrides and Skye, is very depressed, their dwellings miserable, and their living poor, consisting chiefly of potatoes, milk, and oat or barley bread, and in bad harvests it is often insufficient in quantity. The fisheries are not developed to the extent they might be. Whiskey is manufactured in Skye, Islay, and Mull. Gaelic is the universal language of the Hebrides, which in remote times were subject to the kings of Norway, but in 1264 were annexed to the crown of Scotland. They were held by various native chieftains, in vassalage to the Scottish monarch; but subsequently fell into the hands of one powerful chief, who thereupon (1346) assumed the title of "Lord of the Isles," and began to affect an entire independence of his sovereign. The abolition of hereditary jurisdictions in 1748 secured to these islands for the first time the peace and safety afforded by a just and powerful government. Little was known about the Hebrides until the publication of Johnson's 'Journey to the Western Islands of Scotland' (1775), and of Scott's 'Lord of the Isles,' which invested them with a popular interest which has been increased by the facilities afforded to tourists by the steamers of the Clyde.

Hebron, hē'brŏn (originally KIRJATHARBA, now EL-KHALÎL), Asiatic Turkey, a town of great antiquity in Palestine, 18 miles southwest of Jerusalem, 2,830 feet above sea-level. It lies in the narrow valley of Mamre, has narrow streets, high well-built stone houses with flat roofs, extensive covered bazars, with well-furnished shops, exhibiting glass manufactures, consisting of lamps, colored rings, etc., for which the place has long been celebrated. The chief mosque, El-Haram, built around the Cave of Machpelah, from which Christians are rigorously excluded, is esteemed by Mohammedans one of their holiest places. Hebron is one of the oldest existing towns, having been built seven years before Zoan (Num. xiii. 22), and it is mentioned prior to Damascus (Gen. xiii. 18). Abraham resided here, and acquired the Cave of Machpelah as a sepulchre for Sarah and his family. It was David's royal city for seven years. There is a German Protestant mission here. Pop. about 19,000.

Hebron, Neb., city, county-seat of Thayer County; on the Little Blue River, and on the Chicago, R. I. & P., and the Burlington & M. R.R.'s; about 63 miles southwest of Lincoln. It is situated in an excellent agricultural and stock region. It has a large flour-mill, a creamery, and a planing-mill. There are five churches, a high school, three banks, and three weekly newspapers. The shipments of wheat and live stock are extensive. Pop. (1900) 1,511.

Hecatæus, hek-a-tē'ŭs, distinguished Greek historian and geographer: fl. about 500 B.C. He was a native of Miletus, and the son of Hegesander, a member of an ancient and illustrious family. Of his public life the only event of which we have any definite knowledge was the part he took in the insurrection of the Ionians against the Persians. Being well acquainted with the resources of Persia, he vainly attempted to dissuade Aristagoras, the planner of the revolt, from his undertaking. Later he went as ambassador to Artaphernes, and prevailed on the satrap to win the confidence of the Ionians by lenient treatment. His two great works were his 'Tour of the World,' and his 'Genealogies.' The latter is little more than a prose version of the legends already given in versified form. He improved the map of the world made by Anaximander; and his writings were highly esteemed by Herodotus. The fragments of his works were published by Müller (1841-70).

Hecate, hĕk'ā-tē, in Greek mythology, a goddess, whose parentage is variously given.

Homer does not mention her. She appears to have been originally a Titan who ruled in heaven, on the earth, and in the sea. She could bestow or withhold at pleasure the blessings of wealth, victory, and wisdom to mortals, and was the only Titan who retained power under the rule of Zeus. She was subsequently confounded with several other divinities, and at length became a mystic goddess having all the magic powers of nature at her command. She was identified with Demeter and Artemis, and was regarded as the mystic Persephone. Magicians and witches prayed particularly for her aid. Sacrifices used to be offered to her at places where three ways met (whence her epithet Τριοδῖτις, or in Latin, *Trivia*), and these consisted of dogs, honey, and black female lambs. Her mysterious festivals were celebrated annually at Ægina. Her appearance was frightful. She had three bodies or three heads, and serpents hung hissing around her neck and shoulders.

Heck, Barbara, one of the founders of American Methodism: b. Ballygarry, County Limerick, Ireland, 1734; d. near Augusta, Ont., 1804. She was one of a colony of German immigrants in Ireland who were among the first to be influenced by Wesley's preaching. In 1760 she came to America with her husband, Paul Heck, and Philip Embury (q.v.). In 1766 she was very active in the organizing of a Methodist society which met at Embury's house, and she also did much toward the building of the Old John Street Methodist Church. Later she and her family removed to the northern part of New York State, and when the Revolution broke out went to Ontario, where they founded another Methodist society.

Heck'er, Friedrich Karl Franz, German-American soldier: b. Eichtersheim, Baden, 28 Sept. 1811; d. St. Louis, Mo., 24 March 1881. After studying law in Heidelberg, he abandoned his profession for political life. In 1842 he was elected to the Chamber of Deputies of Baden. On the outbreak of the revolution in Germany in 1848 he endeavored to convert the preliminary convention into a permanent republican assembly. Frustrated in this attempt, he put himself at the head of a band of revolutionists, and invaded Baden from the south. He was defeated at Käudern 20 May 1848, and fled to Switzerland. In the following year he removed to the United States, and became a farmer near Belleville, Ill. On the outbreak of the Civil War he raised a regiment of Germans, serving in General Fremont's division as colonel; and afterward for a time commanded a brigade.

Hecker, Isaac Thomas, American Roman Catholic clergyman: b. New York 18 Dec. 1819; d. there 22 Dec. 1888. In early life he was a member of the Brook Farm community, near Boston, where for nearly a year he officiated as baker for the establishment. In 1845 he became a Roman Catholic; went to Germany to study for the priesthood, and joined the Redemptorist Fathers in Belgium in 1847. He was ordained priest in London by Cardinal Wiseman in 1849. Returning to New York he founded the order of the Paulists (1858), became their superior; and established the 'Catholic World' (1865), of which he was editor till his death. An anonymous French version of Elliott's 'Life of Father Hecker' led to the noted "American" controversy. He wrote: 'Questions of the Soul' (1855); 'The Church and the Age' (1888); etc. Consult: Sedgwick, 'Father Hecker' (1900).

Heckewelder, hĕk'ĕ-wĕl-dėr, **John Gottlieb Ernest,** American Moravian missionary: b. Bedford, England, 12 March 1743; d. Bethlehem, Pa., 21 Jan. 1823. At the age of 12 he came with his father to Pennsylvania. He accompanied Post in 1762 in his expedition to the Indian tribes on the Ohio, and in 1771 took up his residence among them as a missionary. After some 40 years' missionary service, he went to Bethlehem, the principal establishment of the Moravians in America, and there remained till his death. He wrote several memoirs upon the Delaware and Mohegan Indians: 'Account of the History, etc., of the Indian Nations' (1818); 'Narrative of the Mission of the United Brethren' (1820).

Hec'la, or Hekla, Iceland, an isolated volcano in the southwest, about 20 miles from the coast. It is of comical shape, terminating in three perpetually snow-clad peaks, the central and loftiest of which, Heklufjall, is 5,110 feet high. The circumference at the base is about 12 miles. It is composed chiefly of columnar basalt, and of lava, mostly covered by stones, scoria, ashes, and other loose volcanic matter. Since the 10th century there are 43 eruptions on record. One of the most tremendous occurred in 1783, after which it remained quiescent till 2 Sept. 1845, when it again became active, and continued with little intermission for 15 months to discharge itself from three craters, its effects being felt as far as the Orkney Islands, 400 miles distant. The last outbreak was in 1878.

Hectic Fever, a type of fever which is intermittent, and is distinguished by an afternoon or evening quickening of the pulse, and rise of temperature. The eyes of the patient brighten, his cheeks flush, and there is some nervous and cerebral excitement. The fever is succeeded by a profuse perspiration. This affection is frequently associated with phthisis, abscess, or septicæmia, and is of dangerous significance.

Hector, in Homeric narrative, the son of Priam and Hecuba, and the bravest of the Trojans, whose forces he commanded. His wife was Andromache, the daughter of Aëtion. He encountered the Grecian heroes in battle, and often gained advantages over them. By his presence Troy was invincible; but when he had slain Patroclus, the friend of Achilles, the latter, forgetting his dispute with Agamemnon, resumed his arms to avenge the death of his beloved companion. Pierced by the spear of Achilles, the body of Hector was dragged at the chariot wheels of the conqueror; but afterward, at the command of Zeus, was delivered to Priam for a ransom, who gave it a solemn burial.

Hector, Annie French ("Mrs. Alexander"), Irish novelist: b. Dublin, Ireland, 1825; d. London 10 July 1902. She began to write at an early age and was a prolific and popular writer. Among her books, all of which enjoyed a wide popularity in the United States, are: 'The Wooing O't' (1873); 'Ralph Wilton's Weird' (1875); 'Her Dearest Foe' (1876); 'The Frères' (1882); 'A Golden Autumn' (1897); and 'A Winning Hazard' (1897).

Hec'uba, in Greek legend, the second wife of Priam, king of Troy, to whom she bore Hector, Paris, Cassandra, Troilus, and other children. After the fall of Troy she was given as a slave to Odysseus, and, according to one form of the legend, in despair leaped into the Hellespont.

Hed'ding, Elijah, American Methodist bishop: b. Dutchess County, N. Y., 7 Jan. 1780; d. Poughkeepsie, N. Y., 9 April 1852. At 19 he entered the Methodist ministry, and was appointed successor of Lorenzo Dow. He extended his travels to Canada, and preached the Gospel in various parts. He became a member of the New York annual conference in 1801, and was made a bishop in 1824. He was instrumental in the establishment of the 'Zion's Herald' at Boston, the first journal published by the Methodist Church in the United States.

Hedge, Frederick Henry, American scholar: b. Cambridge, Mass., 12 Dec. 1805; d. there 21 Aug. 1890. He studied in Germany 1815–23, was later graduated from Harvard and Harvard divinity school, and after holding Unitarian pastorates in Bangor, Maine; Providence, R. I., and Brookline, Mass.; was professor of German at Harvard University (1872–81). Deeply read in philosophy, ecclesiastical history, and German literature, he was a finished writer and a much admired orator, and ranked as perhaps the foremost German literary scholar in the United States. Among his writings are: 'Reason in Religion' (1865); 'The Primeval World of Hebrew Tradition' (1870); 'Martin Luther and Other Essays' (1888); etc. His 'Prose Writers of Germany' (1848) is a standard work. He translated poems from the German and wrote numerous hymns for the Unitarian Church.

Hedge, a fence formed of living trees or shrubs. Hedges are generally composed of one or more of the following species: Hawthorn, crab, blackthorn, holly, privet, beech, hornbeam, maple, barberry, furze, broom, alder, poplar, willow, yew, box, arbor-vitæ, sweet-briar, etc. When there are so many different species to select from, plants may be found suitable for almost all kinds of soil — such as wet or boggy, and dry or sandy; for all situations, whether sheltered or exposed; and for all purposes, such as fences against cattle, or simply as ornaments for garden and pleasure grounds.

Hedge'hog, a small insectivorous mammal of the Old World family *Erinaceidæ*, and especially of the genus *Erinaceus*, characterized by its coat of stiff spines. The family inhabit temperate Europe and Asia, but are not known on sea-girt islands. The best known of the score of species is the common hedgehog (*E. europæus*). It has a long nose, the face, sides, and rump covered with strong, coarse, yellowish hair, the back with sharp, strong spines; and is about nine inches long plus a very short tail. Hedgehogs, as their name indicates, reside under hedges and in thickets, where they turn over the leaves and root in the mould for insects (especially beetles), snails, lizards, roots, fallen fruit, etc.; they are, indeed, omnivorous. The hedgehog defends itself against attack by rolling itself up, and thus exposing no part of its body that is not furnished with a defense of spines. It may be rendered domestic to a certain degree, and has been employed in Europe to destroy cockroaches, which it pursues with avidity. In the winter, in cold climates, the hedgehog wraps itself in a warm nest, composed of moss, dried hay and leaves, and remains torpid till the return of spring. The female produces four or five young at a birth, which soon become covered with prickles. These animals are sometimes used as food, and are said to be very delicate. The long-eared hedgehog (*E. auritus*) of the East is smaller than the common, and is distinguished by the great size of its ears and shortness of tail. Fossil forms as far back as the Miocene differ little from existing species. No true hedgehogs exist in America; the animals often so called being the very different porcupines (q.v.).

Hedge-hyssop. See GRATIOLA.

Hedge-sparrow, a small brown warbler (*Accentor modularis*), with a sweet plaintive song, very common in Europe about gardens and roadsides in summer. It is not a sparrow at all, but nearly related to the American water-thrushes (*Seiurus*). In Great Britain it goes by many names, as dunnock, etc., and is one of the birds most frequently mentioned in books.

Hedin, Sven Anders, svĭn ān'dĕrz hĭ-dēn', Swedish geographer and explorer: b. Stockholm 19 Feb. 1865; was educated at Stockholm, Upsala, Berlin, and Halle, at the latter university receiving the degree of doctor of philosophy. In 1885 he began his first journey of exploration through Persia and Mesopotamia. In 1890 he went to Persia as a member of King Oscar's embassy to the Shah, and the next year journeyed through Khorassan and Turkestan. In 1893 he set out on a remarkable journey from the Russian frontier to Peking, through Tibet and the Lob-nor region. He arrived at his destination in 1897, having experienced four years of exciting and harrowing adventures. His second expedition to Central Asia began in 1899. In 1901, writing from Narkhlik, Dr. Hedin tells of finding the ruins of a beautiful Buddhist temple, some rare specimens of wood carving and 12 complete letters written in Chinese on paper and marvellously well preserved. Dr. Hedin has written five books, four in English: 'A Journey Through Persia and Mesopotamia' (1887); 'King Oscar's Embassy to the Shah of Persia' (1891); 'A Journey Through Khorassan and Turkestan' (1892); and 'Through Asia' (1898). He wrote also a scientific treatise in German, 'The Results to Geographic Science of My Travels in Central Asia.'

Hedonism is the name applied to any system of ethics which regards pleasure or happiness as the chief good; as the good, that is, which makes all other goods desirable and to which they are all means. Not only money, health and the like are valuable merely as sources of happiness, but virtue itself has no better claim to independent worth. In fact, for most hedonists, virtue is the name given to that kind of action which long experience has shown to conduce to happiness. The most important of the many subdivisions of the theory is that which distinguishes psychological from ethical hedonism. According to the first, pleasure is the inevitable content of every choice. Even in those instances of self-sacrifice which seem the most radical contradiction of such a view, the exception is apparent rather than real. For the martyr, death is preferable to denial. If it were not pleasant to him, he would not and could not choose it. Ethical hedonism, on the other hand, makes the choice of pleasure a duty rather than a fact. The two have sometimes been regarded as incompatible, on the ground that what necessarily regulates choice cannot be exalted into an ideal; but the frequent inclusion of both in the same system may have a partial justification in the necessity for the rejection of certain pleasures and the acceptance of certain pains, if the greatest possible happiness is to be attained in the end.

A second division of the forms of hedonism is that between individual and universal, and is based upon the number of persons whose happiness constitutes the good. Individualistic hedonism regards the happiness of the man concerned as his own chief good, while that of other people is either a matter of indifference to him, or else is of importance merely because it forms one of the elements of his own happiness. Evidently psychological hedonism is necessarily individualistic, although its combinations with ethical hedonism have often made it present an appearance of universality not strictly compatible with its original assumptions. Although there are plenty of modern instances of individual hedonism, these do not differ in essentials from the classical forms presented by the Cyrenaicism of Aristippus (cr. 435–356 B.C.) and the Epicureanism that sprang from it (Epicurus 342 or 341–270 B.C.). Both Aristippus and Epicurus taught that individual enjoyment was the supreme good, but they differed in their conception of the nature of enjoyment and of the means by which it was to be obtained. Aristippus advocated seizing the pleasure of the moment, untroubled by regret for the past or dread of the future. Epicurus, while he also preached against fear and regret, maintained that the object of desire was a happy life rather than a succession of pleasant moments, an organized whole, not a mere sum. Another distinction between the conception of the two is found in the nature of the pleasurable state as described by each. For Aristippus its chief characteristic was excitement; for Epicurus, tranquility; a difference that undoubtedly was largely responsible for the different means advocated by them. The later modifications of both theories show the well-known tendency of hedonism toward pessimism.

Universal hedonism was first brought markedly into notice by the Utilitarians, who found the supreme good, not in each man's own happiness, but in happiness in general, usually expressed by the formula «the greatest good of the greatest number.» The moral worth of an action must be judged by the amount of happiness it will tend to bring about in the long run; and the consideration of all the different elements of intensity, length of time, certainty, possible complicating pain, and so forth, known as the hedonistic calculus, is associated with the name of Jeremy Bentham (1748–1832). John Stuart Mill (1806–1873), to whose clear and persuasive mode of statement the theory owes much of its popularity, added to it the distinction between quality and quantity in pleasure. With the exception of Mill, both ancient and modern hedonists have almost invariably regarded pleasures as differing from one another in quantity alone, he, on the contrary, maintained that their differences were primarily qualitative, and that quality must be considered in the conception of the chief good. An action is to be judged, not only from the amount, but from the kind of happiness it causes. Mill's view has met with much adverse criticism, based upon the contention that with qualitative differences in pleasure a non-hedonistic criterion has been introduced, which is inconsistent with the initial assumption of hedonism. The adoption of hedonism by the evolutionists, especially by Spencer, has given it a scientific basis, to which its present currency is partly due. Although the end in such systems is preservation, either of the individual or of the species, or of both, yet the actions best adapted to that end are accompanied by pleasure, and the animal to whom useful actions are painful, does not perform them and is in course of time eliminated. Actions found desirable in the history of the race come to have a feeling of obligation attached to them; and although at present end and means may to the individual consciousness seem incompatible, yet as man becomes better adapted to his environment, all virtuous, that is, useful actions will bring pleasure directly as well as indirectly.

As a theory of ultimate value hedonism can, of course, be neither proved nor disproved. Its chief advantages are: (1) It provides a simple and self-consistent account of moral action. (2) It makes possible a closer union between ethics and natural science than that allowed by any other theory, and is able to make use of the constantly growing store of knowledge in biology, anthropology, and ethnology. The most important objections brought against it are: (1) It confuses origin with value. (2) In regarding the moral end as constituted by feeling alone, it is psychologically inadequate, and psychologically false in so far as it views pleasure as the exclusive object of choice. See also ETHICS; UTILITARIANISM.

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Heel-Fly. See BOT-FLY.

Heer, hār, **Oswald,** Swiss naturalist; b. Nieder-Utzwyl, Switzerland, 31 Aug. 1809; d. in Lausanne, 27 Sept. 1883. He was educated at the University of Halle; entered the ministry in 1831; as privat docent in botany in the University of Zurich 1834–52 and from 1852 professor of botany at the University and at the Polytechnicum, and from 1835–83 was director of the botanical gardens at Zurich. His most important works were: 'Flora Tertiaria Helvetiæ' (1854–6); 'Tertiary Climates in Their Relation to Vegetation' (1860); 'Die Urwelt der Schweiz' (1865–79); 'Flora Fossilis Helvetiæ' (1877); and 'Flora Fossilis Arctica' (1865–83).

Heeren, hā'ren, **Arnold Hermann Ludwig,** German historian and philologist; b. Arbergen, near Bremen, 25 Oct. 1760; d. Göttingen, 6 March 1842. He was educated at the cathedral school of Bremen and the University of Göttingen; in 1794 was appointed professor of philosophy and in 1801 professor of history at Göttingen. His chief works are: 'Ideen über Politik, den Verkehr und den Handel der vornehmsten Völker der alten Welt' (1793-6, 4th ed. 1824-6); 'Geschichte des Studiums der Klassischen Litteratur seit dem Wiederaufleben der Wissenschaften' (1797-1802); 'Hanbuch der Geschichte der Staaten des Alterthums' (1828); 'Geschichte des europäischen Staatensystems und seiner Colonien' (4th ed. 1822); 'Versuch einer Entwickelung der Folgen der Kreuzzuge' (1808); and 'Vermischte historische Schriften' (1803-8).

Heer'mans, Forbes, American dramatist: b. Syracuse, N. Y., 25 Oct. 1856. He was graduated from Cornell University in 1878, and is author of the dramas: 'Love by Induction' (1889); 'The Silent Witness' (1890); 'Between Two Foes' (1899) 'The Vagabond' (1893); 'Jess of the Bar Z Ranch' (1896); 'Down the Santa Fé Trail;' and the novels 'Thirteen Stories of the Far West' (1887); 'The Rancho of Heavenly Rest' (1892); 'The Investigators;' etc.

Hegel, George William Friedrich, philosopher, especially famous as the most systematic and historically influential of the post-Kantian German idealists, was born in Stuttgart, 27 Aug. 1770, and died as professor of philosophy at the University of Berlin, 14 Nov. 1831. He attended as a boy and as a youth the Gymnasium of his native city, and in 1788 was matriculated at the University of Tubingen, where he studied theology, and where he finished his course of study in 1793. From 1793 to 1796 he was private tutor in Switzerland, devoting his leisure, meanwhile, to theological and historical studies. In 1797 he accepted a private tutorship in Frankfurt, and remained there until 1800. During this period he wrote out the earliest sketch of his philosophical system, and, resolving to devote himself to philosophy, went, in November 1800, to the University of Jena, as Privatdocent. Here he lectured on philosophy until the troubles which followed the battle of Jena in October, 1806, interrupted for a time his scholarly work. During the years between 1800 and 1806 Hegel's philosophical teachings had assumed a much more highly organized form; he had published a number of important essays; and at the moment of the battle of Jena was just completing his first great systematic treatise, the 'Phänomenologie des Geistes,' i.e. the 'Phenomenology of Mind.' Unable to obtain, for the time, satisfactory opportunity as an academic teacher, Hegel thereafter passed a year as editor of a journal in Bamberg; and then obtained a position as rector of a gymnasium in Nürnberg, in 1808. He married the daughter of a distinguished Nürnberg family in 1811. Thereafter, while still at Nurnberg, he wrote his most important and finished philosophical treatise, the 'Logik,' in the years 1812-16. In 1816 he was appointed to a professorship of philosophy at the University of Heidelberg. In 1818 he accepted a call to the University of Berlin, where he rapidly won a position of the greatest influence, gathered about him many hearers and disciples, and became the head of a school of philosophy whose influence upon contemporary German thought was of the greatest. During his life he published, in addition to the works already mentioned, a summary statement of his whole system of philosophy entitled 'Encyclopädie der Philosophischen Wissenschaften,' and a treatise on the 'Philosophy of Law.' His lectures on the 'Philosophy of Religion,' on the 'History of Philosophy,' on 'Æsthetics,' and on the 'Philosophy of History,' were published posthumously. His complete works, including his letters, fill 19 volumes, which were edited by a group of his friends, in the years immediately following his death (excepting only the letters, which in their definitive edition, were published as Volume XIX of the works by his son, the historian, Karl Hegel, in 1887).

Hegel's philosophical position can only be understood in the light of his relation to Kant. Immanuel Kant (q.v.) (1724-1804), became, by the publication of his 'Critique of Pure Reason,' in 1781, the leader in the movement of modern German philosophical thought. In an age when the guidance of "Reason" was especially glorified by all the leading liberal and progressive teachers and parties of the day, Kant undertook a systematic inquiry into the nature, the limits, and the scope of the human reason. Previous philosophers, in the 17th and 18th centuries, had been especially divided in opinion regarding the question whether experience or reason is the source of our knowledge. Kant undertook to reconcile the conflicting views regarding this problem, and at the same time to map out, in a systematic way, the whole field which is accessible to human science. His result was, in substance, as follows: Human knowledge depends upon two factors, experience, and our own intelligence. Both factors are equally necessary for knowledge. Experience, when viewed apart from our intelligence, is a collection of mere data of sense, which are given, but which, in so far as they are *merely* given, are meaningless. The data of sense get their coherence solely through the active work of our intelligence. Our intelligence, whose manner of acting is spontaneous, is indeed awakened to reaction only through sense, and can give us knowledge only with reference to the facts of experience; but the data of sense get all their form, coherence, structure, meaning, only through the fact that our intelligence is guided in its activity by certain "categories," and formative principles, in terms of which we interpret these data, view them as due to coherent "objects of experience," and connect these objects so that the latter form the "world of experience.' Without the intelligence, then, with its "forms," no coherent experience is possible. Sense shows us, by itself alone, no objects, no connections of objects, no laws, no facts, no world. That we appear to find, in our world of perception, connected things, subject to laws, is due to the more or less hidden work of our intelligence, which gives form to the otherwise incoherent sensations. That we all have the same phenomenal world to deal with is due to the fact that intelligence is common to us all, in the same forms.

In consequence, what we know, and what our sciences of experience study, is neither a

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world of things simply given to us as brute facts from without, nor yet a world of mere sensations. On the contrary, what we know is the world of experience as our active intelligence inevitably *interprets* experience. Hence we know, not "things in themselves," but "phenomena," and not mere "data" of experience, but experiences as interpreted by the active constructive work of our intelligence.

Meanwhile, our intelligence, upon its higher levels, is indeed not content with this mere interpretation of the contents of sense, but,—still in its own spontaneous way,—defines ideals of objects and of laws which far transcend,—according to our own conception,—the facts of experience. The "Reason" proper, as distinct from the "Understanding" (that is, from the intelligence which merely interprets and renders coherent our experience), is the part or aspect of our intelligence which is concerned with these other and "transcendent" objects. The objects of the "Reason" proper, are objects which no human experience can reach or exemplify, and which we therefore conceive as lying beyond any possible experience. Such objects are God, the human ego itself, in its true nature, the cosmos in its entirety, and the moral law. Such objects we cannot, in any scientific sense, "know," just because our knowledge is limited to our interpretation of experience,—an interpretation due to the functions and to the categories of our lower intelligence, *i.e.* of our "understanding." Yet if the "transcendent" objects of the "pure Reason" cannot be "known," they nevertheless can be and must be "postulated," by virtue of a certain active and spontaneous "faith" which the Reason warrants. For these "transcendent" objects have for us a moral value, and give a meaning to life.

We, "know," then, "phenomena." Our "Reason," meanwhile, gives us "faith" in certain "Ideas" which relate to the "transcendent" objects. This faith is not knowledge, but is rationally warranted. It is the office of philosophy to bring to consciousness the "categories" in terms of which we inevitably interpret phenomena, and so organize our experience and get our science. It is also the office of philosophy to discover and define the "Ideas" in terms of which we just as inevitably organize our moral conduct, and give meaning to our practical life.

So, for Kant, this view of philosophy differs from the view of older philosophy in limiting our inquiries to the business of *interpreting experience* and *organizing life*. The philosopher then, is above all concerned with the universe, as the human Self, that is, as the Self which is, in type, the same in all of us, sees the universe, acknowledges it, and gives to it, in the form in which we experience its presence, the type of rational coherence. Any world which is not the world as the Self views it, is unknowable, and is a world of "things in themselves."

Hegel, in common with the other post-Kantian German idealists, builds upon the basis of this Kantian analysis of knowledge and of reason. His dependence upon Kant is shown by the very fact of his frequent and persistent criticism of that philosopher's positions. That Hegel's results are in one sense far removed from those of Kant becomes obvious upon a very brief consideration. But that, however much Kant's doctrine is transformed in Hegel's system, it is still Kant whose views are the principal ones thus transformed, is also certain. The relation can be made more explicit by the following statement of the contrast between Kant and Hegel:

1. The result of Kant's philosophy is that the accessible world is the world as the rational nature of the human Self requires us to interpret it. This result lies at the basis of Hegel's doctrine. But Hegel transforms it by dropping out of consideration, the adjective "accessible," as being superfluous. It is useless to talk of a world of unknowable or inaccessible "things in themselves," as Kant does. The world of reason is simply the world. There is nothing to know except what the nature of our intelligence requires us to acknowledge. Discover the secret of reason, and you have discovered the secret of the universe. This is the first characteristic thesis of Hegel's idealism. "Behind the curtain which is said to hide the inner nature of things," says Hegel in the 'Phenomenology,' "there is nothing, unless we ourselves go behind that curtain."

2. Kant furthermore divides the work of our intelligence between the activity of the "Understanding," which interprets special experiences, and the "Ideas" of that "Reason," which "postulates" our relations to ultimate reality. Hegel accepts this distinction as valid within its limits, but not as any absolute distinction. Our intelligence may and often does fix its attention upon fragments of knowledge. In that case it "abstracts" from the whole meaning of its own life, and thereby becomes *ipso facto* an "abstract thinking" or "understanding" of this or that object or law. Such abstractions are useful, and inevitable. But they are not final. The truth, however, is in Hegel's phrase, simply "the whole." Only that form of reason therefore which is concerned with the *whole* meaning of life is genuinely philosophical. But since this meaning is, after all, our own meaning, the meaning of the Self, it need not be simply a matter of "Postulates." It can be known to us.

3. Kant limited our knowledge to "phenomena." But this "limitation" loses its significance if once we see that there are no "things in themselves" to know. The world is for us a world of mere "phenomena" only in so far as we do not grasp the principle of which our experience is the expression. But, for Hegel, this principle is simply the absolute principle which lies at the basis of our own nature. As this absolute principle is not foreign to the Self the Self can grasp the principle. When it does so, it sees phenomena as the inevitable expression of the meaning of its own life. And then its phenomena become once more "actualities," as real as any finite facts could be. What we know then is not a *mere* world of phenomena. It is a world of absolute Truth.

4. Our ethical ideals form, for Kant, a world of their own, which we can never *know* to be real, but which we can, and must, *believe* to be real. This contrast of ideal and real, of knowledge and faith, Hegel believes to be founded only in a historical difference of cer-

tain stages of our own self-development. Faith, if once brought to a clear self-consciousness, becomes a knowledge as to what the absolute Self is and determines. And this knowledge philosophy can attain. Such a knowledge is *ipso facto* a knowledge of truth. For all truth is in and of the true Self, i.e. the Absolute

5. Kant, in trying to define the categories which lie at the basis of our interpretation of the world, had simply accepted those categories which he observed to be in use in our daily thinking, and in science. He treated them as a fixed set of principles. Regarding the origin and the mutual relations of these categories he has no extended theory. The categories are, for him, ultimate facts of our intelligence, determining its constitution, but of unknown source. Hegel, on the contrary, regards it as one of the principal tasks of philosophy to show why and how we come by just these categories which we use in the interpretation of experience, and in the ordering of life. His principal work, the 'Logic,' is devoted to such a treatment of the categories. And in fact, since, from Hegel's point of view, the world of "Thought" is the only real world, or, in other words, since the constructions of that absolute process which embodies itself in our thought and in our life are constitutive of *all* truth, this Logic, which is to show the true genesis and nature of the Categories, takes the place of all that, in the older philosophical systems, had been called Metaphysics. For the theory of the absolute constructive process which expresses itself in our experience and in our thinking is simply the theory of the universe. There is no other world to know than this world which thought constructs, which experience observes, and which constitutes our life and its meaning.

6. For Kant, nothing absolute is knowable. All our knowledge is relative. For Hegel, absolute knowledge is possible: for whoever knows the principles that determine the true nature of our thought and of our life, finds these principles, as the expression of the true Self, absolute.

This contrast of the positions of Kant and of Hegel may help to give the Hegelian philosophy its proper historical setting, without which it inevitably appears to be a presumptuous attempt to transcend the natural limits of human reason. For Hegel, these limits are not what they seem. That is, they are not absolute limits. For what we have to consider, when we philosophize, is not a foreign world, but is rather the whole truth with regard to the meaning of the very life which we ourselves are experiencing and are living

In his first great work, the 'Phänomenologie,' Hegel gave an account of the various successive stages through which the human mind, as it appears in history, passes, in its transition from a naïve dependence upon the senses to the stage of philosophical reflection. In his 'Logik,' as has just been stated, Hegel undertakes to describe the way in which philosophical reflection leads us to the categories. The categories themselves are successive stages or phases of our interpretation of absolute truth. Their succession itself is determined by a certain "dialectical" procedure, whereby the lower categories are, through an immanent development, transformed into the higher categories. In the system of Hegel, as he planned the order of its parts, the 'Logik' is next followed by the 'Naturphilosophie,' or 'Philosophy of Nature.' The only connected treatment which this portion of the system ever received is the mere compend contained in the second part of Hegel's 'Encyclopadie.' The 'Naturphilosophie' consequently remained, from Hegel's point of view, imperfectly worked out. The third portion of the system was the 'Philosophy of Mind.' This also was left without adequate working out by the philosopher, although in his 'Rechtsphilosophie,' in the third section of his 'Encyclopädie,' and in his posthumously published lectures, there is a very extended treatment of various parts of this concluding portion of his undertaking Under the 'Philosophy of Mind' Hegel included, first the whole range of psychology, and the philosophical theory of the relations between nature and mind; secondly, ethics and the philosophical theory of the state; thirdly, philosophical aesthetics, or the theory of the beautiful; and finally the philosophy of religion.

The range and general intention of the Hegelian doctrine are thus suggested although, owing to the vast range of his undertaking, this can here be done only in a very inadequate way. Further characteristic of the philosopher are especially (1) his "dialectical method," and (2) his theory of the Absolute.

By the dialectical method Hegel means a procedure of which some of the dialogues of Plato give us classical instances, and which Kant's "Antinomies" as well as Fichte's method of procedure in philosophy had exemplified, although the systematic use of the method in Hegel's way is due to his own initiative. Truth, according to Hegel, comes to us, in the first place, through the medium of "immediate" experience. Without such experience, we could indeed proceed no further on the way toward insight; and this is the permanent justification for "empiricism" in philosophy, if only we observe that this barely immediate experience, although indispensable, remains meaningless unless we transform experience through the activity of our thought. Thought begins by observing that immediate experience, taken merely as it comes, is, so far, not yet intelligible. The first work of our thought is therefore to classify, to divide, to fix upon distinct aspects of facts, to form generalizations and so to convert what comes to us as immediate into the abstract form of our various *Gedanken*, or conceptual constructions. This is, so far, the work of "the Understanding." Such work first results in our regarding truth as something which, on the one hand, is fixed, *universal*, and abstract, while, on the other hand, this world of truth also appears to us to be a world of infinitely *various* special truths, which relate now to this and now to that individual thing, or fact, or law So far as our understanding dwells upon the fixity, the universality, the abstract generality of its truths, it finds, or endlessly seeks to find *unity* in the world. But so far as the understanding, even in this very effort to discover unity, singles out now this and now that fact or law, it is confronted by the *variety* of the results which it reaches. There results the well-known problem of "the One and the Many." In consequence, the understanding is involved in contradictions which are simply inevitable. In the world of the understanding, "everything is self-contradictory," and is so just *because* the understanding makes formal consistency the one test of truth, even at the very moment when it expresses its search for truth in the form of an effort (1) to divide what is inseparable, and (2) to substitute abstractions for life.

The forms which the resulting contradictions assume are well known in the history of philosophy. The interest in abstract unity is shown in extreme form in the Eleatic reduction of the whole world to a simple One Being, by contrast with which all variety is illusory. The Atomistic thesis, which reduces all the qualitative variety of nature to quantitative differences, the material substance of Descartes, whose only attribute is extension, the sole substance of Spinoza,— these are also consequences of the tendency to understand variety by reducing it to an abstract and lifeless unity. On the other hand an equally abstract pluralism, in all the earlier stages of philosophical thought, has emphasized variety, with the result of making it inconceivable how the facts, when regarded as thus mutually isolated, could conspire to make a world at all. Views of one type have, by their very contradictions, led over to views of the opposed type.

The solution of all such difficulties lies in reducing the contradictions to their "ground," which lies in the very "movement" of thought itself. For the truth of such views lies in their synthesis, not in their mere conflict. Such a synthesis is furnished by the discovery that the search for unity and the interest in diversity and variety are but "aspects" or "moments" of that life of self-comprehension in which the very nature of reason consists. When thought, by virtue of a deeper reflection upon the contradictions of the understanding, has reached this higher stage of the reason proper, it therefore views the successive opposing views as inevitably one-sided expressions of different aspects of our rational interest. Our world is indeed one; and in order to bring this fact to our consciousness, we have, upon the stage of the understanding, to emphasize this very aspect of Being and of the life of our own thought to such an extent as to isolate, by our abstraction, the unity upon which we then dwell, from the very variety of which it is the unity. Now unless we passed through the stage of doing this we should never bring the unity of things to light at all, but should leave this aspect of the "immediate" lost in the original obscurity in which, apart from thought, all experience is involved. But so long as we remain upon this stage of abstract reflection, we nevertheless inevitably contradict both experience and ourselves. For experience is of the many, as well as of the unity. And an abstract unity, which is the unity of nothing, is indeed a self-contradiction.

But while our world is indeed also many, and while, in order to bring this aspect of things to light, we must emphasize pluralism, yet the resulting views, taken in their abstraction, are as contradictory as are those of mere monism. The many could never coöperate in one world were they not also one.

Thus we cannot reach truth without passing through contradictions. For the truth is a synthesis of various points of view. No one of these can be appreciated unless it has first been emphasized. If once emphasized it becomes, however, in its isolation, self-contradictory, just because it has its truth not in its isolation, but in its relations to the other points of view. But in order to be able to see that these very relations are necessary, and are not merely adventitious and empirical, we must see *how* the isolated point of view contradicts itself. The sequence of these isolations of special categories (followed by the resulting contradictions, and by the necessary synthesis), constitutes the "dialectic movement of thought," by which the "immediate" experience, with which we begin, is transformed into the system of truth, wherein all the elements appear in necessary interrelations to one another. The principle of this method is what Hegel calls the "Negativity" of thought. *The denial, or sublation of imperfect stages of insight is the only means whereby the perfect stage can be made explicit.* This is the principle of the dialectical method.

The Hegelian theory of the Absolute is the correlate of this theory of the process whereby truth is acquired. For the dialectical method is not only a method of acquiring insight; but, since thought is, in principle, identical with the very life of the universe, the method by which we come to insight is also the very method by which the life of the world is developed. Man is simply the world come to self-consciousness, — the Spirit explicitly aware of its own life. This is the obverse aspect of the thesis that the true Self is the world. Viewed objectively, the Hegelian doctrine accordingly is that the world-ground, or "the Spirit," also called the Absolute, has a life, or activity, whose forms are expressed in the categories of the 'Logic.' This life has first to manifest itself in experience as a world of immediate facts. This immediately given outer world constitutes what we call Nature. Such a world has to exist, and to be found by us, in order that the forms of thought should be, not *mere* forms, but forms expressed in a concrete and immediate way. In live, and especially in rational beings, the thought which is everywhere present in nature reaches a still higher expression, which at last becomes identical with our own insight, as this insight developes through the historical evolution of humanity. The entire world-process is therefore the complete expression of a rational spirit, which indeed eternally possesses self-consciousness, but which, when viewed historically, appears to us as attaining such self-consciousness, in individual form, in the religious and in the philosophical consciousness of man.

This must suffice as an outline of Hegel's main thoughts. Owing to the interest which he had in viewing the entire course of human history as a series of movements determined by the dialectical processes of which all our life, according to him, consists, Hegel took great interest in the philosophy of history. The influence of his school has been, in consequence, of great importance in affecting the spirit of a great number of modern historical inquiries. The highly ambiguous relations of the Hegelian system to traditional theology proved very momentous for the development of the critical study of religious dogma, and of religious history, during the generation after his death. While the original Hegelian school ultimately lost its direct influence in Germany, the indirect influence of the Hegelian system still remains very great, and is especially noticeable in English and American thought since 1865.

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Hegira, hĕj'ĭ-ra, **Hejra**, or **Hijra**, an Arabic word meaning 'going away,' commonly used to indicate Mohammed's flight from Mecca, in 622 A.D. In 639 Caliph Omar instituted a new Moslem calendar, to begin with the first day of the first month of the year in which the flight took place. The Mohammedan year, as a lunar year, is shorter than ours by ten days, 21 hours, and 14 2-3 seconds. A rough and ready method for finding the year in our calendar corresponding to a given year in the Mohammedan is to subtract from the latter 1-33 of itself and add 622 to the remainder. To find the precise year and day, multiply the year of the Hegira by 0.970224, strike off from the product six decimal figures and add 621.5774: this will give the year of the Christian era; and the day of the year is got by multiplying the decimal figures by 365.

Heidelberg, hī'dĕl'bĕrg, Germany, an old university town in Baden, on the left bank of the Neckar, here spanned by two bridges, 12 miles by rail east-southeast of Mannheim. It stands on a narrow strip between the river and the rock on which the castle is built, and chiefly consists of the Hauptstrasse, the long main street, and less important steeply-sloping cross and parallel streets. The city has an electric street railway system. The imposing castle, on a height above the town, an immense ivy-clad ruin begun in the 13th century, exhibits elaborate examples of early and late renaissance architecture. In the town itself the principal buildings are: the Gothic church of St. Peter, the Gothic church of the Holy Ghost, the Roman Catholic Church, the university (q.v.), the town-house, the post-office, gymnasium, real-schule, and other schools. The manufactures, comparatively unimportant, include cement, tobacco, cigars, fire-extinguishing apparatus, chemicals, scientific, medical and surgical instruments, leather, etc., and there are also several breweries. One of the curiosities of the place is the well-known Heidelberg great tun, kept in the cellar under the castle, and long ranking as the largest wine cask in the world, being [illegible] feet in length, 26 feet in diameter, and capable of holding 800 hogsheads. Heidelberg has fine public walks. The gardens around the castle are well laid out, and at every turn present the finest views of the Neckar and the fertile and richly wooded valley through which it winds to join the Rhine. Behind the town and castle, a carriage-road leads by easy ascent to the top of the Königstuhl, the loftiest hill of the district, from which an extensive view is obtained of surpassing beauty. Heidelberg arose around its 13th century castle and was until 1719 the capital of the Palatinate. In 1622, 1688, and in 1693 the French captured and pillaged the city. In 1802 it was united to the Grand Duchy of Baden. Pop. (1900) 40,121.

Heidelberg Catechism, a religious work published at Heidelberg in 1563 by Zachariah Ursinus for the use of the Reformed Church, and published in the Palatinate. It was approved by the Synod of Dort, and was the model on which the Westminster Assembly framed the Shorter Catechism.

Heidelberg University, Germany, a renowned institution founded by Elector Rupert I. in 1386. It was organized by Marsilius von Inghen on the model of the University of Paris, and at the Reformation, from a Catholic became a Protestant stronghold of learning. It flourished till the period of the Thirty Years' War when it declined. In 1802 under the administration of the Grand Duke of Baden, a new era was inaugurated and the university rapidly became famous. It is very complete in its details, and comprises faculties of theology, law, medicine and philosophy; the famous library has over 500,000 volumes and 4,700 MSS. There are 150 professors and instructors, while the average annual attendance of students in all departments is over 1,450. Many of the most famous German scholars have been professors here — Melanchthon, Ursinus, Olevianus, Reuchlin, Œcolampadius, Spanheim, Puffendorf, Voss, Schlosser, Creuzer, Gervinus, Paulus, Kuno Fischer, Helmholtz, Bunsen, Bluntschli, etc. The quincentenary of the university was celebrated with elaborate ceremonial in 1886.

Heidelberg University, Ohio, a coeducational institution at Tiffin, founded in 1850, under the auspices of the Reformed Church in the United States. It has departments of theology, commerce, oratory, art, and music, and preparatory and summer schools. In 1905 it had 24 professors and instructors; 356 students; a library of over 25,000 volumes; the grounds and buildings were valued at $125,000; the productive funds amounted to $275,000, and the income to $20,000.

Heidenmauer, hī'dn-mow-ĕr. (1) A name given in Germany to the remains of old German and Roman fortresses and ramparts, some of which still exist, especially at Ottilienberg, a hill of the Vosges, in Alsace. (2) The title of a novel by James Fenimore Cooper, who laid the scene of his story in the Vosges during the Middle Ages.

Heights, Measurement of. See HYPSOMETRY.

Heilprin, hīl'prĭn, **Angelo**, American naturalist: b. Satoralja-Ujhely, Hungary, 31 March 1853; d. New York city 17 July 1907. He came with his parents to the United States in 1856, but received his education later in Europe, making a special study of natural history. On his return to America, his scientific ability was speedily recognized and he became successively professor of invertebrate paleontology and geology (1880–1900), and executive curator ([illegible]) at the Academy of Natural Sciences, Philadelphia. From 1885 to 1890 he was professor of geology at the Wagner Free Institute. He was for five years president of the Geographical Society of Philadelphia, was leader of the Peary Relief Expedition in 1892 and made a journey of research to investigate the cause of the Mont Pelee (q.v.) diaster in 1902. His published works include: 'Contributions to the Tertiary Geology and Palæontology of the United States' (1884); 'Town Geology'; 'The Lesson of the Philadelphian Rocks' (1885); 'Geographical and Geological Distribution of Animals' (1887); 'Explorations on the West Coast of Florida and in the Okeechobee Wilderness' (1887); 'The Geological Evidence of Evolution' (1887); 'The Animal Life of our Seashore' (1888); 'The Bermuda Islands: a Contribution to the Physical History and Zoology of the Somers Archipelago' (1889); 'Principles of Geology' (1890); 'The Arctic Problem and Narrative of the Peary Relief Expedition' (1893); 'The Earth and Its Story' (1896); 'Alaska and the Klondike' (1899); 'Mont Pelée and the Tragedy of Martinique' (1903); 'Tower of Pelée' (1905).

Heilprin, Louis, American scholar: b. Miskolcz, Hungary, 2 July 1851. He is a brother of Angelo Heilprin (q.v.). In 1856 he came to the United States, where he was privately educated, and where he was connected with various works of an encyclopædic character. He published a valuable 'Historical Reference Book' (1884; 6th ed. 1899) in 'The Concise Knowledge Library.'

Heilprin, Michael, American author: b. Piobrkow, Russian Poland, 1823; d. New York 19 May 1888. Carefully educated by his father, in his 20th year he emigrated to Hungary, chafing under Russian conditions. For a time he had a book-store at Miskolcz and was on intimate terms with Kossuth and his party. When the Revolution was quelled, he went to London, there meeting Kossuth, who advised him to go to America. In 1859 he and his family emigrated to New York, where his literary activity was continuous for nearly 30 years. As coeditor of Appleton's 'Annual Encyclopedia' and reviewer on 'The Nation,' he won a distinct rank for his exact and versatile scholarship, especially in the line of Semitic literature. On the arrival of the Russian Jewish refugees in 1881–2, he took a prominent part in their welfare and personally supervised the colonization of many families. His published works include: 'The Historical Poetry of the Ancient Hebrew,' Vols. I. and II. (1880); 'Bibelkritische Notizen' (1893).

Heimburg, hĭm'boorg, **Wilhelmine.** See Behrens, Bertha.

Heine, Heinrich, German poet: b. Dusseldorf, 13 Dec. 1797; d. Paris, France, 17 Feb. 1856. His father, Samson Heine, of Hanover, was a merchant of honorable family, which sprang from Bückeburgo. He was good natured but without marked intellectual gifts and of little business ability. The mother, Peira (Betty) van Geldern, came from one of the oldest and most prominent Jewish families on the Rhine. Her father, Gottschalk, was one of the first Jewish physicians who graduated as Med.D. from a German university; her brother, Joseph, was also a graduate. Her uncle, Simon van Geldern, was a strange, adventurous, enthusiastic man. He journeyed through all Europe, went to Jerusalem, and returned from there to Germany after a varied and checkered experience. His diary of travel and other writings are still preserved. The fate of this strange relative made a deep impression on the mind of the mature and gifted boy, who first was sent to a private school and then to a lyceum in charge of priests until the year 1814. The greatest influence on his education was exercised by his intellectually gifted mother, who read Rousseau and Goethe and was an enthusiastic German patriot, while his father was just as enthusiastic for Napoleon. Between these contrasts Heine, in his youth, swayed constantly in both directions. The whole life of the poet can be described in one sentence: He was a German, who was born of Jewish parents in a Roman Catholic city on the Rhine in the period of Napoleon's supremacy on the one hand and of flourishing Romanticism on the other. In these words lies the entire biography of Heine, everything which uplifted and hampered, all his defects and excellences, and all the deep contrasts and dissonances with which his life was filled.

When he left the gymnasium, he was ready with his companions to volunteer in the struggle against Napoleon. His first poems glorify German custom and loyalty, German patriotism. But this spirit soon changed, and soon, like so many eminent Germans of the time, he became one of the most enthusiastic supporters of the Emperor's heroic figure, whose fame then filled the entire world. His most ardent wish at that time was to study. But his parents, whose business was already in decline, could not gratify this desire; and even his rich uncle, the celebrated banker, Solomon Heine, in Hamburg, on whose bounty the whole family in reality lived, preferred to have the youth become a clever merchant. So his father in 1815 took him to the Frankfort Fair (Messe) and placed him there with the banking firm of M. G. Rindskopf. But the position was not long to Harry's taste nor was a grocery more endurable. After a short time he returned to Dusseldorf. The attempt was now made to have him settle in Hamburg, first in his uncle's counting-house and then in an independent concern of his own, which was a branch of his father's business. But he showed little talent as a merchant and in 1818 his firm failed.

First Effort as Poet.— In the three gloomy years at Hamburg, however, Heine became a poet. Under the pseudonym "Sy Freudhold Riesenharf" appeared in those days in a Hamburg magazine his first 'Traumbilder' and poems. A luckless love for his rich uncle's fair daughter Amelia filled his heart and aroused those lamentations of deep sorrow, which formed the basis of his poetry. The well known poem, 'A youth loves a maiden, who chose another' contained almost literally his entire heart's romance. After it was shown that Heine had absolutely no mercantile ability, his uncle finally consented that he might study law.

His University Career.— In October 1819 he entered the University of Bonn, which had just been reopened. A fresh and stimulating spirit prevailed at this university both among teachers and pupils. Men like August Wilhelm v. Schlegel, who interested himself very much in the young poet; E. A. Arndt, and others, belonged to the teaching staff. Among the students we find names like Wolfgang Menzel, Hoffmann v. Fallersleben, Hengstenberg, etc. His special friends were Friedrich Steinmann, J. B. Rousseau, and Josef Neunzig. In the vacation, after the first year of study, Heine resided in the little town Beuel, near Bonn, and there he worked on his first tragedy, 'Almansor,' the plot of which was placed in the period of Moorish decline in Spain. In the poem, however, Heine wished to present a picture of the battles which Judaism in Germany had to endure. 'Almansor' is a lamentation of crushed and persecuted Judaism. From Bonn Heine went to Göttingen, whose faculty of law was quite famous at that time. But he did not enjoy its instruction very long, for he had to leave the university on account of a duel, and in February 1821 came to Berlin.

Life at Berlin.— His choice of Berlin was fortunate for the young poet. A vigorous intellectual atmosphere prevailed in that era in the Prussian capital. Before everything else he was attracted by the best salon in which Rahel Varnhagen von Ense had her special circle with Goteht (q.v.) and Fichte together with a coterie of brilliant spirits. Both she and her husband quickly recognized the poetical power in Heine, and admitted him to close intimacy. Her brother Leopold Robert, who was also a poet, was exceedingly friendly to him, and his wife Friedricka aroused Heine's enthusiastic admiration in sonnets and songs. The second coterie which fascinated Heine was a round table of young poets who gathered in Lutter and Wegener's restaurant, made famous by Ludwig Devrient and E. T. A. Hoffmann, which was to become the scene of more than one carouse. These men were Christian Dietrich Grabbe, Friedrich v. Uechtritz, Karl Kochy, L. Gustorf, and others. A third circle formed the greatest possible contrast to the others and in this, perhaps, Heine felt most at home. It was a small body of young men who in a time of general apostasy from Judaism, assumed as their task the reform and development of Judaism which then was regarded as in its decline. At the head of these resolute workers stood Eduard Gans, the celebrated jurist, Moses Moser, a merchant, whom his friend Heine called a living epilogue to Lessing's 'Nathan,' and Leopold Zunz (q.v.), the immortal founder of that branch of critical research called the science of Judaism. Heine took the deepest interest in the labors, hopes, and disappointments of this society. A monument of his love for the general cause which was abandoned by them, is embodied in his romance, 'The Rabbi of Bacharach,' which was then begun but unfortunately remains a torso.

Literary Activity.— In Berlin, too, the university fairly fascinated him. In particular the philosopher Hegel (q.v.) made a deep impression on the young poet, whose first poems were issued by a Berlin firm in 1823 and aroused general interest and he was termed a successor of Byron, the first poet of 'Weltschmerz' in Germany. Varnhagen v. Ense and Karl Immermann, both famous writers of the time, showed special ardor in directing the public's attention to the young poet, the new star on the literary horizon, who was already arousing general comment by his 'Tragedie' (Almansor and Ratcliffe) as well as by his 'Lyrical Intermezzo' which appeared in a volume at the same publishers'. When Heine in 1824 went for a second time to Göttingen, in order to undergo his doctor's examination, he was already a well-known personality in literary circles. During this period of his second stay in Göttingen occurred an act on his part which is wholly unintelligible, judged by his previous labors, his writings, and letters, and which can only be explained by the sad conditions of the time — on 28 June 1825 at Heiligenstadt, near Göttingen, he embraced the Protestant religion. Clearly this act was done only to promote his professional career, for his sympathies in increased degree remained on the side of his coreligionists. Heine regretted the step his entire life.

His Choice of Literature as Profession.— After his graduation as doctor of law he returned to Hamburg. But all his efforts to maintain his hold there or in Berlin were unavailing despite his baptism. The failure was due either to the prejudices of the time or to other drawbacks. So Heine devoted himself wholly to literature. Two years earlier he made a journey from Gottingen to the Harz Mountains, in the course of which he visited Goethe at Weimar, but met a rather cool reception. This journey he now described in his 'Harzreise,' which had many readers who were delighted with the new and fresh tone in which the varied and picturesque experiences were narrated. In the years 1826–1831 Heine's rank as poet was firmly established. That period forms the crown of his life and activity — his high-water mark of achievement. The four volumes 'Reisebilder' ('Pictures of Travel') published 1826–1831, showed him from an entirely different point of view. His 'Buch der Lieder' ('Book of Songs'), gave on the other hand, a faithful picture of his lyrical skill, which also struck entirely new paths. Heine had emerged from romanticism. He knew its mysteries and magic spells. Close thereby, or rather far above it, stood the well of German popular poetry, out of whose depths he drew such wealth as no other German poet had accomplished. Goethe and Uhland, Brentano and Wilhelm Müller were not without their influence on the matter as well as the metrical form of his poems; yet he was original and his songs, aroused a practical revolution in the world of German poesy.

His Genius and Its Influence.— The secret of his originality and of the marvelous influence which he exercised not only on his contemporaries, but also on every age, lies in the peculiar charm which characterizes these songs, as they sound the tenderest tones of the heart, and then in cutting dissonances shatter the sentimental quality which is at their basis, thus producing a humorous-poetical effect incomparable in its way. The subjectivity, with which Heine wove his sorrows, whether trivial or serious, in the warp and woof of his verse, was something unheard of in the history of German poetry. There was as little hypocrisy in his feeling of sorrow (Weltschmerz) as in that of Lord Byron, but it was truer and deeper, because it was blended with the Jews' sorrow from gray antiquity. His pictures and thoughts, his Oriental sensuousness, and his German sensitiveness, all this in its combination formed

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a poetical *ensemble* which was to destroy romanticism, with its fairyland of legends, and to construct the poetry of a new age and a new generation. The verse included a mass of new poetical material; for instance, the description of sea in the splendid-colored North Sea pictures. In marked contrast was the wonderful effect produced by the form of the poems, which, apparently somewhat careless, was really intentional and just adapted to elevate the mood. With his 'Book of Songs' Heine became at once the first German poet of his time. His prose writings exercised in those days a similar influence. Heine loosened the tongue of the modern man of culture; he taught him what and why he suffers. In an age which was gloomy, depressed, and poor in deeds, he unfurled the banner of freedom and announced to the young generation the dawn of new days which had to come. While much in his 'Pictures of Travel' was of transient worth and importance for the history of civilization, of permanent value was the blending of humor and sentiment, wit, and earnest reflection, wherein following his great predecessors, men like Laurence Sterne, Jean Paul, and others, he created an entirely new *genre*. The modern Feuilleton rest wholly on Heine's prose. The "Young Germany" school which gave the death-stroke to romanticism in the 30's of the past century followed in his steps. His travel picture and sketch remained for decades a model for young German writers after which to pattern their prose.

Further Activity.— Despite his popularity, however, Heine could never attain a life of entire self-reliance in the conditions of his age. His steady dependence on his rich uncle, who let his nephew feel his power, embittered his stay in Hamburg. Accordingly in 1827 he accepted the offer of Cotta, the publisher, to assume the editorship of the Munich 'Political Annals.' But he continued at this work only one winter; then he undertook a journey to Italy, which he described in his incomparable fashion in his 'Pictures of Travel.' He expected to receive on his return a professorship at the Munich University, which the Bavarian minister Eduard v. Schenck desired to secure for him from the king; but owing to the intrigues of the clericals all efforts in Heine's behalf were unavailing.

In 1828 he was recalled from his Italian trip by the news of his father's death — a man whom Heine had most tenderly loved. The following years were occupied in violent attacks on the poet August v. Platen and his followers, whom Heine regarded as his worst foes, besides literary labors and traveling. When the intelligence of the July Revolution in Paris reached him, the poet could no longer endure the home atmosphere, while the powerful Austrian chancellor Mettenich, who found refreshing youth "in the melancholy waters of his lyric" warned him that he was not entirely secure from persecution. It was on a May day in 1831 when Heine forsook his fatherland, of course of his own accord, but in the firm conviction that sooner or later he would suffer the fate of all those who were leaders of freedom in Germany.

His Life in Paris.— In Paris Heine labored from the very start at the great task of his life — to promote an understanding between the French and the Germans. His correspondence in the 'Augsburger Allgemeine Zeitung,' his book on 'The Romantic School,' his contributions to 'The History of Religion and Philosophy in Germany,' are devoted to this great purpose. The first appeared in 1832 as 'French Conditions'; the others — with literary sketches, reflections on the drama and art, poems, etc., as 'Salon' (4 vols. 1832-36). The persecutions which the German Diet (Bundestag) set in motion against the "Young Germany" school of writers, leading to the ban against their works, this act of mediævalism affected the poet deeply, and other unpleasantness was added thereto. His only compensation was his recognition in his fatherland, the esteem in which he was held in France, and the love of a beautiful young Frenchwoman, Mathilde Creszentia Mirat, whom he married in 1841, after having lived with her many years. Despite many storms and although his wife had no idea of her husband's eminence, the marriage was a happy one. The heavy material burden which she obliged Heine to assume, forced him in 1836 to receive from the French Government, when Guizot was head of the Ministry, a pension of 4,800 francs—a charity which France at that time bestowed on all prominent fugitives. It is to be understood, however, that Heine incurred thereby no obligation to praise or defend the political administration. Nevertheless, later he was violently attacked for this step.

His Illness and Last Works.— The death of his rich uncle from whom he received an annual sum of 4,000 francs threw him into a terrible state. He was not mentioned in the will, and anxiety was added lest his cousin Carl Heine would refuse the further payment of his stipend unless he would submit his writings to a rigid censure by the family. Violent conflicts followed that cost the poet his rest and his health, which last had long been undermined. A severe nervous trouble had tortured him from his youth, and now as added illness came paralysis of the eye.

In 1843-4 Heine visited his old mother in Hamburg. The poetical description of his journey in the winter tale 'Germany,' which appeared in 1846 with his 'New Poems,' and the epic poem 'Atta Troll,' which was issued in 1837, showed an entirely new line of poetical genius; for both these satirical epics are pearls of poesy. Since 1848 Heine was practically chained to his bed of illness — his famous "mattress grave." He bore his sufferings, however, with true heroism; his intellectual power was not weakened. But a great religious change took place which led him back through the Bible to belief in God and to the memories of his race. The two great works of the last period of his life, 'Romancero' (1851) and 'Confessions' (in Lutetia, 3 vols. 1854), are proofs of this great change, both in poetry and prose. Once more did the poet reveal himself to his admirers in agonizing strains of sorrow, in classical ballads, in Hebrew melodies, in profound lamentations of vivid effectiveness. Once more steps the great writer before us, and in prose of the loftiest beauty and strength he seeks to answer the most vital questions of our human existence.

On 17 Feb. 1856 he died after much suffering. He rests at Montmartre, next to his wife. His grave is adorned with a monument, the work of the sculptor Hasselriis. An artistic memorial was erected by an enthusiastic admirer, the late Empress Elizabeth of Austria, at her country palace Achilleion, near Corfu in the Ionian Sea, with its classic memories. The continued efforts, however, made to place a memorial to the poet in his home on the Rhine have so far been fruitless, and have but led to bitterest conflicts between clericals and anti-Semites on the one side, and the large body of his admirers on the other. It is not without significance that the Loreley fountain which could find no lodgment in Germany, has been placed in New York, the metropolis of the United States, a country where Chas. G. Leland's translation of the 'Pictures of Travel' appeared in 1855, and where the poet's works have appeared in numerous editions and translations. The poet's body of admirers grows from day to day, and with this vast congregation of thoughtful men and women in every land the history of literature, judging without prejudice, gladly recognizes Heine as the greatest German lyric poet, after Goethe, and as one who is and will remain among the most illustrious poets in the world's literature.

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GUSTAV KARPELES,
Author of 'Jewish Literature and other Essays.'

Heinemann, hī'ne-man, **William**, English publisher and author: b. Surbiton 18 May 1863. He founded the publishing house which bears his name in 1890. He has published under the pen name of "KASSANDRA VIVARIA": 'Via Lucis': 'The Garden of Olives': 'The First Step,' a play (1895): 'Summer Moths,' a play (1898): 'War,' a play (1901).

Heinrich, H. H., American horologist: b. Granz, Germany, 1822; d. Brooklyn, N. Y., February 1903. He was apprentice to a Hamburg watchmaker, studied with Martin Zeller of Vienna, in Switzerland became a manufacturer of watches and escapements, and there taught for 10 years in a horological school which he had established. He became known as one of the foremost European chronometer-makers, came to the United States and finally set up in business for himself in New York. In 1880 his time-recording instruments excelled all others at the tests held in Washington. He also received highest awards from the expositions at Berne 1885, Paris 1889, and Chicago 1893.

Heintzelman, hīnt'sĕl-man, **Samuel Peter**, American military officer: b. Manheim, Pa., 30 Sept. 1805; d. Washington, D. C., 1 May 1880. Graduated at the United States Military Academy 1826, and served during the Mexican War. In 1861 he commanded a division at Bull Run, where he was wounded 21 July. Afterward promoted brigadier-general of volunteers, Heintzelman, during the organization of the army in the winter of 1861–2, held command of a division. On the moving of the Army of the Potomac, in March 1862, the 3d Army Corps was placed under his command. His corps formed the right wing of Pope's army at the second battle of Bull Run 30 Aug. 1862. During the Maryland campaign he commanded the defenses at Washington, and was afterward appointed to the command of the Department of Washington, and of the 22d Army Corps, which he held during the battles of Chancellorsville and Gettysburg, in May and July 1863. He retired in 1869, with the rank of major-general.

Heir (Lat. *heres*), in law, one entitled by descent and right of blood to lands, tenements, or other hereditaments. Hence it is an ancient apothegm, that "God only can make an heir." An heir is really one who is born or begotten in lawful wedlock, and on whom the law casts the estate, in lands, tenements, or hereditaments immediately on the death of his ancestor. The rights of heirs in most of the United States are determined by the principles of the common law unless specially modified by statute. It is a matter of judicial decision that the rights of heirs in the United States are statutory only. Hence they cannot plead, for instance, that an inheritance tax is unconstitutional. An heir presumptive is one who will be the heir at the death of the owner, as the elder son of a deceased brother in England, or all the children of a brother in the United States, where the owner has no children: for they will be heirs if he dies without issue. As an heir presumptive may lose his heirship by a change of circumstances, he does not become an heir apparent so long as this change is legally probably, though physically or naturally impossible. Thus the nephew of the owner can never be his heir apparent, however aged or feeble or near to death the owner may be: for in contemplation of law it is always possible that a son may be born to him, who would be an heir apparent, and who would therefore supersede an heir presumptive. An heir apparent is one who must be the heir if he survive the owner, as the eldest son in Great Britain, or all the children in the United States.

Heiss, his, **Michael**, American Roman Catholic prelate: b. Pfahldorf, Bavaria, 12 April 1818; d. Milwaukee 26 March 1890. He studied at the University of Munich and at the Catholic seminary at Eichstädt, and was ordained in 1840. In 1843 he came to the United States, and was first assigned to a church in Covington, Ky.; he next went to Milwaukee as missionary priest and secretary to the bishop. In 1868 he was consecrated as the first bishop of La Crosse, Wis.; in 1880 he was appointed coadjutor to the archbishop of Milwaukee, with the right of succession, and two years later became archbishop of Milwaukee. He has taken an important part in American councils, and was a member of the Vatican Council (1869–70). He has written:

'The Four Evangelists,' and a treatise on marriage (in Latin).

Heistand, Henry Olcot Sheldon, American soldier: b. near Richwood, Ohio, 30 April 1856. He was graduated from West Point 1878, and was assigned to 11th United States infantry as 2d lieutenant. He was appointed government inspector and instructor Ohio National Guard in 1892, and during the presidential campaign of 1896 was confidential secretary to McKinley. He was promoted lieutenant-colonel in 1900, and became adjutant-general and chief of staff in the China expedition for relief of Peking 1900. He has written: 'Alaska, Its History and Description' (1898).

Hejra, or Hijra. See HEGIRA.

Helen, in Greek legend, the most beautiful woman of Greece, daughter of Zeus by Leda. By advice of Ulysses her numerous suitors were bound by oath to respect her choice of a husband, and to maintain it even by arms. She chose Menelaus, but was afterward carried off to Troy by Paris, the Trojan war arising from the claim made by Menelaus for the fulfilment of the oath. After the death of Paris she married his brother Deiphobus. On the fall of Troy she returned to Sparta with Menelaus, but at his death was driven from the country, and was murdered at Rhodes by the queen of that island.

Helena, hĕl'ĕ-na, **Saint,** the mother of the Emperor Constantine the Great. She was of humble origin, probably the daughter of an innkeeper of Bithynia. She captivated Constantius Chlorus, and became his wife; but when Diocletian elevated him to the dignity of Cæsar, in 292 A.D. he was compelled to repudiate her. The succession of her son, and the influence she had exercised in educating him as a Christian, compensated her for previous humiliations, while her piety and zeal for the propagation of Christianity have made her a saint in the Roman Catholic calendar.

Helena, hĕl'ĕ-na or hĕ lē'na, Ark., city, county-seat of Phillips County, on the Mississippi River, and on the St. Louis, I. M. & S., the Yazoo & M. V., the Arkansas M. R.R.'s., and is the terminus of the Arkansas Central; about 75 miles below Memphis and 95 east by south from Little Rock. It has boat communications with all important river-ports. A conflict between the Federal and Confederate forces took place here 4 July 1863. The Union army, about 4,500, was under Gen. Prentiss, the Confederate, about 9,000, under Gen. Holmes. The Confederate loss was about 1,800, including killed, wounded and prisoners. Helena is in an agricultural and lumbering region; the chief manufactures are lumber, cottonseed-oil, and foundry products. It has cotton-compresses, a shingle-mill, brick-yards, and large lumber-yards. Some of its educational institutions are the Jefferson High School, and the Sacred Heart Academy; it has a public library, nine churches, and three banks. Pop. (1900) 5,500.

Helena, Mont., city, capital of the State, and county-seat of Lewis and Clarke County; on the Northern Pacific and the Great Northern R.R.'s; about 70 miles north by east of Butte. The city is surrounded on all sides by the Rocky Mountains; on the south and west the mountains are within two miles of the city, while to the north there is a wide valley between the city and the foothills, and the same condition exists on the east. The city is protected from severe wind storms, and in the winter season there is a difference in temperature between the city and the mountain country of from 10 to 20 degrees. The country tributary to the city is rich in both mineral and agricultural resources. The mines are principally gold-producing, while the products of the farms are cereals and the ordinary vegetables. Tributary to the city are large areas devoted to the raising of cattle and horses, but this industry is gradually being replaced by diversified farming.

Helena is noted as the richest city per capita not only in Montana, but in the entire Rocky Mountain country. It is principally a city of homes; cattlemen, miners, and others engaged in industries elsewhere in Montana have their residence in Helena because of its church, school, and social attractions. It is the best built city in the State; its hotels, office buildings, mercantile establishments and private residences being equal to any found in cities of 100,000 in the east.

The geographical situation of Helena has made it a great distributing centre. Before the days of the railroads, when stage lines and freight wagons drawn by oxen were the only means of transportation, the geographical position of the city brought to it many travelers and great stores of merchandise. From Helena the people and the goods were distributed to other settlements. The Northern Pacific Railroad, the first to reach the city, following the trend of business, built branch lines from Helena, and thus it retained its commercial supremacy. Later the Great Northern was also extended to the capital city, and it likewise reached out for trade in the surrounding country by building branches. The original of Helena was "Last Chance Gulch"; the town came into existence as a result of discoveries of placer gold. The first discovery of gold was made in 1864, by four prospectors, John S. Cowan, John Crab, D. J. Miller, and Robert Stanley. These four men started early in the spring of 1864 from Alder Gulch, now Virginia City, in the southern part of the State, to search for placer gold. They went first to western Montana, and finding nothing there started east, prospecting the streams. They finally found what is now known as Prickly Pear Creek, running through the valley north of Helena, and here they discovered a few traces of gold, but they continued their journey north. Provisions becoming scarce they retraced their steps, intending to return to Virginia City, and again they came to Prickly Pear Creek where they noticed a little gulch. One of them said: "Boys, this is our last chance to strike it. If we do not find gold here we must strike straight for Alder." On 16 July 1864, they sunk two holes to bedrock, and in each they found gold. It was the "last chance" that turned out favorably, and that was the name of the camp until 30 October of the same year. The news of the find spread, and soon there were 500 men in the camp. At the meeting to name the town, Pumpkinville, Squashtown, Tomahawk, and Tomah were suggested. Finally John Somerville suggested Saint Helena. This was amended to Helena, and on a ballot Helena won by two votes over Tomah.

The educational institutions are public and parish schools, the Montana Wesleyan University (M. E.), opened in 1890, Saint Vincent's Academy, and the State, city, and other libraries.

Among the principal buildings at Helena are the Government building, costing $500,000; State capitol, costing $400,000; the county courthouse, costing $100,000; the high school building, costing $150,000, and seven graded school buildings valued at $200,000. There are also Saint John's Hospital, Saint Joseph's Orphanage, and several fine churches. Twelve miles from Helena, on the Missouri River, is located the plant of the Missouri River Power Company. This company furnishes electrical power for operating street cars and lighting the city of Helena, and for manufacturing purposes. It also transmits electrical power to Butte for use in the mines, a distance of 100 miles. Four miles from Helena is located the smelter of the American Smelting and Refining Company. The principal gold mine now operated in the vicinity of Helena is the Big Indian, located in a gulch four miles south of the city. Marysville is the largest mining camp tributary to the city. Here is located the Drum Lummon mine, owned by an English company, and in the near vicinity are other mines which are large gold producers.

In the 20 years after the opening of the "Last Chance Gulch," gold to the amount of $25,000,000 was taken out of the gulch and the town grew to a city of 20,000 and became the capital of the State.

From the discovery of gold until 22 Feb. 1881, when the city government was organized under a charter from the State government, the government of the city was by a committee representing the merchants and bankers.

The government is now vested in a mayor, who holds office two years, and a council. The executive appoints, subject to the approval of the council, all the subordinate officials except the city treasurer and police magistrate, both of whom are chosen at a popular election. The assessed valuation of property in 1903 was $13,000,000.

Helena has been the capital of Montana since 1869. In that year the capital was removed by popular vote from Virginia City. After Montana was admitted as a State two elections were held for the permanent location of the capital, and in 1894 Helena was chosen.

The altitude of Helena is 4,200 feet. The climate is not severe, the average temperature in January and February, the two coldest months in the year, being 20 above zero, with no moisture in the air. In summer the average temperature is 75. The growth of the city from now on may not be as rapid as in the early days; but it promises to be a healthy, steady development. Pop. (1900) 10,770.

Charles D. Greenfield,
Editor 'The Helena Independent.'

Helena, Battle of. Helena, Ark., is on the west bank of the Mississippi River, about 82 miles below Memphis. Since 13 July 1862, when Gen. Curtis arrived there from western Arkansas, it had been occupied by Union troops, and on 4 July 1863, was held by a division of the Thirteenth corps, under Gen. Salomon, and a brigade of cavalry, in all 4,129 effective men, under command of Gen. B. M. Prentiss. The place is surrounded by hills, and those nearest the city were occupied by strong redoubts; Graveyard Hill in the centre, Fort Righter on the north or right, and Fort Hindman on the south or left, were all connected by a line of bastions and rifle-pits, both ends of which rested on the river. In the river lay a gunboat. Toward the middle of June it was determined by the Confederates to take the place, whereby it was hoped to raise the siege of Vicksburg or, if Vicksburg fell, still to keep the river closed. Gen. Holmes was ordered to move from Little Rock with about 7,600 men, Price's and Marmaduke's divisions, Fagan's brigade of infantry, and Walker's brigade of cavalry. Holmes bivouacked about four miles from Helena on the evening of 3 July, and at midnight advanced to within a mile of the outer works. The assault was ordered at daylight. On the Confederate right Fagan with 1,770 men advanced on Fort Hindman, carried all the outer entrenchments, and made a desperate attempt to take the fort, but was repulsed with a loss of over 400 men. On the Confederate left, Marmaduke's division of infantry and Walker's cavalry brigade, aggregating 2,780 men, attacked Fort Righter and were repulsed. Price, in the centre, with 3,100 men, made a strong assault, carried all the entrenchments in his front, seized Graveyard Hill, and ordered one brigade to move on the town and another to assault Fort Hindman in the rear, but the Union troops checked the advance of the two brigades and drove them back and, the attacks on the right and left being repulsed, the fire of the forts, rifle-pits, and gunboat was concentrated on Price, and at 10.30 A.M. Holmes gave the order to withdraw, and led his troops back to Little Rock. The Union loss was 57 killed, 146 wounded, and 36 missing; the Confederate loss was 173 killed, 687 wounded, and 776 missing. Consult: 'Official Records,' Vol. XXII.; Greene, 'The Mississippi'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. III.

E. A. Carman.

Hel'enin, a chemical substance extracted by hot alcohol from the root of the elecampane (*Inula helenium*). It has the formula C_6H_8O, and is nearly insoluble in water, but very soluble in alcohol. The first crystals obtained from the root-extract contain considerable quantities inula-camphor; but this may be removed by repeated crystallization from alcohol. Pure helenin crystallizes in white prisms or needles, melting at 232° F.

Helicidæ, hē-lĭs'ĭ-dē, the family of terrestrial pulmonate mollusks which includes most of the land and many fresh-water snails. See Snails.

Heligoland, hĕl'ĭ-gō-lănd, or **Helgoland,** hĕl'gō-länt (Dan. "holy land"), a small island and popular sea-bathing resort in the North Sea, belonging to Germany, situated about 40 miles northwest of the mouth of the Elbe. It is about a mile long and one third of a mile broad, and has an area of about one quarter of a square mile. It consists of two parts, the Oberland, a flat-topped rock 206 feet high, affording a little soil for pasture and the growth of potatoes, etc., and communicating with the Unterland, a small stretch of shore at its foot, by 192 steps and an elevator. Most of the houses stand on the Oberland. The Unterland gives partial shelter to the shipping. Steamboats ply between the island and Hamburg. The principal buildings are the church, lighthouse, and a royal Prussian biological station for the study of the fauna and flora of the North Sea. The bathing facilities, which attract so many visitors, are found in a dune or sand-bank separated from the main island by a channel about a mile wide. This Sandy Island, as it is called, is slowly being reduced in size by the inroads of the sea. The inhabitants are chiefly employed in fishing, and speak a Friesian dialect. The island is well fortified, and has cable communication with Cuxhaven and Wilhelmshaven. Christianity was first preached here by St. Willibrod in the 7th century. Taken from the Danes in 1807, it was ceded to Great Britain in 1814, but was transferred to Germany in 1890. Pop. (1900) 2,307, in the bathing season increased by several thousand visitors.

Heliocentric, hē″lĭ-ō-sĕn′trĭk, "having the sun as centre," a term applied to the Copernican system, as in opposition to the Ptolemaic system, which was geocentric, that is, "having the earth as centre" of the solar system. In modern astronomy the word is applied to calculations in which the sun is referred to as centre of the planetary system. Thus the heliocentric place of a planet is the position it would occupy at a given time when calculated from a point of view in the centre of the sun.

Heliodorus, hē-lĭ-ō-dō′rŭs, the earliest of the Greek writers of romance: b. Emesa, Syria, and lived near the end of the 4th century. He became a believer in the Christian religion, and bishop of Tricca in Thessaly. His youthful work, 'Æthiopica (that is, Æthiopic Affairs), or the Loves of Theagenes and Charicleia,' is a tale in poetical prose, with an almost epic tone. It is distinguished by its strict morality from the other Greek romances, and interests the reader by the wonderful adventures it recounts. One of the best editions is that of Hirschig in the 'Erotici Scriptores' (1856). An English translation by R. Smith appeared in 1855.

Heliogab′alus. See ELAGABALUS.

He′liograph, an instrument invented by De la Rue for obtaining photographs of the sun. Also an apparatus for telegraphing by means of the sun's rays. See HELIOSTAT; MILITARY TELEGRAPH.

Heliogravure, hē″lĭ-ō-grā′vūr. See PHOTOGRAVURE.

Heliom′eter, an instrument for measuring small distances on the sky, particularly the apparent diameters of the sun and of the moon. The heliometer of Bouguer is an astronomical telescope provided with two object-glasses, one of which is movable, and which form two distinct images of the same object, visible through the same eye-glass. A single object-glass cut into two parts, which are relatively movable by a screw, is always employed now. If, in contemplating a celestial body, the object-glasses are placed so as to bring the images to touch each other, the distance of the centres of the glasses gives the diameter of the image. In this manner the instrument gives, for instance, the difference of the diameter of the sun in perigee and apogee.

Heliopolis, hē-lĭ-op′ō-lĭs ("City of the Sun"), Egypt, the On of the Hebrew Scriptures, on a site now partly occupied by Matarieh, six miles northeast of Cairo, was one of the most ancient and extensive cities during the reign of the Pharaohs, and so adorned by monuments as to be esteemed among the first sacred cities of the kingdom. During the flourishing ages of the Egyptian monarchy the priests and scholars acquired and taught all the learning of the Egyptians within the precincts of its temples. It may be regarded as having been the university of the land of Misraim, and at the time of Strabo, who visited this town 24 B.C., the apartments were still shown in which, four centuries before, Eudoxus and Plato had labored during 13 years to learn the philosophy of Egypt. Solon and Thales were also reputed to have visited its schools. Here Joseph and Mary are said to have rested with the infant Jesus. Near the village stands the Pillar of On, a famous obelisk, supposed to be the oldest monument of the kind existing in Egypt. Its height is 67½ feet, and its breadth at the base 6 feet. Hieroglyphical characters are sculptured upon it, but are partly illegible. A fierce battle was fought here, 20 March 1800, between the French under Kleber and the Turks, when the latter were defeated.

Heliornithidæ, hē-lĭ-ôr-nĭth′ĭ-dē, a family of tropical birds, the fin-foots or sun-birds, placed by some ornithologists among the *Cecomorphæ*, and by others, more probably, with the rails. They are about a foot long, mottled brown and white, with long pointed wings and long stiff tails; and frequent the borders of forest streams and ponds, in which they spend much of their time swimming and diving well. They feed on small fish, crustaceans, insects and seeds. The best-known species is *Heliornis fulica* of southern South America.

Helios, hē′lĭ-ŏs, in mythology, the god of the sun (Latin, *Sol*) in the Greek mythology: son of Hyperion and Theia, and brother of Eos (Aurora, the dawn) and Selene (Luna, the moon). He is frequently called by the name of his father. He dwells with Eos in the ocean behind Colchis. From the portals of the morning he rides through the air in an oblique curve to the gates of evening, and after having cooled his horses in the ocean, he drives his chariot into a self-moving golden vessel, made by Hephæstus (Vulcan), which with wonderful rapidity bears him during the night along the northern shore of the ocean back to Colchis, where he bathes his horses in the lake of the Sun, and rests till the dawn of the morning. Other accounts represent him as making this nightly passage while slumbering in a golden bed. His horses and chariot are first mentioned in the Homeric hymn on Helios. Among events in the history of Helios the poets relate his contest with Poseidon for the Isthmus of Corinth, his revealing the secret amours of Ares and Aphrodite, and his disclosure to Demeter of Pluto as the ravisher of her daughter. This idea of his omniscience seems to have been the reason why he was confounded and identified with Apollo, though they were originally quite distinct. As he was descended from the race of the Titans he is often called Titan. The famous Colossus of Rhodes was a representation of Helios.

He′lioscope is a telescope behind which the image of the sun is received upon a plane surface. An astronomical telescope is drawn out a little farther than is necessary for common use, and directed toward the sun, and the image which is formed is received in a dark place. For this purpose a dark chamber is employed, or the telescope is placed in a dark funnel-shaped enclosure, the bottom of which is covered with oiled paper or closed with ground glass, on which the sun's image is formed. Upon the paper or glass a circle is described equal to the image, and it may be divided by concentric circles into rings. With this instrument the spots on the sun, eclipses, etc, may be observed.

Heliostat, hē'lĭ-ō-stăt, an instrument used in optical experiments with sunlight for keeping a beam always falling in the same direction in spite of the motion of the sun. It consists of a mirror mounted equatorially, and carried round by clock-work in such a way as to neutralize the apparent motion of a beam of sunlight reflected from it. This instrument has been employed among other purposes as a means of signaling. A beam of light being directed to the point to which it is intended to convey the signals, the dot-and-dash alphabet is made use of by the device of exhibiting and obstructing the light for longer or shorter periods. A short flash represents one letter, a long flash another, a short quickly followed by a long a third, and so on. As adapted to this purpose the heliostat has received the name of heliograph.

Heliotherapy (Gk. ἥλιος, sun — θεραπεία, service), the treatment of disease by the action of sunlight. See PHOTOTHERAPY.

Heliotrope, hē'lĭ-ō-trōp, a genus (*Heliotropium*) of plants of the borage family, characterized by the undivided ovary prolonged into a style, many of whose species have vanilla-scented blossoms. The one most in repute is a small shrub (*H. peruvianum*), originally South American, which has small fragrant flowers growing compactly together in the spikes. Cuttings taken from the young branches grow readily, and come soon into blossom. The *H. europæum*, or common heliotrope, is a flowering herb indigenous in the south and west of Europe. The heliotropes are natives of warm climates, and very numerous, several growing wild in the United States. Many delightful varieties have been produced as garden and greenhouse flowers.

Heliotrope, the bloodstone, is a variety of quartz partaking of the character of jasper and of chalcedony. It is of a deep green color, and is covered with red spots like drops of blood. Many fine antique Greek and Roman intaglios and cameos, also seal rings carved in bloodstone, are preserved in the great gem collections. It is found in Tartary, Persia, Siberia; in the island of Rum, Scotland, and many other places. It received the name heliotrope, or as some of the older writers give it, elitropia, because it was said that if the mineral be put into water contained in a basin rubbed with the juice of the plant heliotrope, and be exposed to the sun, the water will appear red and the sun blood-like, as if it was eclipsed.

Heliotropism, hē-lĭ-ŏt'rō-pĭzm, or **Phototropism**, the influence and effect of sunlight on organisms. When a seedling plant is placed in a transparent vessel of water within reach of the light of a window, the stem and leaves gradually bend toward, and the roots from, the light. The former phenomenon is termed positive, and the latter negative, heliotropism. The shoots and leaves of nearly all plants turn toward the light, and the turning of the sunflower toward the sun is familiar to every one. In the case of organs which are positively heliotropic the growth of the side next the light is retarded, and that of the opposite side increased; the result of these combined actions is a concavity on the former, and a convexity on the latter, thus causing a curvature toward the light. In the case of roots these actions are reversed. That these results are brought about by the action of light is evident; the cells on the concave side become less, while those on the convex side become more, turgid, thus forcing the organ to bend; but the cause of turgescence is unknown.

In animals a similar heliotropism is operative and is plainly manifested in some low forms, as hydra, where it is of great service in their almost automatic food-getting. Heliotropism is closely allied to, and much modified by chemotropism (q.v.) and other influences.

Heliozoa, hē''lĭ-ō-zō'a, the "sun animalcules," an order of rhizopods (q.v.) with or without silicious skeletons, and having slender and radiant pseudopodia, stable and rarely interlaced. The majority live in fresh water, but some are marine. A common and widespread example is the genus *Actinophrys*.

Helium, a gaseous element, known to be present in the atmosphere and in certain minerals, and, like argon, characterized by a singular chemical inertness. The discovery of helium was a consequence of the discovery of argon, and on account of the close chemical, physical and historical relations of the two, reference should be made to the article ARGON, and to the references there given. Helium was known to exist in the sun many years before it was discovered upon the earth. During a total eclipse of the sun, in 1868, Jannsen observed a brilliant yellow line in the spectrum of the solar chromosphere, very close to the D lines of sodium, and yet not identical with either of them. The new line was assumed to be due to a previously unknown element, and in the same year Lockyer proposed the name "helium" for this hypothetical element, from the Greek word "helios," meaning the sun. No evidence of the existence of helium upon the earth was adduced until 1882, when an Italian scientist named Palmieri announced that he had obtained the spectrum of helium from certain of the lavas given off by Mt. Vesuvius. He made no attempt to isolate the new body, however, and while it is quite possible that his observations were correct, he can hardly be credited with the actual discovery of helium. No further progress was made in this direction until 1895. When argon had been discovered, and its chemical inertness had been established, Mr. Miers, mineralogist of the British Museum, pointed out that the mineral cleveite (q.v.) had been shown to contain nitrogen gas, apparently in the free state, and made the suggestion that part of what had been assumed to be nitrogen might in reality prove to be argon. Professor William Ramsay examined the gas from this source, and found that while it undoubtedly did contain argon, it also showed a brilliant yellow line, which did not appear to coincide with either of the sodium lines, though it was very close to them. He sent a specimen of the gas to Sir William Crookes for a more careful examination, and Crookes promptly reported that the new line was identical with the helium line. It was therefore proved that helium, which had previously not been certainly known except as a constituent of the solar chromosphere, is also a terrestrial element. Subsequent study revealed the presence of helium in several other minerals. It is given off from cleveite when that mineral is heated to about 400° F. in an exhausted tube, or when the mineral is treated with sulphuric acid, or with acid sulphate of potassium. All the minerals which contain any considerable quantities of helium also contain uranium, yttrium or thorium. It is not certainly known whether the helium is chemically combined with the mineral, or whether it is merely occluded by it. The latter supposition would appear to be the more probable, judging from the chemical inertness of the gas, and from the fact (presently to be noted) that radium appears to be generating helium continuously. Certain observations upon the mineral fergusonite, however, appear to give some color to the hypothesis that the helium is present in a state of chemical combination. Helium has also been found in solution in the waters of certain hot springs.

The presence of helium in the earth's atmosphere was established by means of subjecting the apparently pure argon that had been obtained from this source to a process of diffusion through a series of porous partitions of baked clay. Helium, being much lighter than argon, diffuses far more rapidly, and a mixture in which the two gases exist together may be partially separated into its constituents in this manner.

Helium, when pure, has a density of only 1.98, that of oxygen being taken as 8. Its atomic weight cannot be directly determined, because helium has not yet been made to combine with any other substance, although it has been subjected to the same experimental attempts as were tried in the case of argon (q.v.). It has been found, however, that the ratio of the specific heat of the gas at constant pressure to the specific heat at constant volume is about 1.65, and this indicates that helium is a monatomic gas (see GASES, KINETIC THEORY OF), and that its atomic weight is about $2 \times 1.98 = 3.96$; the atomic weight of oxygen being taken as 16. It therefore has the smallest atomic weight of any of the known elements except hydrogen. The chemical symbol He has been assigned to helium, although, as has been already noted, no compounds of it have as yet been obtained.

Dewar thought he had liquefied helium at the temperature of melting hydrogen (about 436° F. below zero), but this was not confirmed by subsequent experiments, and it is now believed that the liquefaction of helium is a problem still reserved for the future. Its critical temperature is probably still nearer to the absolute zero than that of hydrogen, and for this reason the gas is well adapted for use in thermometers intended for the measurement of exceedingly low temperatures. It has, in fact, been used for this purpose with success, in studying the properties of hydrogen.

A most remarkable and previously unparalleled fact in connection with helium remains to be recorded. It has been known for some time that helium occurs in cleveite, and in other minerals in which the newly discovered element radium is found; but whether this was to be regarded as a mere coincidence, or whether it has some actual physical and chemical significance, has been a subject of considerable discussion. The most striking experiment bearing upon this matter, is one that is due to Huggins, who caused the radiation from radium to pass through a spectroscope provided with a quartz prism, and to fall upon a sensitive photographic plate. Upon developing the plate after a prolonged exposure, he found that cold radium gives a line spectrum when treated in this manner; and he made the further discovery that nearly all of the lines in the spectrum so obtained are apparently coincident with lines in the spectrum of helium. The full significance of this fact is not yet known; but when taken in connection with the observations of Soddy and Ramsay, which indicate that helium occurs in the gaseous emanation that is given off by radium, it is considered by no means impossible that we have here an instance in which one element is being slowly but continuously transformed into another one. If this inference is corroborated by future experiments, it will throw an altogether new light upon the nature of the chemical elements, and upon their relation to one another. The case is the more noteworthy, since helium has a smaller atomic weight than any other element save hydrogen, and radium has a greater atomic weight than any other element save uranium and thorium. Radium, moreover, appears to be metallic in nature, while helium, by its chemical inertness, resembles nitrogen.

Helix, hē'lĭks, a curve generated by winding a line around in a coil of gradually increasing radius. (1) In anatomy, a prominent and incurved margin surrounding the thinner and larger portion of the pinna in the ear. (2) In architecture, the small volute under the abacus of a Corinthian column. Of these there are in every perfect capital 16: two at each angle, and two meeting under the middle of each face of the abacus. (3) In geometry, a curve the tangents to which make, with the horizontal plane, a constant angle. The edge of the path of a screw is a helix, as is also the path described by any point of the surface of the thread when moved in the nut. (4) In zoology, the typical genus of the snail family. See SNAILS.

Hell (A. Saxon, *hel*, from *helan*, to cover), signifies originally the covered or invisible place. In the Bible the word is used to translate the Hebrew *Sheol* (grave or pit), and *Gehenna* (properly the valley of *Hinnom*), as well as the Greek *Hades* (the unseen). In the Revised Version of the New Testament, hell is used only to translate Gehenna, Hades being left where it stands in the Greek. In common usage hell signifies the place of punishment of the wicked after death, its earlier meaning being lost. The distinctive Scriptural term for the place of future punishment of the wicked is Gehenna. The belief in a state of punishment after death for the finally impenitent is held by almost all sects of Christians, as an analogous belief in the future punishment of unexpiated guilt is a tenet of nearly all religions ancient or modern. The nature of the punishment of hell, its locality, and its duration, have given rise to interminable controversies among Christian writers. The early Christian writers sometimes apply the word hell to a place of temporary purgation, in which the soul is freed from the stains of guilt contracted on earth preparatory to its enjoying the pure bliss of heaven. In this sense it corresponds in some degree with the Roman Catholic purgatory, and with the pagan idea of purification, as illustrated by Virgil in the sixth Æneid. Sometimes it is applied to the place of waiting of the just under the old law, till the coming of Christ should secure for them the completion of their reward; sometimes to the place where unbaptized children are detained because of unremitted original sin; and more frequently to the place of final and everlasting punishment for impenitent sinners. As to the locality of the scene of final punishment none at the present day makes a formal declaration. The terms above and beneath, as applied to heaven and hell, are merely relative, and though conventionally accepted convey no information. The Churches are not fully agreed as to the nature of hell-punishment. The prevailing idea among modern theologians is that the «fire» and the «worm» are significant emblems to give us the most correct and living conceptions of the reality that we can possibly attain in our present circumstances. They are fit emblems of anguish, and as such had laid hold of the Jewish imagination in connection with the word Gehenna, the term used in Mat. v. 22, 29, 30; Luke xii. 5. Gehenna, unlike Sheol and Hades, has never any intermediate signification, but is invariably applied to the place of punishment of the wicked after death. See IMMORTALITY.

Hell Gate, a narrow part of the East River between Long Island and Manhattan and on the east and west sides of Ward's Island. The passage between Ward's and Randall's Island is called Little Hell Gate. The rocks which were in Hell Gate were of such form and so situated as to make navigation dangerous, and the difference in the times and heights of the two tides which enter East River increased the dangers. The East River receives at one extremity the Sound Tide and at the other the tide from off Sandy Hook. "One sailing vessel out of every fifty" was the proportion damaged seriously when trying to pass through the channel between the reefs. Much had been said and written about the necessity of doing something to remove or at least lessen the dangers of Hell Gate, and officials of the United States navy, Lieutenants Davis and Porter, made a survey of Hell Gate in 1848. They reported the necessity of making the channel safe, and suggested the destruction of some of the most dangerous rocks; but nothing was done until the year 1851, when the work of destroying the rocks was begun. The process used was that of surface-blasting introduced by Maillefert. A portion of some of the rocks was removed, but this method of overcoming the dangers to navigation was found practically useless. In 1866 another survey was made by Brevet-Maj.-Gen. John Newton of the United States Engineer Corps, and in 1867 he submitted his report, in which he advised the removal of the reefs — the work to be done by blasting, and the drilling of the surface to be made from a fixed platform. Soon after the work of making Hell Gate safely navigable was resumed and placed in charge of John Newton. For the work Newton invented a steam-drilling cupola scow, which served as a transport and a working platform from which the drilling-engines were operated. The new machine proved satisfactory. A new system of explosion had to be devised in order to protect Ward's and Randall's Islands and Astoria. Diamond, Coenties, and Ways reefs were removed, also Pilgrim Rock, before operations were begun on Hallet's Point Reef. The last mentioned was an obstacle to both large and small vessels. The excavations, begun in October 1869, were completed in June 1875. The drilling was completed 25 March 1876. The area operated upon was about three acres. The method of explosion was most successful. No damage was done to the windows of buildings near; it had no perceptible effect on the air, but little on the water, and the underground shock was slight, but was perceptible on Manhattan and the western part of Long Island. The removal of Flood Rock, which was in the middle of Hell Gate, made the navigable capacity of the channel more than double. The work of removing this most formidable obstruction was begun 7 June 1875. Lack of funds caused delay, and the explosion did not take place until 10 Oct. 1885. For the removal of Flood Rock about nine acres were tunneled and drilled; and the aggregate length of the tunnels was 21,670 feet, and of the drill-holes, 113,102 feet. The object sought to be gained by removing the rocks and reefs was to make a channel of the uniform depth of 26 feet and of sufficient width for the largest steamers. The work as planned and designed by Gen. Newton has not been completed (1904).

Helladotherium, hĕl″a-dō-thē′rĭ-ŭm, an extinct genus of giraffes, found fossil in the upper Miocene (Pikermi) rocks of Attica. Its body was about as large as that of the existing giraffe, but the legs were of nearly equal length, and the skull was hornless.

Hellas, hĕl′as, the abode of the Hellenes, was first a town, and afterward, under the name of Phthiotis, a district in Thessaly. The ancients applied this name to the whole of Thessaly. With the spread of the Hellenic people the term embraced a gradually increasing territory, till it came to denote the whole of Middle Greece, and then the whole of Greece, with its islands and colonies. The Hellenes received this name in the belief that they were descended from Hellena, a mythical personage, a son of Deucalion and Pyrrha, or, according to others, of Zeus and Doripпe, and the father of Æolus, Dorus, and Xuthus, was said to have been king of Phthia. See GREECE.

Hell′bender, a large salamander (*Cryptobranchus alleghaniensis*) found chiefly in the streams emptying into the Great Lakes and those draining the western slope of the Appalachian Mountains. The hellbender is an ugly looking but perfectly harmless creature from 18 to 24 inches long; with the head and body much flattened and a prominent wrinkled fold of skin along the sides. Although entirely aquatic, no gills are present in the adult, and only a single pair of small pores represents the gill-clefts; the lungs are simple sacs. The limbs are functional, the anterior with four, the posterior with five digits, and the tail is provided with a wide fin. A wide mouth with teeth in both jaws, very small eyes and a slimy skin of a deep mottled brown color are further external characteristics. The giant salamander (*Megalobatrachus maximus*) of Japan is the only known closely related form. The hellbender is a sluggish animal, active chiefly at night, when its voracity causes great annoyance to fishermen whose bait and fish it devours. It is extremely tenacious of life, and hibernates during cold weather. Although very common, its breeding habits are yet unknown.

Hellebore, a genus (*Helleborus*) of the crowfoot family (*Ranunculaceæ*), consisting of perennial erect herbs with scanty, palmately divided leathery leaves, and yellowish, greenish, or white terminal flowers. They are of interest on account of their poisonous and medical properties. About 10 species are natives of Europe and Asia, one of which (*H. viridis*) has become naturalized in the eastern United States. The Christmas rose (*H. niger*) is the source of the black hellebore of modern pharmacopœias, but the ancient black hellebore, a famous remedy for insanity, was probably obtained from other species. *H. viridis* and *H. fœtidus* have emetic and purgative properties, and the latter, which is poisonous, has become a common introduced weed along the eastern American seaboard. These plants are closely allied to the aconites.

White Hellebore is a very different plant, a species (*V. album*) of the genus *Veratrum* of the lily family, which contains several poisonous plants allied to colchicum. They are profusely leaved tall herbs growing in rich woods, and their roots contain the peculiar alkaloids veratroidin and jervin, to which their poisonous properties are mainly due. North America has a widespread species in the Indian poke (*V. viride*), which, like the European species, enters into the pharmacopœia, while its rootstocks are ground into the powder used as an insecticide.

Hellenes, hĕl'ēnz, a native name for the ancient Greeks.

Hell'enists, a name given the Jewish colonists who settled in Egypt after the destruction of the kingdom of Judah, about 600 B.C. Their number was increased by the many colonies of Jews planted by Alexander the Great (336 B.C.), and later by Ptolemy Lagus. Under the reign of the Emperor Augustus they amounted to nearly 1,000,000. They laid the foundation of a new epoch of Græco-Jewish literature, which, from its prevailing character, received the name of the Hellenistic. The Alexandrian Jews were the most influential in developing Hellenizing tendencies, and to them chiefly is to be referred the formation of the peculiar dialect termed the Hellenistic. In their literature the systems of Pythagoras and Plato were strangely combined with those Oriental phantasies which had been reduced to a system in Egypt, and with which the mystical doctrines of the Gnostics were imbued. The most noted Jewish Hellenistic philosopher was Philo of Alexandria, and the chief of the learned labors of the Alexandrian Jews was the Greek translation of the Old Testament.

Hellespont, hĕl'es-pŏnt. See Dardanelles.

Hellgrammite, hel'gra-mīt, the large black aquatic larva of the insect Corydalus (q.v.), much used as bait for black bass and other game fish. It lives in streams, preying upon smaller animals, and just before pupation crawls under large stones, where it can be found at about the same time as the bass are biting. It is also called «Dobson» after a maker of artificial baits.

Helm, Israel, Swedish colonist in America: b. 1615; d. 1695. He settled on the Delaware River, in 1649; was collector of customs at Philadelphia 1659, and became a member of Captain Carr's council 1668. He was chief interpreter between the colonists and Indians, and rendered valuable service at the meeting of the New Jersey Indians, Governor Andros, and the Swedish authorities, in 1675.

Helmet-shell, a large gasteropod of the genus *Cassis*, family *Cassidæ*. Most of the species inhabit tropical shores, but a few are found on the coast of the Mediterranean. The shells of *C. rufa*, *C. cornuta*, and *C. tuberosa* (the queen conch), are the material on which shell cameos are usually sculptured.

Helmholtz, Hermann Ludwig Ferdinand von, hĕr'män lood'vĭg fĕr'dē-nänd hĕlm'hōlts, German scientist: b. Potsdam 31 Aug. 1821; d. Charlottenburg 8 Sept. 1894. He studied medicine in Berlin, and received the appointment of assistant-surgeon in the Charité Hospital there in 1842. Next year he went to Potsdam as a military surgeon, but in 1848 he returned to Berlin to assume the duties of teacher of anatomy at the Academy of Art and assistant in the Anatomical Museum. He was called to the chair of physiology at Königsberg in 1849, and six years later went to Bonn as professor of anatomy and physiology. In 1858 he was appointed professor of physiology at Heidelberg, whence he returned in 1871 to Berlin as professor of physics. In 1888 he was appointed to the post of president of the new Physikalisch-Technische Reichsanstalt (Imperial Physico-Technical Institute) in Charlottenburg. Helmholtz was distinguished alike in physical science, in mathematics, and in physiology; but his most valuable and most original work was done in those departments of physics which stand in intimate relations with physiology, especially acoustics and optics. He had an eminently philosophical mind, and his works are no less valuable for their masterly exposition of the methods of experimental science than for the important results contained in them. His scientific fame was securely established as early as 1847, when he published 'Über die Erhaltung der Kraft' (On the Conservation of Energy). This subject was pursued further in 'Über die Wechselwirkungen der Naturkräfte' (On the Interactions of Natural Forces) (1854). His greatest works are the 'Handbuch der Physiologischen Optik' (Handbook of Physiological Optics) (1856–66); and 'Die Lehre von den Tonempfindungen' (1862; 5th ed. 1896), translated into English by Ellis under the title 'Sensations of Tone as a Physiological Basis for the Theory of Music' (1875). A collection of 'Vorträge und Reden' reached a fourth edition in 1896, and has been translated into English as 'Popular Lectures on Scientific Subjects' (1873–81). An edition of his scientific treatises was published at Leipsic in three volumes (1882–95), and in 1897 his 'Lectures on Theoretical Physics' appeared in one volume. In his 'Beschreibung eines Augenspiegels' (1851) he described the ophthalmoscope he had recently invented. In 1883 he was ennobled by the German emperor.

Hel'mont, Jan Baptista van, Flemish physician and chemist: b. Brussels 1577: d. near Brussels 30 Dec. 1644. He devoted his attention to scientific research, and although he put forth some visionary theories on the constitution of man, and on diseases, made some genuine discoveries in chemistry. He was probably the first to introduce the term "gas" into science, and was the earliest observer of the acid reaction of the gastric juice. He published 'Ortus Medicinæ' (1648): and 'Opuscula Medica Inaudita' (1644), works which still possess interest for students.

Hel'muth, William Tod, American physician: b. Philadelphia 30 Oct. 1833: d. New York 15 May 1902: graduated Homeopathic Medical College, Philadelphia, 1853: Hahnemann College, San Francisco, 1866. In 1877 he became professor of surgery and dean of the New York Homeopathic College and Hospital. He was an officer in numerous medical associations and a member of the Société Medicale Homeopathique of France. Among his published works were: 'Treatise on Diphtheria'; 'Medical Pomposity': 'System of Surgery': 'Scratches of a Surgeon': 'Suprapubic Lithotomy.'

Heloderma, hē-lō-dėr'ma. See GILA MONSTER.

Heloïse, ā-lō-ēz, or **Eloise.** See ABELARD.

Helots, hē-lōts, were the lowest of the four classes into which the population of ancient Sparta was divided. They are generally supposed to have been the aboriginal population of the country, and to have been reduced to bondage by their Dorian conquerors, their numbers being swelled from time to time by the addition of peoples conquered in war. The name is generally derived from the town of Helos, the inhabitants of which were carried off and reduced to slavery by the Heraclidæ about 1000 B.C., though a more probable derivation is the Greek *helein*, to take, making the name signify captives. They were the property of the state, which alone had the disposal of their life and freedom. The state assigned them to certain citizens, by whom they were employed in private labors, though not exclusively, as the state still exacted certain services from them: and they were attached to the soil — that is, each citizen received the number that belonged to his allotment, without any power to sell or free them. Agriculture and all mechanical arts at Sparta were in the hands of the Helots, since the laws of Lycurgus prohibited the Spartans from all lucrative occupations. But the Helots were also obliged to bear arms for the state, in case of necessity. Their dress, by which they were contemptuously distinguished from the free Spartans, consisted of sheep's skin and a leather cap of a peculiar shape. They were sometimes liberated for their services or for a sum of money: but they were not admitted to the full dignity of citizenship. In 424 B.C. 2,000 of the Helots, who had conducted themselves with distinguished bravery in war, were treacherously put to death. They several times rose against their masters, but were always and finally reduced.

Helper, Hinton Rowen, American author: b. near Mocksville, N. C., 27 Dec. 1829. He published in 1857 'The Impending Crisis of the South,' which the Republican party used as a campaign document with great effect. Later works by him are: 'The Three Americas' Railway' (1881): 'Nojoque' (1867): 'The Negroes in Negroland' (1868): 'The Land of Gold'; 'Oddments of Andean Diplomacy.'

Helps, SIR Arthur, English essayist and historian: b. Streatham 10 July 1813: d. London 7 March 1875. He was educated at Eton and Cambridge: became private secretary to Lord Monteagle as chancellor of the exchequer, and was afterward commissioner of French, Danish, and Spanish claims. In 1860 he was appointed clerk of the privy council, and held this post till his death. He was created K.C.B. in 1872. As an essayist he was one of the most popular writers of his day, and his historical works had an extended reputation. He possessed very wide and general culture and sound judgment, was painstaking and accurate in details, and in his historical works displayed considerable breadth of view. His principal works are: 'Thoughts in the Cloister and the Crowd' (1835): 'Essays Written in the Intervals of Business' (1841); 'Friends in Council' (1847–57); 'Conquerors of the New World and their Bondsmen' (1848–52); 'Companions of my Solitude' (1851); 'History of the Spanish Conquest of America' (1855–61): 'Oulita the Serf, a Tragedy' (1858): 'Life of Pizarro' (1869): 'Realmah' (1869): 'Casimir Maremma' (1870); 'Brevia, Short Essays and Aphorisms' (1870): 'Life of Hernando Cortes and Conquest of Mexico': 'Thoughts upon Government' (1871): 'Life and Labors of Mr. Brassey' (1872): 'Social Pressure' (1874).

Helsingfors, hĕl'sing-fōrs, Russia, a seaport town, capital of Finland, on a small peninsula in the Gulf of Finland, 180 miles by rail west-northwest of St. Petersburg. It is defended by the fortress of Sveaborg about three miles distant, and is the residence of the governor of Finland, the seat of important courts and public offices. Its university, removed from Abo in 1827, has a library of over 190,000 volumes. There are manufactures of linen, sail-cloth, tobacco, etc., and an important trade is carried on. Pop. (1903) 94,000.

Helve'tian Republic, the designation of the republic established in Switzerland by France in 1798. See SWITZERLAND.

Helvet'ic Confession, the name of a document drawn up by Martin Bucer in 1536 to settle the controversy between the Lutherans and the Zwinglians; and also of one drawn up by Bullinger (1566) at the request of Friedrich III., elector of the Palatinate, and adopted in Switzerland, the Palatinate, France, Hungary, Poland, and Scotland.

Helvetii, hĕl-vē'shĭ-ī, a former Gallic or Celtic nation living between the Rhone and the Rhine, the Jura, and the Rhætian Alps. They were more numerous and warlike than the neighboring Gallic tribes. They first appear in history 107 B.C., but were not known to the Romans until the time of Julius Cæsar, who, as governor of Gaul, prevented their intended emigration, and

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after many bloody battles, in which even the Helvetian women fought, pressed them back within their frontiers. The story of their meditated irruption into and seizure of southern Gaul is circumstantially related in the First Book of the Commentaries of the Roman general, who not only repulsed them with terrible slaughter, but almost exterminated them. Not a third of those who left their homes on this ill-fated expedition ever returned. Helvetia, which was less extensive than the present Switzerland, was divided into four districts, which had an entirely democratical constitution. Cæsar subjected the country to the dominion of the Romans, who established several colonies there. After the death of Nero, the Helvetii, for refusing to acknowledge Vitellius as emperor, were mercilessly punished by Cæcina, one of his generals, and thenceforth they almost disappear as a people.

Helvétius, Claude Adrien, klōd ä-drē-oṅ ĕl-vā-sē-ŭs, French metaphysician: b. Paris Jan. 1715; d. there 26 Dec. 1771. At the age of 23 he obtained the lucrative post of farmer-general, where he was distinguished by his mildness and indulgence from his colleagues, whose base practices filled him with indignation. He therefore resigned his office, and purchased the place of *maître d'hôtel* to the queen. Aspiring after literary fame he first directed his efforts to mathematics, then attempted to rival the dramatic fame of Voltaire by writing a tragedy. In 1758 he published 'De l'Esprit,' the materialism of which drew upon him many attacks. It was condemned by the doctors of the Sorbonne, and publicly burned in accordance with a decree of the Parliament of Paris. Helvétius went in 1764 to England, and the year afterward to Germany, where Frederick the Great and other German princes received him with many proofs of esteem. A complete edition of his writings was published at Paris in 1795.

Hem'ans, Felicia Dorothea Browne, English poet: b. Liverpool 25 Sept. 1793; d. near Dublin, Ireland, 16 May 1835. She displayed the bent of her genius when a mere child, and wrote some tolerable poetry in her 9th year. She first appeared as an author, in 1808, in a volume entitled 'Early Blossoms,' but it was subjected to harsh criticism, which she took very seriously to heart. A second volume, published in 1812, 'The Domestic Affections,' was much more successful. The same year she married Captain Hemans, from whom she was separated in 1818. She then resumed her literary pursuits, made herself acquainted with Latin and modern languages, and wrote much in the periodicals of the time. At the suggestion of Reginald Heber, afterward bishop of Calcutta, she wrote a tragedy entitled 'The Vespers of Palermo,' which, owing partly to Sir Walter Scott, who wrote an epilogue for it, was favorably received at the Edinburgh theatre, though it had previously, in 1823, proved unsuccessful at Covent Garden. Before this time she had added greatly to her popularity by her poems entitled 'The Restoration of the Works of Art to Italy'; 'The Skeptic'; 'Modern Greece'; and 'Dartmoor.' Later works were 'Lays of Many Lands'; 'Forest Sanctuary'; 'Records of Woman'; and 'The Songs of the Affections' (1830). She visited Sir Walter Scott at Abbotsford, and Wordsworth at Rydal Mount, and left with each the impression of a singularly graceful and gifted woman. Her poetry is essentially lyrical and descriptive, and is always sweet, natural, and pleasing. In her earlier pieces she was imitative, but she ultimately asserted her independence, and produced many short poems of great beauty and pathos. Mrs. Hemans had no dramatic power, her effusions being always intensely subjective.

Hem'atin, or **Hæmatin.** See Hæmoglobin.

Hem'atite, native sesquioxide of iron, Fe_2O_3, a mineral widely distributed, and constituting a valuable ore of iron. It crystallizes in the rhombohedral system, and also occurs in massive form, sometimes forming beds of great thickness. It has a hardness of from 5.5 to 6.5, and a specific gravity ranging from 4.9 to 5.3. It is usually dark gray or black in color, with a metallic lustre, and is sometimes slightly magnetic, occasionally even showing magnetic polarity. Hematite occurs in the rocks of every age. The extensive masses that occur in metamorphic rocks are believed to have been deposited, originally, in marshes, undergoing metamorphosis at the same time as the rocks with which they are now associated. Fibrous and columnar forms of the mineral, brownish-red or black in color, are also known, and to these the name «red hematite» is sometimes applied. In crystalline and metamorphic rocks a variety known as «specular iron» is met with, which is distinguished by the presence of crystals having a splendent lustre. Hematite occurs in vast quantities in various parts of the United States, notably in upper Michigan, in the Marquette district, and in Menominee and Gogebic counties; in Northern Wisconsin; and in St. Louis County, Minnesota. Iron Mountain, Missouri, is a hill about 200 feet high, the surface of which consists of loose blocks of hematite, many of which weigh as much as 10 or 20 tons. The name «hematite» is from a Greek word signifying «blood,» and was given to the mineral by the ancients from its fancied resemblance to coagulated blood. Hematite is sometimes called «bloodstone» at the present time, though that name is more properly applied to a green variety of quartz, which contains small spots of red jasper. An allied mineral, consisting of hydrated sesquioxide of iron and known to mineralogists as limonite, is often popularly called «brown hematite.»

Hemianæsthesia, hĕm-ĭ-ăn-ĕs-thē'sĭ-a, loss of sensation on one half of the body, right or left.

Hemiplegia, hĕm-ĭ-plē'jĭ-a (lit. «half a stroke,» that is, of paralysis), paralysis of one side of the body. It is usually caused by hemorrhage in the brain cavity, commonly known as apoplexy; often a local accumulation of serum, or a tumor is the cause. The paralysis falls on the side of the body opposite to the lesion in the pyramids of the brain, unless the lesion occurs below the decussation of brain fibres. The treatment of hemiplegia requires the services of a physician. It is amenable to timely remedies, and a cure is generally obtained after the first attack, if it result from apoplexy; but the patient is liable to subsequent attacks.

Hem'ipode. See Button-quail.

Hemiptera, hē-mĭp'te ra, an order of insects. It contains two leading groups, the *Homoptera* and *Heteroptera.* In the former the two pairs of wings when present are applied in rest pent-house fashion to the sides of the body. Several families are wingless. Cicadas, plant-lice (*Aphis*) and the like come here. In the second group the wings, when at rest, placed horizontally across the body, the second pair covered by the upper, which are *hemielytra,* that is, the basal half is leathery, the distal portion membranous. See BUG.

Hemlock, one of various plants. (1) A highly poisonous umbelliferous herb of the genus *Conium,* one species of which is European and the other African. The well-known officinal European one (*C. maculatum*) has become extensively naturalized as a weed in the United States. It is easily recognized by the wavy, crenate ridges of its short, laterally compressed fruit, and also by the disagreeable mouse-like odor when bruised (see CONIUM). (2) The water hemlocks or cowbanes of the closely allied genus *Cicuta,* which is also both European and American. The common American species is *C. maculata,* which grows in swamps and wet places, and is also dangerously poisonous, especially in its turnip-like cavernous root. See CICUTA.

Hemlock-spruce, an American coniferous tree of the genus *Abies* (or *Tsuga*) of which two species are recognized, the common northern one (*T. canadensis*), and a lesser one of the Southern Alleghanies (*T. Caroliniana*). The wood is too soft, weak, and brittle to be of extensive use as lumber, but the bark is of great importance in tanning. See FIR.

Hemlock, Water. See HEMLOCK.

Hem'meter, John Cohn, American physician: b. Baltimore, Md., 25 April 1864. He studied at the Royal Gymnasium, Wiesbaden, Germany; Baltimore City College; and University of Maryland; and became clinical professor of medicine in the last named institution, and director of the clinical laboratory. He is associate editor of 'Archives for Digestive Diseases,' Berlin, and author of: 'The Special Pathology and Treatment of Diseases of the Digestive Organs' (1896); 'Diseases of the Stomach' (1897); 'Diseases of the Intestines' (1901); 'Theodore Billroth, a biography' (1900). He is also a composer, and has composed 'Hygeia' (cantata); 'Prelude and Choral Music to the 23d Psalm' and other works.

Hemorrhage. See BLEEDING.

Hemp. The hemp plant proper, or "common hemp," is *Cannabis sativa,* an annual shrub belonging to the *Urticaceæ.* The term hemp, however, is used to designate many other kinds of fibre which are in no way related to the species of common hemp, such as Manila hemp, from a plantain, sisal hemp from an agave, bowstring hemp, from a liliaceous plant, and 30 or more other kinds. The different kinds of common hemps are also specially designated, with prefixes, as Breton hemp, Piedmontese, Russian, English, Chinese, and Japanese hemps, and many others, some of these being trade names, or the names of varieties. The hemp plant proper is a native of that part of Asia which includes India and Persia, though, like flax, its culture has been extended to many portions of the world in both temperate and tropical climes. It was used by the Scythians 2,500 years ago, and it was probably known to the Chinese and Europeans many centuries earlier. The Romans used it for sails and cordage, but not until after the dawn of the Christian era. It grows wild in many parts of India, where it is regarded more for its product known as chang or hasheesh than for its fibre. It flourishes on both the east and west coasts of Africa, and has been naturalized in Australia, as well as in several South American countries. In Europe it is cultivated chiefly in France, Italy, Germany, and central and southern Russia, and it will grow in Great Britain and Sweden. The plains of Hungary are peculiarly adapted to its culture. It is a favorite textile in China and Japan, the fibre from the last named country being particularly strong and fine, and at the same time, better prepared than many European hemps. The plant is an annual shrub, the fibre being produced in the bark of the straight stiff stalks or stems, and is therefore a bast fibre. In the experiments of Roxburgh and others, Russian hemp is taken as the standard of comparison for all other fibres. The stems vary from 3 to 20 feet long, dependent upon the variety and the soil in which grown. The best kinds have a hollow stem, the wood of which breaks down readily when cleaned for the fibre. While hemp is produced commercially in very few localities of the United States, it will thrive from ocean to ocean, and from the Gulf to Canada. Its cultivation as a fibre crop is confined chiefly to Kentucky, Illinois, Missouri, Nebraska, and California, though considerable hemp, in past time, has been produced in New York. Lately it has been experimented with in the South, notably in Mississippi and Texas. The bulk of the crop is grown at the present time in Kentucky and California.

The Kentucky hemp industry is very old, for the fibre was cultivated in the early part of the last century. The annual production, in 1859, reached a total of 75,000 tons, but 20 years later it had fallen off to such an extent that 5,000 tons only were recorded for the entire country. Since that time it has fluctuated between 5,000 and 12,000 tons as the total crop of the country, the annual production at the present time being less than the smaller figure. In late years the price has ruled at about 3½ cents per pound, though now it is quoted at 4½ cents. American hemp was at one time used to some extent for the rigging of vessels, although its largest use was for bagging. As early as 1824 it was employed in the navy, and efforts were made later by the government toward the production of better grades of hemp by water retting. The fibre has also been used for twines, and for woven fabrics. In late years the demand has been largely for a low grade fibre that could be manufactured into binder twine, though the bulk of the binder twine is made from manila and sisal. Very recently there has been a demand for a better grade of fibre, which has resulted in more careful methods, particularly on the Pacific coast, where a fibre has been produced fit for fine twines and cordage. Kentucky, Illinois, and Nebraska hemps are coarse, dark in color, and are not carefully prepared, which is the reason for the low price of 3½ cents against 8 and 10 cents per pound for finer imported hemps. The best hemp comes from Italy, chiefly from the provinces of Bologna and Ferrara, the fibre being very white, very well prepared, and of superb strength. Breton hemp from France is almost as good, but rarely imported. Russian comes in several grades, some light, but not as light as the Italian, some dark like the native fibre, and low in grade. Some good hemp comes from Austria-Hungary, and a trifle from other portions of Europe. Little if any of the Japan fibre reaches this market, though the best Japanese is as good as the Italian. We consume annually less than 10.000 tons, including both the native and imported.

There are many varieties of the hemp plant, four or five having been grown in the United States, though it is said that the bulk of the seed at present sown is the China hemp and a Japanese variety. Five varieties are cultivated in Europe, a common form reaching a height of 5 to 7 feet; Piedmontese or Bologna, an Italian variety that averages 12 feet in height; China hemp, introduced in 1846; a small hemp found in the valley of the Arno, and around Tuscany, and Arabian hemp, cultivated for the resinous principle or drug.

Limestone soils and the alluvial soils of the river bottoms are best adapted to hemp culture, and the seed bed should be almost as carefully prepared as for flax. One to three bushels of seed are sown per acre broadcast, and lightly covered. The planting, in Kentucky, usually begins in April, and the crop may be harvested in 100 days. For further particulars regarding the culture and preparation of this fibre, see Special Reports Nos. 1, 8, and 11, office of Fibre Investigations of the Department of Agriculture, and Hemp Culture in the United States, Year-book of Agriculture for 1901. See also the 'Dictionary of the Economic Products of India.'

While some 300 patents have been issued in this country for hemp machines, the bulk of the fibre is extracted by means of the old-fashioned, clumsy wooden "slat brake" that has been employed from time immemorial and without improvement or change. With one of these brakes a Kentucky negro can extract perhaps 150 pounds of fibre in a day. The brakes used in European hemp countries are little better, though they are smaller and less clumsy. The best foreign hemps are water retted, the stalks dried with great care, often in kilns, and therefore are more evenly prepared, and the fibre soft, strong, and light in color — almost white as in the Italian and French hemp. On the contrary most of the American hemps are dew retted, and are exposed to alternate freezing and thawing, as the stalks lie on the ground, giving an inferior product, uneven, and very dark in color, often a slate gray. See CORDAGE; CORDAGE INDUSTRIES; FIBRE; FLAX; MANILA HEMP; RAMIE; SISAL.

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Hemp-agrimony. See EUPATORIUM.

Hemp-nettle, a genus (*Galeopsis*) of European plants of the mint family, two species of which have become naturalized as weeds in the eastern United States.

Hemp'hill, James C., American journalist: b. Due West, Abbeville County, S. C., 18 May 1850. Was graduated at Erskine College in his native town in 1870 and entered journalism as editor of the Abbeville, S. C., 'Medium' in 1871. In 1880 he joined the staff of the Charleston *News and Courier*, of which since 1888 he has been manager and editor.

Hempl, George, American philologist: b. Whitewater, Wis., 6 July 1850. He was graduated at the universities of Michigan in 1879 and of Jena in 1889, and was appointed instructor in German at Johns Hopkins University in 1884. After spending three years abroad (1886–9) in study at Gottingen, Tubingen, Strasburg, and Berlin, he became junior professor of English in the University of Michigan, where he has been professor of English philology and general linguistics since 1897. He has been a voluminous writer, and among his technical works may be mentioned 'German Orthography and Phonology' (1897): 'German Grammar' (1901).

Hemp'stead, N. Y., village, in the town of the same name, in Nassau County; on the Long Island Railroad; about 15 miles east of the borough of Brooklyn, and 10 miles from the ocean. The village was settled in 1643 by people from New England. The Presbyterian Society of Hempstead claim the oldest Presbyterian organization in the country, dating their beginning in this village in 1644. Hempstead is located in a section of Long Island in which there are many summer homes. During the war with Spain an encampment for State troops was located at Hempstead; it was called Camp Black after the then governor of the State. The chief industrial interests are market gardening, farming, and the manufacturing of cork insoles, phosphates, and carriages. Pop. (1900) 3,582.

Hempstead, Texas, town, county-seat of Waller County; on the Houston & T. C. railroad; about 50 miles northwest of Houston and 113 miles east by south of Austin. It is situated in a fertile agricultural region, noted for its cotton fields and its vegetable products. It has a cottonseed-oil mill, cotton-gins, and its trade is chiefly in cotton, grain, fruits, and vegetables. Pop. 1,978.

Hems, or Homs, hōms (Lat. *Emesa*), Syria, an ancient city, near the Orontes and the Lake of Homs, 86 miles northeast of Damascus. Its temple of the sun-god Elagabalus was famous, and one of its priests became emperor of Rome, assuming its title, in 218. Here in 272 Zenobia was defeated by Aurelian, and in 1832 the forces of the sultan of Turkey by Ibrahim Pasha. The town is still surrounded by its ancient walls now in a ruinous condition. It has some manufactures of silk goods and gold ornaments, and a trade in oil and agricultural produce. Pop. est. 30,000.

Hem'street, Charles, American journalist and author: b. New York 20 Sept. 1866. He entered the profession of journalism as a reporter in 1886, and was connected with the City Press Association until 1900, when he resigned to devote himself to literature and historical research. He has published: 'Manhattan' (1888); 'Nooks and Corners of Old New York' (1899); 'The Calendar of Old New York' (1900); 'History of New York City' (1901); 'When Old New York was Young' (1901).

Hem'yng, Bracebridge, English author: b. London 1832; d. 1891. In early life a journalist he began at the age of 35 a series of sensational tales for boys known as the 'Jack Harkaway' stories, which for a dozen years had great vogue in Great Britain and the United States. He wrote not only some 20 serial stories having to do with the adventures of 'Jack Harkaway,' but upward of 40 volumes of sensational fiction, none of which, however, found readers in America.

Hen-hawk, or **Chicken-hawk**, any kind of hawk which attacks poultry, or is supposed to do so. Two or three large buzzard-hawks are popularly so called in the eastern United States, and at least two smaller falcons. In the West, and in other parts of the English-speaking world, are other species of the same repute, more or less well-deserved. In England the analogue of the American marsh-hawk (q.v.) is known as "hen-harrier." Certain owls everywhere kill much poultry where it is not safely housed at night. In North America the best known hen-hawks are the broad-winged, red-tailed, and red-shouldered (q.v.; also BUZZARD). They are comparatively harmless to poultry, however, feeding mainly on squirrels, mice, frogs, etc. The broad-wing (*Buteo pennsylvanicus*) is one of the most familiar of our hawks, breeding numerously in the woods all over the country. It is 16 inches long, with the tail 7 inches, and the wing 11 inches. The upper parts are dull umber-brown, the tail almost black, crossed by two to four pale brown bands; the lower parts are dull rufous brown, nearly unbroken on the breast. It is rather sluggish in temperament, though capable of swift and bold action, and feeds mainly on mice, but will now and then seize young chickens, ducklings, etc. On the whole, as in the case of the other buzzard-hawks, it is of more service than injury to the agriculturist. The real culprits are two small, swift, agile falcons, Cooper's (*Accipiter cooperi*), and the sharp-shin (*A. velox*). The former is nearly two feet long, grayish-brown on the upper parts and white below, with the sides and breast barred with dusky red-brown, and tail barred with blackish. The sharp-shin has much the same colors, but is little more than half as large, and is further distinguished by the triangular shape of the tarsus, giving it an edge in front. These bold and active falcons live mainly on birds, and on farms prey largely on chickens and house-sparrows, compensating somewhat for the former by killing the latter. Consult Fisher, 'Hawks and Owls of the United States' (Washington 1893).

Henbane, a dangerous plant (*Hyoscyamus niger*) of the order *Solanaceæ*, which contains the tobacco, stramonium and other plants abounding in narcotic poisons. The black henbane (*Hyoscyamus niger*) represents some 15 species of the Mediterranean region, and springs up in waste places throughout Great Britain and the eastern United States, where it has become naturalized. It is an annual, somewhat bushy, about two feet high, with large sinuated or sharply lobed leaves without leaf-stalks, and large dingy yellow flowers with purplish veins. The whole plant is covered with unctuous hairs, and has a nauseous smell. The seeds contain in largest quantity the specific alkaloid hyoscyamin, which crystallizes in stellated acicular crystals of a silky lustre. The symptoms of poisoning by henbane are similar to those produced by other narcotic poisons, and the proper treatment is the same as in cases of poisoning by opium. In medicine henbane is employed both externally and internally. The leaves are the part commonly used; they are gathered and quickly dried when the plant is in full flower. Fomentations of henbane are applied to painful glandular swellings, parts affected with neuralgia, etc., and are often found to afford relief. An extract of henbane is sometimes employed instead of belladonna to dilate the pupil of the eye. Tincture and extract of henbane are often administered in cases of annoying cough, spasmodic asthma, and other diseases requiring sedatives and anti-spasmodics. For many cases it has one great advantage over laudanum, in not producing constipation. The other species of henbane possess similar properties. The dried stalks of *H. albus* are used by smoking in Greece to allay toothache.

Hen'derson, Charles Hanford, American educator and author: b. Philadelphia 30 Dec. 1861. He was graduated from the University of Pennsylvania in 1882, was lecturer at the Franklin Institute 1883–5, 1885–6; lecturer on education at Harvard 1897–8; and director of Pratt Institute, Brooklyn, 1898–9. He has published 'Elements of Physics' (1900); 'John Percyfield: the Anatomy of Cheerfulness' (1903); 'The Children of Good Fortune' (1904).

Henderson, Charles Richmond, American educator: b. Covington, Ind., 17 Dec. 1848. He was graduated from the University of Chicago in 1870, and has been professor of sociology there since 1892. He was president 26th National Conference of Charities 1898–9, and vice-president National Prison Association. He has published 'Social Spirit in America' (1896); 'Social Settlement' (1897); 'Social Element' (1898).

Henderson, David Bremner, American statesman: b. Old Deer, Scotland, 14 March 1840; d. Dubuque, Iowa, 25 Jan. 1906. He was educated in the public schools and Upper Iowa University; in 1861 entered the army as lieutenant of the Twelfth Iowa regiment; lost a leg at Corinth (1863), and was discharged from the service. He then became commissioner of the board of enrolment in the 3d Iowa district, but re-entered the army as colonel in 1864. He studied law and was admitted to the bar in Iowa in 1865, and was United States district attorney in the northern division of Iowa 1869–71. He early became prominent in the local politics of his district, and was a delegate to three Republican national conventions. In 1882 he was elected to the House of Representatives, and was re-elected biennally till 1902. He was for many years one of the leaders of the Republicans in the House, served on the committee of appropriations for 10 years, and was chairman of the judiciary committee and a member of the committee on rules in the 54th and 55th Congresses. He assisted Speaker Reed (q.v.) in the making of the "Reed rules," was consistently an advocate of sound money, and a strong supporter of President McKinley's Cuban policy. At the organization of the 56th Congress in 1899 he was chosen speaker of the House, and re-elected in 1901; he was an impartial presiding officer and took important part in shaping the legislation made necessary by the Spanish war and the acquisition of new territory. In 1902 he declined a unanimous renomination from his district, because he could not support the policy of tariff revision then made a prominent issue by Iowa Republicans.

Henderson, Isaac, American journalist and novelist: b. Brooklyn, N. Y., 13 Feb. 1850. He was graduated from Williams College in 1872, and the same year joined the staff of the New York *Evening Post*, of which journal he became publisher in 1876. He sold his interests in 1880, and went abroad in 1888, making his home in London and Rome. Author of 'The Prelate' (1898); 'Agatha Page' (1900).

Henderson, James Pinckney, American soldier and politician: b. Lincoln County, North Carolina, 21 March 1808; d. Washington, D. C., 4 June 1858. He practised law in Mississippi; went to Texas in 1836, and became secretary of state of the Texan Republic 1837–9. In the latter year he was sent as a minister to England and France to secure the recognition of Texan independence, and went to Washington in 1844 to secure annexation. He was a member of the Texas constitutional convention 1845, and the following year was elected first governor of the State. In 1857 he was appointed senator from Texas as a State Rights Democrat. Henderson fought in the Mexican War and Congress gave him a sword for his gallantry.

Henderson, Mary N. Foote, American writer on domestic science: b. New York 1842. She was married to J. B. Henderson, and in 1876 organized the St. Louis School of Design. She is the author of 'Diet for the Sick,' 'Practical Cooking and Dinner Giving.'

Henderson, Peter, American horticulturist: b. Porthead, Scotland, 1823: d. Jersey City, N. J., 17 Jan. 1890. He came to America in 1843, and opened a seed-store in New York city in 1862. He has been called "the father of horticulture and ornamental gardening in the United States." He published 'Practical Floriculture' (1867); 'Gardening for Profit' (1866); 'Gardening for Pleasure' (1875); 'Garden and Farm Topics' (1884); 'How the Farm Pays' (1884).

Henderson, Richard, American pioneer: b. Hanover County, Virginia, 1734; d. North Carolina 1785. He studied law and in 1769 was appointed associate justice of the superior court of North Carolina. After the adoption of the Declaration of Independence he declined re-election to the bench, in order to participate in the scheme of the Transylvania Land Company. By this scheme the company organized as a political community with president, legislature, and judges, all the territory lying between the Cumberland River, the Cumberland Mountains, and the Kentucky River. The State of Virginia annulled the deed of sale of this tract of territory which the Cherokee Indians had given to the Transylvania Land Company, but as a reward for the pioneer work of the company, granted them an area 12 miles square on the Ohio River, below the mouth of the Greene River.

Henderson, William James, American musical critic and author: b. Newark, N. J., 4 Dec. 1855. He was graduated from Princeton College in 1876, and joined the staff of the New York *Tribune*, the following year becoming musical critic of the New York *Times*. He was associate editor of 'The Standard Dictionary' (1892–4), and has published: 'The Story of Music' (1889); 'Preludes and Studies' (1891); 'Sea Yarns for Boys' (1894); 'Afloat with the Flag' (1895); 'Elements of Navigation' (1895); 'The Last Cruise of the Mohawk' (1897); 'What is Good Music?' (1898); 'How Music Developed' (1899); 'The Orchestra and Orchestral Music' (1899); 'Richard Wagner' (1901).

Henderson, Ky., city, county-seat of Henderson County; on the Ohio River, and on the Illinois C., the Louisville & N., the Louisville, H. & St. L. R.R.'s; about 10 miles below Evansville, Ind., and 103 miles, in direct line, southwest of Louisville. It has regular steamboat connection with Louisville, Evansville, Memphis, and other river ports. It is one of the oldest settlements on the Ohio River, but it was not incorporated until 1797. It is situated in a fertile agricultural region, rich in timber and coal. The chief manufactures are cotton and woolen goods, flour, hominy, lumber, tobacco products, furniture, carriages and wagons, foundry products, car-works, and agricultural implements. Large shipments are made of corn, wheat, and tobacco. It has large coal and lumber yards, grain-elevators, tobacco-stemmeries, fine fairgrounds, and Atkinson Park, the area of which is about 100 acres. It has a sanatorium and a number of well-built churches and schools. The charter of 1893 provides for a mayor, who holds office four years and is not eligible for re-election, and a common council. The city owns and operates the electric-light and gas plants and the waterworks. Pop. (1900) 10,272.

Henderson, N. C., town, county-seat of Vance County, on the Southern and the Seaboard A. L. R.R.'s; about 12 miles east of Oxford and 42 miles north of Raleigh. Henderson was settled in 1820, but was not incorporated until 1842. It is situated in a cotton and tobacco region of the State. The chief industrial establishments are cotton-gins, cotton-seed oil mills, cotton-mills, knitting-mills, tobacco warehouses, wagon-factories, flour-mills, and lumber-yards. Its chief trade is in cotton and tobacco. Pop. (1890) 4,191; (1900) 3,746.

Henderson, Texas, town, county-seat of Rusk County; on a branch of the International & G. N. railroad; about 122 miles southeast of Dallas and 165 miles north by east from Houston. It is situated in an agricultural section, and the chief industries are connected with agricultural products. Its chief industrial establishments are a foundry, a pottery, and cotton-gins. The trade is in manufactured articles, live-stock, cotton, and vegetables. It is the seat of a normal college.

Hen'dersonville, N. C., town, county-seat of Henderson County; on the Southern Railway; about 21 miles south of Asheville and 100 miles west of Charlotte. It is situated in a mountainous portion of the State, but in the valleys are fertile farm lands. The chief industrial establishments are a furniture factory, a tannery, a canning factory, and a lumber yard. Apples and vegetables are among the agricultural products shipped to other markets. Hendersonville has a large number of summer guests owing to the healthfulness of the climate and the beauty of the scenery. Pop. (1900) 1,917.

Hen'dricks, Thomas Andrews, American politician, 21st Vice-President of the United States: b. near Zanesville, O., 7 Sept. 1819: d. Indianapolis, Ind., 25 Nov. 1885. He was graduated at South Hanover College, Indiana, in 1841: studied law and was admitted to the Indiana bar in 1843. In 1845 he was elected to the legislature, and in 1850 and 1852 to Congress. In 1860 he was the Democratic candidate for governor of Indiana, but was defeated. He was a United States senator 1863–9: and at the Democratic National Convention of 1868 received 132 votes for the Presidential nomination. In the same year he was again defeated for the governorship of Indiana, but in 1872 was elected. In the Democratic National Convention of 1876 he was nominated for the Vice-Presidency, but the ticket, headed by Tilden, was defeated. Hendricks was again nominated for the Vice-Presidency in 1884, however, on the ticket with Cleveland, and on this occasion was elected.

Hen'drix, Eugene Russell, American Methodist bishop: b. Fayette, Mo., 17 May 1847. He was graduated from Wesleyan University, Middletown, Conn., 1867: and the Union Theological Seminary 1869. Appointed bishop of the Methodist Episcopal Church South, in 1886, he has since made official visits to China, Japan, Korea, Mexico, and Brazil. He is the possessor of John Wesley's manuscript 'Journal' written in America 1736–7. He has written 'Around the World' (1878): 'Skilled Labor for the Master' (1900).

Hengist, hĕng'gist, Saxon founder of the kingdom of Kent in Great Britain: d. about 488. He and his brother Horsa were renowned among the Saxons for their bodily strength and the antiquity of their family, which derived its origin in a direct line from Odin. In 449 the Britons sued for aid from the Saxons against the inroads of the Scots and Picts. Under command of Hengist and Horsa the Saxons landed at the mouth of the Thames, attacked the enemies of the Britons, and defeated them near Stamford in 450 A.D. As soon as they had received reinforcements from home they sought occasion for a quarrel, and uniting with the Scots and Picts they attacked the Britons, who were forced to flee or submit to the Saxons. Some fled to Armorica (Haute-Bretagne), to which they gave their name. Hengist, who had lost his brother in the battle near Eglesford (now Aylesford) in 455 A.D., founded the kingdom of Kent. He established his residence in Canterbury. By some of our writers Hengist and Horsa are regarded as mythical personages.

Hening's Statutes, the first complete collection of the laws of any American State, including those of its colonial times, those repealed and those dropped in revision. These were the 'Statutes at Large of Virginia, 1619–1792,' in 13 volumes, published at Richmond 1809–23, by William Waller Hening, clerk of the court of chancery; Jefferson is said to have suggested the publication. It is highly valued as a historical source.

Hen'ley, William Ernest, English poet, critic, and journalist: b. Gloucester 23 Aug. 1849: d. Woking 12 July 1903. He entered on a journalistic career in London, and in 1877 became first editor of the magazine 'London.' He was then editor successively of the 'Magazine of Art' (1882–6), of the 'Scots'— later the 'National Observer'—(1888–93), and of the 'New Review' (1893–8). His first publication, 'In Hospital: Rhymes and Rhythms' (1888), was inspired by his own experiences as a patient in Edinburgh Infirmary. Its contents were subsequently included in 'A Book of Verses' (1888). A second volume of poems, 'The Song of the Sword,' appeared in 1892 (2d ed. as 'London Voluntaries' 1893). Both of these books were incorporated in the collection of his 'Poems' (1898). Later poetical works were: 'For England's Sake' (1900): and 'Hawthorn and Lavender, and Other Verses' (1901). Henley collaborated with Stevenson four plays, 'Deacon Brodie,' 'Beau Austin,' and 'Admiral Guinea' and 'Macaire.' He also edited, either alone or in cooperation with others, the following anthologies and collections: 'Lyra Heroica' (1891), an anthology of English patriotic verse; 'A London Garland: from Five Centuries of English Verse' (1895): 'Book of English Prose' (1896): 'English Lyrics, 1340–1809' (1897): 'The Works of Lord Byron' (1897): 'The Poetry of Wilfrid Blunt' (1896): and 'London Types' (1898), and was editor of a series of 'Tudor Translations.' The 'Centenary Burns' (1896–7) is an important work edited by him with the cooperation of T. F. Henderson. The fourth volume contains an elaborate estimate by Henley of Burns as poet and man, published separately in 1898. His critical work appears at its best in 'Views and Reviews: Literature' (1890), and 'Views and Reviews: Painting and Sculpture' (1901). Both as poet and critic he was prejudiced and aggressive, but keen, vigorous, and often distinguished in style. A paper on Stevenson contributed to the 'Pall Mall' in 1901 aroused much unfavorable comment by its arraignment of Balfour's 'Life.'

Henley-on-Thames, England, a market-town and municipal borough of Oxfordshire, on the Thames, 35 miles by rail west of London. The town is especially famous for its annual regatta in July, a notable event in the British sporting world. The university boat races are held on the river here, and Americans frequently take part in the various open events. Pop. (1901) 5,984.

Henlopen. See CAPE HENLOPEN.

Henna, a shrub (*Lawsonia inermis*) resembling the privet, but of the order LYTHRACEÆ. It grows in moist situations throughout the north of Africa, Arabia, Persia, and the East Indies, and has acquired celebrity from being used by the inhabitants of those countries to dye the nails of their fingers and the manes, hoofs, etc., of their horses. For this purpose the leaves are dried, powdered, and made into a paste with hot water, which imparts a yellow color, requiring renewal every three or four weeks. It is cultivated extensively in Egypt, and the powdered leaves form a large article of export to Persia and Turkey. Henna is supposed to be the *kopher* of the Hebrew, translated *camphire* in the Song of Solomon.

Hennepin, Louis, loo-ē ĕn-păṅ or hĕn'ĕ-pĭn, French Franciscan missionary and explorer in North America: b. Ath, Belgium, about 1640; d. Utrecht, Holland, about 1706. He entered a convent, and being sent by his superiors to Calais and Dunkirk, the stories he heard from the sailors inspired him with a desire to visit distant countries. At length he embarked for Canada, and arrived at Quebec in 1675. In 1676 he went to the Indian mission at Fort Frontenac, whence he visited the Five Nations and the Dutch settlement at Albany. In 1678 he was attached to La Salle's expedition, and, in company with the Chevalier de Tonty and the Sieur de la Motte, was ordered to sail from Fort Frontenac to Niagara, and there construct a vessel for navigating the Lakes above the falls. This accomplished, La Salle joined the party, and on 7 Aug. 1679 the adventurers began their voyage on Lake Erie. They passed through Lakes Erie, Huron, and Michigan, to the mouth of the St. Joseph's River, ascended this in canoes to the portage, carried their frail barks several miles by land to the Kankakee, and floated down this stream and the Iroquois to the Illinois, on the banks of which they built Fort Crèvecœur near the present site of Peoria. After a delay of two months at this place, La Salle returned to Fort Frontenac for supplies, charging Father Hennepin with a voyage of discovery to the sources of the Mississippi, which had never been explored above the mouth of the Wisconsin. Accompanied by Picard du Gay and Michel Ako, he set out in a canoe 29 Feb. 1680, followed the Illinois to its mouth, and ascended the Mississippi to the Falls of St. Anthony, which he was the first European to see, and which he named in honor of his patron saint. This was on 30 April. Arriving at the mouth of the St. Francis River, in what is now the State of Minnesota, he traveled by land about 180 miles along its banks, naming it in honor of the founder of his order, and visited the Sioux Indians, whom he mentions by the names Issati and Nadouessioux. He stayed with them three months, being, according to his own account, held in captivity, and then, meeting a party of Frenchmen who had come into the country by way of Lake Superior, returned with them to Canada, descending the Mississippi to the Wisconsin, and passing up that river and down the Fox, and so through Green Bay to Lake Michigan. From Quebec he sailed for France, where he published in 1683 his 'Description de la Louisiane Nouvellement Découverte au Sud-Ouest de la Nouvelle-France, etc.,' containing the fullest published account of La Salle's first expedition, a history of his second voyage, and of Hennepin's own explorations, with a description of the upper Mississippi. Notwithstanding the writer's vanity and fondness for exaggeration, the work is valuable. He put off his clerical dress in Holland about 1697, but to the end of his life seems to have written himself: "Recollect missionary and apostolic notary." In 1697, 10 years after La Salle's death, Hennepin published his extraordinary 'Nouvelle Découverte d'un Très-Grand Pays Situé dans l'Amérique entre le Nouveau Mexique et la Mer Glaciale, etc.,' reprinted the next year under the title 'Nouveau Voyage dans un Pays Plus Grand que l'Europe, etc.' In this work, which embodies his 'Description de la Louisiane,' written anew and enlarged, he claims to have descended to the mouth of the Mississippi, and to have been the first European who floated on that river. He gives a description of the scenery, Indian tribes, and distances along the route, with a minuteness which easily gained him credit for veracity, and explained his long silence on this important point by saying that he feared the enmity of La Salle, who had ordered him to follow a different course, and who prided himself upon his own claims as the first who descended the Mississippi to the Gulf of Mexico. Notwithstanding the utter impossibility of reconciling the dates given in Hennepin's narrative, the story obtained general credence until its falseness was exposed by Jared Sparks. (See 'Life of La Salle' by Sparks in the 'Library of American Biography.') Consult: Saint-Genois, 'Les Voyageurs Belges du XIII. au XIX. Siècle' (1867); Van Hulet, 'Notice sur le Père Louis Hennepin' (1845); Shea, 'Discovery of the Mississippi' (1852); Parkman, 'La Salle and the Discovery of the Great West'; Winsor, 'Narrative and Critical History of America,' Vol. IV. (1884).

Hen'nessey, William J., Anglo-American artist: b. Thomastown, County Kilkenny, Ireland, 1839. He was brought to New York when 10 years of age, and became a student of the Academy of Design in 1856. He paints in oil and water colors, with a preference for landscape, and draws in black and white as an illustrator. In 1863 he was elected a National Academician, and since 1870 has lived in London, England.

Hennessy, John, American Roman Catholic bishop: b. Ireland 20 Aug. 1825; d. Dubuque, Iowa, 4 March 1900. He came to the United States in 1847, and pursued his theological studies in Carondelet Seminary, near St. Louis. After serving several years as a missionary in Missouri he became professor in Carondelet Seminary in 1854, and its president in 1857. He was afterward pastor in St. Joseph, Mo.; became bishop of Dubuque in 1866, and archbishop in 1893.

Hennessy, John Joseph, American Roman Catholic bishop: b. County Cork, Ireland, 19 July 1847. He came to America in early life and was graduated at the Christian Brothers' College, St. Louis, Mo., in 1862. He was ordained priest in 1869; founded the Railroad Men's Benevolent Union 1871; established the Ursuline convent, Arcadia, Mo., 1877; and edited 'The Youth's Magazine,' St. Louis, 1880–6. He was consecrated bishop of Wichita, Kan., in November 1888.

Hen'niker, Hon. Mrs. **Arthur,** English novelist. She is a daughter of Richard Monckton Milnes (q.v.), 1st Baron Houghton, and was married to Hon. Arthur Henniker in 1882. Her books, which have had an American as well as English circulation, include: 'Sir George' (1891); 'Foiled' (1893); 'Outlines' (1894); 'In Scarlet and Gray' (1896); 'Sowing the Sand' (1898); etc.

Hen'ningsen, Charles Frederick, American military officer: b. in England, of Swedish parents, 1815; d. Washington, D. C., 14 June 1877. He joined the Carlists in Spain in 1834, and later was a follower of Kossuth in the Hungarian Revolution. He went to Nicaragua in 1856, where he distinguished himself in the defense of Granada, and in the victory at Queresma. During the Civil War he served in the Confederate army, becoming a brigadier-general. He directed the construction of the first Minie rifles manufactured in the United States. His publications include 'Eastern Europe'; 'Past and Future of Hungary'; 'Sixty Years Hence'; 'Personal Recollections of Nicaragua'; 'The White Slave'; etc.

Henri, Robert, American painter; b. Philadelphia, Pa., 1865. He began his art studies in his native city and became an instructor in the Philadelphia School of Design. He has exhibited in Paris, and his picture 'Snow' was purchased by the French government and hangs in the Luxembourg. While in Paris he gathered round him a group of pupils in his studio, and as a landscape painter did much to impress younger men with his breadth and vigor of style. While he is a landscape painter of notable attainment, his portraits also are admirable for the power of individualization and the directness which characterizes them.

Henriet'ta, Duchess of Orleans: b. Exeter 16 June 1644; d. St. Cloud, France, 30 June 1670. She was the daughter of King Charles I. Her mother fled with her to France where she was educated a Roman Catholic. Her marriage with the brother of Louis XIV., Philip of France, Duke of Orleans, was celebrated in March, 1661. Louis XIV. was desirous of detaching her brother, Charles II., from the triple alliance with Holland and Sweden, in order to accomplish his plan of obtaining possession of a part of Holland. She went, therefore, in 1670, with the court to Flanders, and, under pretense of visiting her brother, passed over to Dover, where Charles was awaiting her arrival, and there succeeded in obtaining his signature to the secret treaty of Dover. Shortly after her return she died so suddenly as to excite the suspicion of her being poisoned. Bossuet pronounced her funeral oration.

Henrietta Maria, queen of Charles I. of England: b. Paris 25 Nov. 1609; d. Colombes, near Paris, 31 Aug. 1669. She was the youngest child of Henry IV. of France. Her marriage ceremony was celebrated by proxy at Paris in 1625. On Henrietta's first arrival in England she enjoyed great popularity with her husband's subjects, but her attachment to the Roman Catholic faith, combined with her hauteur and despotic ideas as to divine right, soon dissipated these favorable prepossessions. Much of Charles' subsequent arbitrary and injudicious procedure, may be traced indirectly to the influence of his queen. On the breaking out of the civil war Henrietta proceeded to Holland, where she procured money and troops for the assistance of her husband, and afterward joined him at Oxford. She again returned to the Continent, and took up her abode in France.

Henriet'ta, Texas, town, county-seat of Clay County; on the Little Wichita River, and on the Missouri, K. & T., and the Fort Worth & D. R.R.'s; about 90 miles northwest of Fort Worth and 128 miles northwest of Dallas. It is situated in an agricultural and stock-raising region, and the building-stone quarries in the county add to the industrial wealth of the town. The chief manufactures are flour and lumber. The town has cotton-gins, grain elevators, lumber-yards, and stock-yards. The trade is chiefly in live stock, grain, flour, lumber, cotton, and building-stone. Pop. (1900) 1,614.

Hen'rotin, Ellen M., American social reformer; b. Portland, Maine, July 1847. She was educated in Europe and in 1869 was married to Charles Henrotin, Belgian consul at Chicago. In 1893 she was vice-president of the Congress Auxiliary of the World's Columbian Exposition; the same year she was decorated by the Sultan of Turkey with the order of Chafkat and made an Officier de l'Academie by the French Republic, 1899. She was president from 1894 to 1898 of the General Federation of Women's Clubs.

Henry I., king of England, surnamed Beauclerc, youngest son of William the Conqueror: b. Selby, Yorkshire, 1068; d. Rouen, France, 1 Dec. 1135. He was hunting with William Rufus in the New Forest when that prince received his mortal wound in 1100, and instantly going to London, caused himself to be proclaimed king, to the prejudice of his elder brother Robert, then absent in the Crusade. To reconcile the people to his usurpation Henry issued a charter containing concessions to public liberty, and also performed another popular act, by recalling Anselm, archbishop of Canterbury. In November 1100 he married Matilda, daughter of Malcolm III., king of Scotland. This union strengthened his party, when his brother landed an army in 1101, with a view of asserting his claim to the crown. Actual hostilities were prevented by Anselm, who induced Robert to accept a pension; and it was agreed that in the event of the death of either of the brothers without issue, the other should succeed to his dominions. He subsequently invaded Normandy, and in 1106 took Robert prisoner, and reduced the whole duchy. His usurpation of Normandy involved him in continual war, but although William, son of Robert, escaped out of custody, and was assisted by the king of France, Henry maintained possession of the duchy. His only son William was drowned in 1120 in returning from Normandy, and Henry was never seen to smile afterward. He married his only daughter, Matilda, to the Emperor Henry V., and when she became a widow married her a second time to Geoffrey Plantagenet, son of the Count of Anjou. Henry was succeeded by Stephen.

Henry II., king of England, the first of the line of the Plantagenets, b. Normandy 1133; d. Castle of Chinon, near Saumur, France, 6 July 1189. He was the son of Geoffrey, count of Anjou, and the empress Matilda, daughter of Henry I. He was invested with the duchy of Normandy, by the consent of his mother, in 1150. The next year he succeeded his father in the possession of Anjou and Maine, and by a marriage with Eleanor of Guienne, just divorced from Louis VII., king of France, annexed that province with Poitou to his other dominions. He succeeded Stephen as king of England in 1154. Although involved with his brother Geoffrey, who attempted to seize Anjou and Maine, and in a temporary dispute with France, he reigned prosperously till the memorable contest with Thomas Becket. Anxious to dominate the clergy, Henry in 1164 summoned a general council of nobility and prelates at Clarendon, which assembly passed the famous constitutions named from that place, the effect of which was to render the church and ecclesiastical dignitaries subject to the temporal authority. (See CLARENDON, CONSTITUTIONS OF.) After the murder of Becket Henry receded from his position and restored the Church to its rights. Before this matter was terminated, Henry, in 1171, undertook an expedition into Ireland, and having left Earl Richard in the post of seneschal of Ireland he returned to England — proceedings so important to the future destinies of both countries having occupied only a few months. Being an indulgent father Henry had assigned to each of his four sons a provision out of his extensive territories. The eldest son, Henry, was not only declared heir to England, Normandy, Anjou, Maine, and Touraine, but actually crowned in his father's lifetime. On paying a visit to the court of his father-in-law, Louis VII. of France, the prince was induced by the French monarch to demand of his father the immediate resignation either of the kingdom of England or of the dukedom of Normandy. This request being refused he withdrew from his father's court, and was openly supported in his claim by Louis. Henry's various gallantries, exemplified in the popular and not altogether unfounded legend of fair Rosamond, or Rosamond Clifford, also embroiled him with his queen, Eleanor, who incited her other sons, Richard and Geoffrey, to make similar claims. A general invasion of Henry's dominions was in this way concerted, and began in 1173 by an attack on the frontiers of Normandy, but the king presently subdued his opponents and entered into an accommodation with his sons on less favorable terms than they had previously rejected. Henry now employed himself in regulations and improvements which equally manifest his capacity and love of justice. He partitioned England into four judiciary districts, appointed itinerant justices to make regular excursions through them, revived trial by jury, discouraged that by combat, and demolished all the newly erected castles as shelters of violence and anarchy. The turbulence of his sons still disquieted him; but Henry, the eldest, was cut off by fever in 1183, and three years after the death of the equally restless Geoffrey occurred. Philip Augustus, then king of France, however, continued to foment the differences between Henry and his sons, and Richard was again prompted to rebel. A war followed, the event of which was so unfavorable to Henry, that he was at length obliged to agree that Richard should receive an oath of fealty from all his subjects. He also stipulated to pay a sum of money to the French king, and to grant a pardon to all Richard's adherents. The mortification of Henry at these humiliating terms was aggravated to despair when he saw the name of his favorite son John at the head of the list of delinquents whom he was required to pardon. Henry II. ranks among the greatest kings of England. His wisdom and love of justice were acknowledged by foreign potentates, who made him arbiter of their differences, and regarded him as the first prince of the age. Consult: Stubbs, 'The Early Plantagenets' (1876); Mrs. J. R. Green, 'Henry II.' (1888); Norgate, 'England Under the Angevin Kings' (1887).

Henry III., king of England: b. Winchester 1 Oct. 1207; d. Westminster 16 Nov. 1272. He was the son of John, whom he succeeded in 1216. As Henry approached to manhood he displayed a character wholly unfit for his station. One of his first false steps was to discard his most faithful and able minister Hubert de Burgh. In 1236 Henry married Eleanor of Provence, which increased the dislike which his subjects already felt toward him; for she brought a train of foreigners to the court, and encouraged her husband in extravagant courses which forced him to all kinds of oppressive exactions to raise money. He received frequent grants of money from Parliament, but always on condition of confirming the Great Charter, which had been extorted from King John. Henry at length raised the national discontent to such a pitch that the nobles rose in rebellion under Simon de Montfort, the earl of Leicester, the husband of the king's sister; and in 1258, obliged the king to sign a body of resolutions, which threw all the legislative and executive power into the hands of an aristocracy of twenty-four barons, assisted by a lower house, consisting of four knights chosen from each county. By the aid of his son Edward, Henry was gradually restored to authority; on which Leicester, calling in Llewellyn, prince of Wales, involved the kingdom in a civil war. The power of the barons was by this means partially restored; but both parties agreed to abide by the award of Louis IX., king of France. This being favorable to the king, Leicester and the barons refused to submit to it, and a battle was fought near Lewes, in which Henry was taken prisoner, and the person of Prince Edward also ultimately secured. A convention provided for the future settlement of the kingdom; but in the meantime Leicester ruled without control. To him, however, was owing the first example of a genuine House of Commons in England; for in a Parliament summoned by him in 1265, deputies from boroughs were sent, as well as knights of shires. Prince Edward at length escaped, and, assembling an army, defeated Leicester's son. The decisive battle of Evesham (1265) quickly followed, in which Leicester himself was slain. Replaced upon the throne Henry remained as insignificant as ever. He died in the 64th year of his age, and the 56th of his reign, the longest in English history, except those of George III. and Victoria. He was succeeded by his son, Edward I.

Henry IV., king of England, first king of the house of Lancaster: b. Bolingbroke 3 April 1367; d. 19 March 1413. He was the eldest son of John of Gaunt, duke of Lancaster; fourth son of Edward III. by the heiress of Edmund, earl of Lancaster, second son of Henry III. In the reign of Richard II. he was made Earl of Derby and Duke of Hereford, and while bearing the latter title appeared in the Parliament of 1398, and preferred an accusation of treason against Mowbray, duke of Norfolk. The latter denied the charge, and offered to prove his innocence by single combat, which challenge being accepted, the king appointed the lists at Coventry; but on the appearance of the two champions at the appointed time and place, Richard would not suffer them to proceed. Both were banished the kingdom, Norfolk for life, and Hereford for 10 years, shortened by favor to four, with the further privilege of immediately entering upon any inheritance which might accrue to him. On the death of John of Gaunt in 1399 he succeeded to the dukedom of Lancaster, and laid claim, according to agreement, to the great estates attached to it; but Richard retained possession of the estates. The duke, therefore disregarding the unfinished term of his exile, landed with a small retinue at Ravenspur in Yorkshire, where he was quickly joined by the Earls of Northumberland and Westmoreland, and soon found himself at the head of 60,000 men. Richard falling into the hands of his enemies, was brought to London by the duke, who now began openly to aim at the crown. A resignation was first obtained from Richard, who was then solemnly deposed in Parliament; and Henry unanimously declared lawful king under the title of Henry IV. The death of Richard soon removed a dangerous rival; yet a short time only elapsed before the nobles rebelled against the king of their own creation. The first plot, in 1400, was discovered in time to prevent its success, but an insurrection in Wales, under Owen Glendower, proved more formidable. That chieftain having captured Mortimer, earl of March, who was descended from Lionel, duke of Clarence, the second son of Edward III., and therefore the lineal heir to the crown, Henry would not suffer his relation, the Earl of Northumberland, to treat for his ransom. He thus offended that powerful nobleman, who, with his son, the famous Hotspur, soon after joined Glendower. The king met the insurgents at Shrewsbury, and a furious battle ensued, 21 July 1403, which ended in the death of Percy, and the defeat of his party. A new insurrection, headed by the Earl of Nottingham and Scrope or Scroop, the archbishop of York, broke out in 1405, which was suppressed by the king's third son, Prince John. The archbishop afforded the first example in this kingdom of a capital punishment inflicted upon a prelate. The rest of this king's reign was comparatively untroubled. Henry was succeeded by his son of the same name.

Henry V., king of England: b. Monmouth 19 Aug. 1387; d. Vincennes, France, 31 Aug. 1422. He succeeded his father, Henry IV., in 1413. His dissipated youth, and fondness for joviality and low company, gave his father much uneasiness; but circumstances occurred, even in the midst of his wildness, which showed that better principles were latent in his mind. His conduct when he ascended the throne justified the best expectations. The circumstances of France, torn asunder by the opposing factions of the dukes of Orleans and Burgundy, afforded a tempting opportunity to an ambitious neighbor, and Henry was easily induced to revive the claims of his predecessors upon that country. He accordingly assembled a great fleet and army and landed near Harfleur, 14 Aug. 1415. He took that town after a siege which so much reduced his army that he was advised to return to England by sea. But Henry determined to march on Calais, and on his way was met on the plain of Agincourt by a French army ten times as numerous as his own. A battle took place there on 25 October, in which the French host was totally defeated, with a comparatively trifling loss on the side of the English. In 1417, the liberal grants of the Commons enabled Henry once more to invade France with 25,000 men. By the famous Treaty of Troyes (21 May 1420), Henry engaged to marry the Princess Catharine, and to leave Charles in possession of the crown, on condition that it should go to Henry and his heirs at his decease, and be inseparably united to the crown of England. Henry, after espousing Catharine, took possession of Paris, and then went over to England to raise recruits for his army. All his great projects seemed about to be realized, when he was attacked by a disease which carried him off at the age of 34, and in the 10th year of his reign. He was succeeded by his son Henry VI. Henry V., as the gallant, youthful, and successful conqueror of France, is a favorite name in English history; but he was inferior in wisdom and solid policy to many of his ancestors.

Henry VI., king of England: b. Windsor 6 Dec. 1421; d. London 21 May 1471. He was crowned at Westminster in November 1429, and at Paris in December 1430. As he was not nine months old at the death of his father Henry V., John, duke of Bedford, a brother of the late king, was appointed Regent of France; and Humphrey, duke of Gloucester, another brother of the same, Protector of the realm of England, with a council at his side appointed by Parliament. A few weeks after Henry's succession, Charles VI. of France died, when, according to the provisions of the Treaty of Troyes, Henry was proclaimed King of France. But the French did not quietly submit, and a war began at first favorable to the English, but in the end, after they had been roused to more effectual efforts by the heroism of Joan of Arc (q.v.) (1428–30), resulted in the almost total loss to the English of their possessions in France. In 1453 nothing remained to them in that country but Calais. In April 1445, Henry married Margaret of Anjou, daughter of René of Provence. Two years later the Earl of Suffolk acquired the chief power in the kingdom, and was created first marquis and then duke. His government was very unpopular, which caused the people to look to the claim of Richard, duke of York. The insurrection of Cade followed, and the Duke of York was by Parliament declared Protector of the kingdom. The York and Lancaster parties were now in such a state that the sword only could decide between them; and that course of civil contention commenced, the first bloodshed in which occurred at St. Albans in May 1455, and as far as the reign of Henry was concerned, the last in the battle of Tewkesbury in 1471. When the latter took place the king was a prisoner in the Tower, where he soon after died, but whether by a natural or violent death is uncertain. Henry was gentle, pious, and well-intentioned, but weak. Eton College reveres Henry as its founder, as does likewise King's College, Cambridge.

Henry VII., king of England, first sovereign of the house of Tudor: b. Wales 28 Jan. 1457; d. Richmond, Surrey, 22 April 1509. He was the son of Edmund, earl of Richmond, son of Owen Tudor and Catharine of France, widow of Henry V. His mother, Margaret, was the only child of John, duke of Somerset, grandson of John of Gaunt. After the battle of Tewkesbury he was carried by his uncle, the Earl of Pembroke, to Brittany, to seek refuge in that court from the jealousy of the victorious house of York. On the usurpation of Richard the young Earl of Richmond was naturally turned to as the representative of the house of Lancaster. In 1485 Richmond landed at Milford Haven, where he was immediately joined by some leaders of rank, but had only 6,000 men when Richard met him at Bosworth, with an army twice as numerous in appearance; but the defection of Lord Stanley with his forces, who joined Richmond during the battle, obtained for the latter a complete victory. Henry was proclaimed king on the field of battle, and his right was subsequently recognized by Parliament. In 1486 he married Elizabeth, daughter of Edward IV., and heiress of the house of York, and thus united the claims of the rival houses of York and Lancaster. The reign of Henry VII. was troubled by repeated insurrections. The project of France for annexing the province of Brittany, by marriage with the heiress, induced Henry to declare war, but his measures were so tardy and parsimonious that the annexation was effected. He then raised large sums on the plea of the necessity for hostilities; and landing a numerous army at Calais in 1492, almost immediately accepted a large compensation for peace. The Duchess-dowager of Burgundy, governess of the Low Countries, now advocated the cause of Perkin Warbeck, a youth who gave himself out to be Richard Plantagenet, the younger of the two sons of Edward IV., supposed to have been murdered in the Tower of London, and the justice of his claim has been maintained even by some historians of a recent date. The duchess professed to be satisfied with the proofs of his identity, and acknowledged him as her nephew. He was so far successful as to secure a large following, with which he marched to Taunton; but there his heart failed him, and he fled. Captured by Henry he confessed himself an impostor, and was sent to the Tower, where he became acquainted with the Earl of Warwick, and persuaded him to accompany him in an attempt to escape. They were both retaken, and Warwick was recommitted to the Tower and Perkin Warbeck hanged at Tyburn (1499). Soon after, the king ordered the Earl of Warwick also to be executed. After a long negotiation he brought about a match between the Infanta Catharine, daughter of Ferdinand of Aragon and of Isabella of Castile, and his eldest son Arthur; and on the death of the latter, in order to retain the dowry of this princess, caused his remaining son Henry to marry the widow by Papal dispensation, an event which, in the sequel, led to a separation from the See of Rome. He married his eldest daughter to James IV., king of Scotland, from which union there ultimately resulted the union of the two crowns. His reign was, upon the whole, beneficial to his country. Being conducted upon pacific principles it put a period to many disorders, and gave an opportunity to the nation to flourish by its internal resources. His policy of depressing the feudal nobility, which proportionably exalted the middle ranks, was highly salutary; and it was especially advanced by the statute which allowed the breaking of entails and the alienation of landed estates.

Henry VIII., king of England: b. Greenwich 28 June 1491; d. Westminster 28 Jan. 1547. He succeeded his father, Henry VII., in 1509. His disposition for show and magnificence soon squandered the hoards of his predecessor. James IV., king of Scotland, having made an incursion with a numerous body of troops into England, was completely defeated and slain at the battle of Flodden Field. Henry, however, granted peace to the Queen of Scotland, his sister, and established an influence which rendered his kingdom long secure on that side. The aggrandizement of Cardinal Wolsey now began to give a leading feature to the conduct of Henry, that prelate being appointed chancellor in 1515. His favor was now sought by Maximilian I., emperor of Germany, who hoped to secure the support of England against France, and as Wolsey was at first neglected by the French king the German emperor gained his point; but when Maximilian was succeeded by Charles V., hereditary king of Spain as well as emperor of Germany, Francis found it expedient to gain Wolsey, and for that purpose entered into an amicable correspondence with them. In order to cement this new friendship the two monarchs had an interview near Calais, the magnificence of which gave the place of meeting the denomination of the Field of the Cloth of Gold (1520). Notwithstanding these indications, a prospect of the papacy being artfully held out to the cardinal by the young emperor Charles, his interest at length gained a preponderance in the English councils. The principles of the Reformation were now making rapid strides, and Henry himself wrote a Latin book against the tenets of Luther, which he presented to Pope Leo X., who favored him in return with the title of defender of the faith. After being married to Catharine for about 18 years, Henry began to feel some scruples as to the validity of the marriage, on the ground that she had previously been his brother's wife, and his scruples were no doubt increased by the fact of his having conceived a passion for Anne Boleyn, one of the queen's maids of honor. He accordingly applied in 1527 to Pope Clement VII. for a divorce, and the Pope appointed cardinals Wolsey and Campeggio to try the case. Wolsey had at first been favorable to the project of a divorce, but when he perceived the desire of Henry to marry Anne Boleyn, fearing that this marriage would result in winning over Henry to the side of the reformers, since Anne Boleyn's friends belonged to that party, he did all in his power to prolong the inquiry, until the commission was at last withdrawn, and it was decided by the Pope that the case should be tried at Rome. This procrastination on Wolsey's part led to his own ruin. Henry, disgusted at these delays, eagerly caught at the advice of Thomas Cranmer (q.v.), afterwards archbishop of Canterbury, to refer the case to the universities, from whom he got the decision desired. In May 1533 his marriage with Catharine was declared null, and as he had by that time privately married Anne Boleyn, this second marriage was a few days later declared lawful. As these decisions were not recognized by the Pope, an act of Parliament was obtained in the following year (1534), setting aside the authority of the chief pontiff in England, which was followed by another in 1535 declaring Henry the supreme head of the church. Thus was effected the great revolution by which, in ecclesiastical annals, this reign is so much distinguished. The birth of a daughter by the new queen produced a bill for regulating the succession, which settled it on the issue of this marriage, and declared the king's daughter by Catharine illegitimate. But although Henry discarded the authority of the Roman Catholic Church, he adhered to its theological tenets. While he executed Bishop Fisher and Sir Thomas More (who had been appointed chancellor after the fall of Wolsey) for refusing the oath of supremacy, he displayed an aversion to the principles of the reformers, and brought many of them to the stake. Finding that the monks and friars in England were the most direct advocates of the papal authority, he suppressed the monasteries by act of Parliament. The fall of Anne Boleyn was, however, unfavorable for a time to the reformers. Henry then married Jane Seymour, and the birth of Prince Edward in 1537 fulfilled his wish for a male heir, although his joy was abated by the death of the queen. Henry now resolved to marry again, and Thomas Cromwell, a Protestant, who had succeeded More as first minister, recommended Anne of Cleves. The marriage took place in January 1540, and Henry created Cromwell Earl of Essex: but his dislike to his new wife hastened the fall of that minister, who was condemned and executed upon a charge of treason. At the same time Henry procured from the convocation and Parliament a divorce from Anne of Cleves. He then married Catharine Howard, niece to the Duke of Norfolk, but Henry now found that his new queen, of whom he was very fond, had proved false, and on further inquiry her conduct before marriage was discovered to have been loose and criminal. She was therefore accused and brought to the block in 1542. In 1543 he married his sixth wife, Catharine Parr, widow of Lord Latimer, a lady of merit, secretly inclined to the Reformation.

Henry was succeeded by his son, Edward VI. The complete union of Wales with England, and the conversion of Ireland into a kingdom, date from the reign of Henry VIII. Consult: Histories of England by Lingard (1854–5); Froude (1870); and Green (1879 and 1884); also Brewer, 'History of the Reign of Henry VIII. to the Death of Wolsey' (1884); Dixon, 'History of the Church of England from the Abolition of the Roman Jurisdiction' (1884–91); Froude, 'The Divorce of Catharine of Aragon' (1891).

Henry I., king of France: b. 1005; d. Vitri, 4 Aug. 1060. He was the third son of Robert II. He succeeded to power in 1031. His reign was a continuous series of difficulties with the nobility and with the growing power of the clergy. His younger brother, Robert, led a revolt against him, but this he suppressed with the aid of Duke Robert of Normandy.

Henry II., king of France: b. St. Germain-en-Laye 31 March 1519; d. 10 July 1559. He succeeded his father, Francis I., 31 March 1547. He severely persecuted the Huguenots, and was involved in wars with the Emperor Charles V. and Philip II. of Spain. The Constable de Montmorency was defeated at St. Quentin (10 Aug. 1557); the Marshal de Thermes at Gravelines (13 June 1558), and the peace of Cateau-Cambrésis (3 April 1559) lost to France most of the advantages previously gained. Henry was a monarch of slight capability, despite his regal bearing.

Henry III., king of France: b. Fontainebleau 19 Sept. 1551; d. by assassination St. Cloud 2 Aug. 1589. He was the third son of Henry II. He fought, as Duke of Anjou, against the Huguenots, was elected king of Poland in 1573 and crowned 15 Feb. 1574, but in June 1574 left Poland and succeeded his brother, Charles IX., as king of France. The Peace of Beaulieu (1576), confirmed by the Edict of Poitiers (1577), granted to the Huguenots so many privileges that the Holy League was formed, seeking openly Catholic supremacy and secretly the elevation of Henry of Guise to the French throne. When all privileges granted to Huguenots were repealed by the Edict of Nemours (1585) war broke out. Henry of Navarre was victor at Coutras, while Henry of Guise drove the king from Paris. The king then caused the murder of Guise and Guise's brother, the Cardinal of Lorraine, in consequence of which the doctors of the Sorbonne absolved the people from obedience to him. He then joined cause with Henry of Navarre, with whom he marched against Paris; but in camp at St. Cloud was stabbed by Jacques Clément, a fanatical Dominican, 1 Aug. 1589. Henry III. was the last of the branch of Orléans-Angoulême of the stock of the Valois.

Henry IV., known as Henry of Navarre, king of France: b. Pau 13 Dec. 1553; d. 14 May 1610. He was a son of Anthony of Bourbon, Duke of Vendôme, and of Jeanne d'Albret, daughter of Henry, king of Navarre, and herself afterward queen of Navarre. Educated by his mother in the Calvinistic faith, he early joined, at her wish, the Protestant army of France, and served under Admiral Coligny. In 1572 he married Margaret of Valois, sister of Charles IX., and after the massacre of St. Bartholomew, which took place during the festivities in connection with this marriage, adopted the Roman Catholic creed. For the next four years he was compelled to reside in Paris, but 3 Feb. 1576 succeeded in making his escape, and after retracting, at Tours, the abjuration of Calvinism which he had made at Paris, put himself at the head of the Huguenots, and took a leading part in all the subsequent religious wars. He occupied a still more important position, when, in 1584, the death of the Duc d'Anjou, brother of the king (Henry III.), made him presumptive heir to the crown, as descended from Robert, Count of Clermont, the sixth son of Louis IX. Rejected by the Roman Catholic party and the League as a heretic, Henry found himself obliged to resort to arms to assert his claims. On 20 Oct. 1587 with an inferior force, he defeated the army of the League at Coutras. In 1589 he became king through the assassination of Henry III. (q.v.), but found innumerable difficulties in establishing his claims. His Protestant religion was brought forward by all the competitors to prejudice the Catholics against him. At the head of the opposite party stood the Duke de Mayenne. Philip II. of Spain also claimed the French throne, and sent aid to the League. Henry IV. defeated his enemies in the celebrated engagement of Ivry (14 March 1590). In consequence of this victory Paris was besieged, and Henry IV. was upon the point of compelling the citizens to surrender by famine, when the Spanish general, Alexander, Duke of Parma, by a skilful maneuver, obliged him to raise the siege. Convinced that he should never enjoy quiet possession of the French throne without professing the Catholic faith, Henry at length yielded to the wishes of his friends, was instructed in the doctrines of the Roman Church, and professed the Catholic faith, 23 July 1593, in the church of St. Denys. He was anointed king at Chartres in 1594; and entered the capital amid the acclamations of the people. He quickly brought France entirely into subjection, and concluded the war against Spain in 1598, by the Peace of Vervins, to the advantage of France. The same year was signalized by the granting of the Edict of Nantes, which secured to the Protestants entire religious liberty, and freed them from all political disabilities. Henry made use of the tranquillity which followed to restore the internal prosperity of his kingdom, and particularly the wasted finances. In this design he was so successful, with the aid of his prime minister Sully, that the national debt of 350,000,000 livres was diminished by 125,000,000, and 41,000,000 livres were laid up in the treasury. As Henry was riding through the streets of Paris he was stabbed by the fanatic Ravaillac. The great benefits which Henry IV. bestowed upon France entitle him to the designation which he himself assumed at an assembly of the Notables at Rouen in 1596, the Regenerator of France. His benevolent mind, his paternal love to his subjects, his great achievements, his heart, always open to truth, though it exposed his own faults, have preserved his memory in the hearts of the nation. To the end of his life he had to contend against the governors of provinces, Protestant as well as Catholic, who had rendered themselves almost independent under the last kings of the house of Valois. Many of the acts of his internal government show that, while he aimed at restoring the prosperity of the nation by encouraging agriculture, commerce, and manufacturing industries, he was determined by all means in his power to strengthen the authority of the crown. In his foreign policy Henry IV. revived the projects of Francis I. and Henry II. against the house of Austria, and re-established the influence of France in the Catholic states of Italy. He supported Holland in its revolt against Spain; allayed the bitterness of feeling between the Lutherans and the Calvinists, and induced them to form the Evangelical Union. Consult: Lacombe, 'Henri IV. et sa Politique' (1878); and Willert, 'Henry of Navarre and the Huguenots in France' (1893).

Henry V. (of France). See Chambord, Compte de.

Henry I., emperor of Germany: b. about 876; d. Memleben 2 July 936. He was the son of Otho I., the Illustrious, duke of Saxony, who had refused the regal dignity offered him in 912. Henry, on the death of his father, became duke of Saxony and Thuringia. He was chosen king of the Germans by the Franks and Saxons, April 919, at Fritzlar. The surname der Finkler or der Vogler (the Fowler), sometimes applied to him, did not arise until the 12th century, and is based upon the unauthentic legend that the princes who notified him of election found him at fowling. He subdued Duke Giselbert of Lorraine, and in 924 concluded with the Hungarians a nine-years' treaty of peace, with the condition that he should pay a yearly tribute. This tribute he finally refused (933), whereupon the Hungarians invaded his realm with two large armies which he defeated, the one near Göttingen, the other at Riade (Riethenburg). In 934 he waged a victorious contest against the Danes. He thoroughly reorganized the German defensive military system, built fortified cities, and fortified others. Though he did not technically possess the title of emperor, he was the real founder of the mediæval German empire, and is recognized as a wise ruler and skilful military leader.

Henry II., the Lame, emperor of Germany: b. 6 May 973; d. Grona, near Göttingen 13 July 1024. He was the last of the Saxon line, a son of Henry the Quarreler of Bavaria, and great-grandson of the Emperor Henry I. He inherited Bavaria on the death of his father in 995. On the death of Otho III. in the beginning of 1002 he laid claim to the kingdom, and was crowned at Mainz 7 June. He was for a time busily occupied in wars with Duke Boleslav II. of Bohemia, the Margrave Henry of Schweinfurt, and the Margrave Ernest of Austria. In 1004 and 1013 he was obliged to make expeditions to Italy, where Arduin of Ivrea was twice chosen king. Having thoroughly defeated his opponent, he was invested with the imperial insignia at Rome by Pope Benedict VIII. 14 Feb. 1014. His somewhat protracted struggle with Boleslav of Poland ended without any considerable success. At the call of the Pope he fought against the Greeks in lower Italy. For his zeal in the interests of the Church he was canonized by Eugenius III. in 1146.

Henry III., variously surnamed the Old, the Black, and the Pious, emperor of Germany: b. Osterbeck, Netherlands, 28 Oct. 1017; d. Botfeld 5 Oct. 1056. He was the second of the house of the Salian Franks, son of the Emperor Conrad II., whom he succeeded in the imperial dignity 1039. He had already been chosen king in 1026. He weakened the power of the nobles by keeping the great fiefs when they became vacant for himself or members of his family, or by bestowing them upon less powerful nobles than had previously possessed them. He also extended the power of the empire by forcing the duke of Bohemia in 1042, and the king of Hungary in 1044, and again in 1047, to accept their dominions as imperial fiefs. His influence was paramount in Italy, especially in the south, where the Normans in Apulia and Calabria paid homage to him as their feudal chief. On the occasion of his first visit to Italy (1046) he put an end to the contention between Benedict IX., Sylvester III., and Gregory VI. for the papacy, causing them all to be deposed, and Suitger, bishop of Bamberg, to be elected in their stead with the title of Clement II. His efforts were now directed toward rooting out the evils which were rife among the clergy, but not less toward securing the permanence of the influence of the empire over the See of Rome. Henry III. was not only a powerful ruler, but also a patron of arts and sciences. He founded numerous schools in connection with the monasteries, and built the cathedrals of Worms, Mainz, and Spires.

Henry IV., emperor of Germany: b. 11 Nov. 1050; d. Liège 7 Aug. 1106. He was the son of Henry III. He was crowned at Aix-la-Chapelle in 1054. His reign was from the first disturbed by contests with his vassals. The Saxons joined with the inhabitants of Thuringia, drove Henry from Saxony (1073), and destroyed many of the castles which he had built to overawe the inhabitants. But some churches having been destroyed by the populace, Henry accused the Saxons to the pope of sacrilege, and thus gave him an opportunity to interfere as umpire. The Saxons offered to make every satisfaction; but Henry suddenly invaded their territory with a powerful army, and attacked them 9 June 1075, at Hohenburg, on the Unstrut, where they suffered a total defeat. He imprisoned nobles and ecclesiastics, and aroused the attention of the papacy. Gregory VII. (Hildebrand), who had been elevated to the papal chair some years before, without the consent of the imperial court, eagerly seized this opportunity to challenge Henry's usurpation of the power of investing bishops with the spiritual insignia of office, and in December 1075 presented to the king a list of charges, and demanded proofs of obedience to the Church. Henry then instigated the bishops, assembled by his order at Worms, to renounce their obedience to the pope (24 Jan. 1076). Gregory, however, pronounced the sentence of excommunication against him (22 Feb.), and absolved his subjects from their allegiance, and Henry soon found himself deserted. In this state of affairs he was obliged to go to Italy and make his submission to the pope. He found Gregory at Canossa, not far from Reggio, a strong castle belonging to Matilda, countess of Tuscany, whither he had retired for security. Three days successively, in the depth of winter, Henry appeared in a penitential dress, in the court of the castle, before the intercession of Matilda obtained for him an audience of the pope (28 Jan. 1077), when he was, after all, released from the sentence of excommunication only upon submitting to the most humiliating conditions. Some of the Italian princes, who had long been dissatisfied with Gregory, and were desirous of deposing him, gathered round Henry, who was not disposed to fulfil the hard conditions imposed upon him, and offered him their assistance. The German princes, however, at the instigation of the pope, assembled at Forchheim in 1077, and elected Rudolf, Duke of Swabia, king. Henry hastened back to Germany and overcame his rival, who lost his life in battle at Merseburg, in 1080. Gregory again excommunicated Henry; but at the councils of Brixen and Mainz in 1080, he was declared deposed by the German bishops as a heretic and a sorcerer, and Guibert, archbishop of Ravenna, set up in his place, with the title of Clement III. In 1081 Henry marched into Italy to take vengeance on Gregory, and appeared at Easter before Rome. He was not able in that year, however, to pursue the siege of the city, which did not fall into his hands till 1084. He was forced by a conspiracy of the majority of the nobles, led by his son, Henry V., to abdicate at Ingelheim 31 Dec. 1105.

Henry V., emperor of Germany: b. 11 Aug 1081; d Utrecht 23 May 1125. He was the son and successor of Henry IV. He was crowned emperor in 1111. His reign was continually disturbed by troubles with the papacy. He was excommunicated no less than four times, and finally in the concordat of Worms (23 Sept. 1122) conceded the advantage to the pope. He also carried on wars with Flanders, Hungary, and Poland, and with various German nobles. He was the last of the Salic or Frankish family of emperors, which was succeeded by the Swabian house.

Henry VI., the Cruel, emperor of Germany; b. 1165; d. Messina 28 Sept. 1197. He was the son of Frederick I. (Barbarossa), was crowned king in 1169, and succeeded his father as emperor in 1190. He was involved in wars in Italy to assure his possessions there. It was during his reign that Richard Cœur de Lion, returning from Palestine, was imprisoned by Leopold of Austria and surrendered to the emperor, who exacted a heavy ransom.

Henry VII., of Luxemburg, emperor of Germany: b. 1269; d. Buonconvento, Italy, 24 Aug. 1313. He was son of the Count of Luxemburg, and was chosen king of the Romans 27 Nov. 1308, and crowned at Aix-la-Chapelle 6 Jan. 1309. In 1311 he received the iron crown of the Lombards, and 29 June 1312 was crowned emperor at the Lateran. His march into Italy at the head of a Ghibelline army (October 1310) was hailed by Dante, who did homage at some time and place unknown. His sudden death immediately after reception of the Eucharist led to the unfounded rumor that he had been poisoned.

Henry, prince of Portugal, surnamed the Navigator: b. 4 March 1394; d. 13 Nov. 1460. He was a grandson of old John of Gaunt; nephew of Henry IV. of England; and great-grandson of Edward III. His father, King João or John, who formed a close English connection by marrying Philippa of Lancaster, was the first king of the house of Avitz, under which Portugal, for two hundred years, rose to its highest prosperity and power. The career of Portugal in exploration and discovery, due to the genius and devotion of Prince Henry, his biographer characterizes as "a phenomenon without example in the world's history, resulting from the thought and perseverance of one man." Prince Henry had become one of the first soldiers of his age when, in 1420, he refused offers of military command, and undertook to direct, at Sagres (the extreme point of land of Europe looking southwest into the Atlantic Sea of Darkness), plans of exploration of the unknown seas of the world lying to the west and south. His idea was to overcome the difficulties of the worst part of that immense world of storms, that lying west of Africa, and thereby get round Africa to the south and sail to India, and China, and the isles beyond India. Every year he sent out two or three caravels; but his great thought and indomitable perseverance had yielded only "twelve years of costly failure and disheartening ridicule," when, in 1434, the first great success was achieved by Gil Eannes, that of sailing beyond Cape Bojador. Prince Henry made his seat at Sagres, one of the most desolate spots in the world, a school of navigation, a resort for explorers and navigators. His contemporary Azurara says of him: "Stout of heart and keen of intellect, he was extraordinarily ambitious of achieving great deeds. His self-discipline was unsurpassed; all his days were spent in hard work, and often he passed the night without sleep; so that by dint of unflagging industry he conquered what seemed to be impossibilities to other men. His household formed a training-school for the young nobility of the country." Consult: Major, 'Life of Prince Henry the Navigator' (1868).

Henry, prince of Prussia, German naval officer: b. Berlin 14 Aug. 1862. He is a brother of Emperor William, and married Princess Irene, daughter of the late Grand Duke Ludwig IV. of Hesse, in 1888. He succeeded Vice-Admiral von Diederichs in command of the German fleet in Chinese waters, in March 1899. In January 1902, Emperor William requested that the president's daughter, Alice, should christen the royal yacht then building in the United States. After receiving the consent of President Roosevelt, the Emperor informed the President that he had ordered his yacht, the "Hohenzollern," to be present at the ceremony, and had appointed his brother, Admiral Prince Henry of Prussia, to represent him on the occasion. The Prince arrived in New York city on 23 February and left on 12 March, after receiving many national, municipal, and social honors.

Henry, surnamed THE LION, duke of Saxony and Bavaria: b. Ravensburg 1129; d. Brunswick 6 Aug. 1195. He was the son of Henry the Proud, and the head of the Guelphs. He greatly enlarged his domains, and so increased in power as finally to become a dangerous rival of the Emperor Frederick I., Barbarossa. His refusal to support Frederick was among the chief causes of the latter's defeat at Legnano (29 May 1176). He was summoned to appear at three diets, and, having failed to attend was placed under the imperial ban (1180). Later he was allowed to retain Lüneburg and Brunswick upon condition of going for three years into exile. He was finally reconciled with Henry VI.

Henry, Alexander, American traveler: b. New Brunswick, N. J., 1739; d. 1824. He joined the Canadian expedition under Amherst against the French (1760) and when peace followed he went to Michilimackinac and engaged in the fur trade. After the massacre of the English by the Indians in that place he being one of the few survivors, remained a captive among the Ojibways at Sault Ste. Marie for 12 months, when he escaped and resumed the fur trade. In the pursuit of this business he traveled between Montreal and the Rocky Mountains. He also interested himself in the copper mines on Lake Superior and for many years made an effort to establish a company for their exploitation.

Henry, Edward Lamson, American painter: b. Charleston, N. C., 12 Jan. 1841. He began his artistic studies at the Philadelphia Academy and in 1860 went to Paris where he studied for three years under Saisse and Courbet. In 1869 he was elected a member of the National Academy. He has frequently revisited Europe for the purpose of sketching the scenery, although his specialty is domestic genre, and history. In the Corcoran Gallery at Washington is one of his most characteristic pictures, which shows his careful grouping of figures, his attention to detail as well as the stiffness of his drawing and his deficiency in the sense of color which recalls Wilkie, whose swing and movement he lacks, though he exhibits some of the humor of the Scottish master. The picture referred to is a crowded canvas of fifty figures with the title 'Initial Excursion of the First Railway Ever Constructed in New York State.' Among his historical pictures the best are 'Battle of Germantown,' owned by William Astor, 'Declaration of Independence,' owned by J. W. Drexel, and 'Reception to Lafayette.'

Henry, Guy Vernon, American soldier: b. Fort Smith, Indian Territory, 1839; d. Ponce, Porto Rico, 1899. He was graduated at West Point 1861, and went to the front in the Civil War, taking part in four years of the hardest fighting, from Bull Run to Cold Harbor. At 23 he was commissioned colonel of the 40th Massachusetts volunteers. After the Civil War he was transferred to the 3d Cavalry, and in 1874 was in Arizona. He continued his Indian campaign, though severely wounded on one occasion, and compelled to be invalided. He served through the outbreak of the Sioux in 1890, and was also on service at Porto Rico during the Spanish-American War, where he died of typhoid fever.

Henry, Joseph, American physicist: b. Albany, N. Y., 17 Dec. 1797; d. Washington, D. C., 13 May 1878. He was educated at the Albany Academy, after graduation undertook the study of chemistry, anatomy and physiology with a view to adopting the medical profession. During the years 1824–5, he contributed occasional scientific papers to the Albany Institute, his especial subjects being chemistry and mechanics, and was appointed assistant engineer on the survey instituted for a road between Lake Erie and the Hudson. In the spring of 1826 he was elected teacher of mathematics and natural philosophy in the Albany Academy and in the latter part of 1827 read a very important paper before the Albany Institute, 'On Some Modifications of the Electro-Magnetic Apparatus.' He made his first public demonstration of his magnetic discoveries in exhibiting before the Institute small electro-magnets wound with silk-covered wire. These magnets had a greatly multiplied lifting power over any that had yet been known. In this lay the essential point of his first discovery, for he was undoubtedly the earliest physicist to adopt insulated or silk-covered wire for the magnetic coil, and to employ spool winding for the limb of the magnet. He demonstrated also for the first time, by a very intelligent experiment, the difference of action in a quantity magnet excited by a quantity battery of a single pair, and an intensity magnet with a long fine wire coil excited by an intensity battery of many elements, having their resistances suitably proportioned. The first of these two forms was not capable of being employed for telegraphic purposes, while the intensity magnets with their attachments could be so applied. The quantity magnets which he exhibited caused a good deal of excitement in the scientific world. Their attractive power was at that time quite unprecedented. One of them had sufficient power to raise as much as 3,500 pounds.

Henry was the first to show that iron could be magnetized at a distance, and to invent a suitable combination of magnet and battery for the production of this result. In 1831 he made this experimental demonstration. He suspended a mile of insulated copper wire round a chamber in the Academy, and so placed a bell at one extremity of it that it was struck by the polarized armature of an intensity battery connected with the other extremity. This was the earliest example of the magnetic telegraph, for the galvanometer or needle had been the principle on which all preceding experiments had been conducted. It was not long after that he invented a machine, and finally constructed it, which is recognized as the first electro-magnetic engine with automatic pole-changer. In 1832 after repeated experiments he discovered how to give greater intensity to a magnetic discharge by the induction of a current on itself in a long spiral or helical wire. These progressive steps in magnetic science gained for him an extended reputation, and soon after the publication of the last experiment in Silliman's 'American Journal of Science' Henry was elected professor of natural philosophy in Princeton College. The discovery of the spiral or helical conductor suggested to him further experiments, and his extended researches and their results were announced by him in a paper published 1834, under the title 'On the Influence of a Spiral Conductor in Increasing the Intensity of Electricity from a Galvanic Arrangement of a Single Pair.' He supplemented these discoveries by many others, and by his experiments produced electrical combinations which were undoubtedly precursors of later relay and receiving magnets, while his demonstration of the conditions and range of induction from electrical currents, and the successive orders of induction in the passage of frictional electricity, as well as his discovery of the oscillatory nature of electricity, paved the way for that great scientific and practical resolution which was to consummate by the genius of Morse and his confrères.

In 1846 Henry was called to a new sphere of activity, in which he exhibited his usual zeal and enthusiasm. The Smithsonian Institution had just come into existence, and during the formative period of the great museum, he was appointed to be its secretary. The office did not so far engross his attention as to make him neglectful of practical work in science. He found time to investigate the acoustics of public buildings, meteorological changes of the atmosphere and methods for telegraphic transmission of meteorological observation from all points of the continent. From 1868 up to his death he was president of the National Academy of Sciences, and of the Philosophical Society of Washington from 1871, when it was first organized.

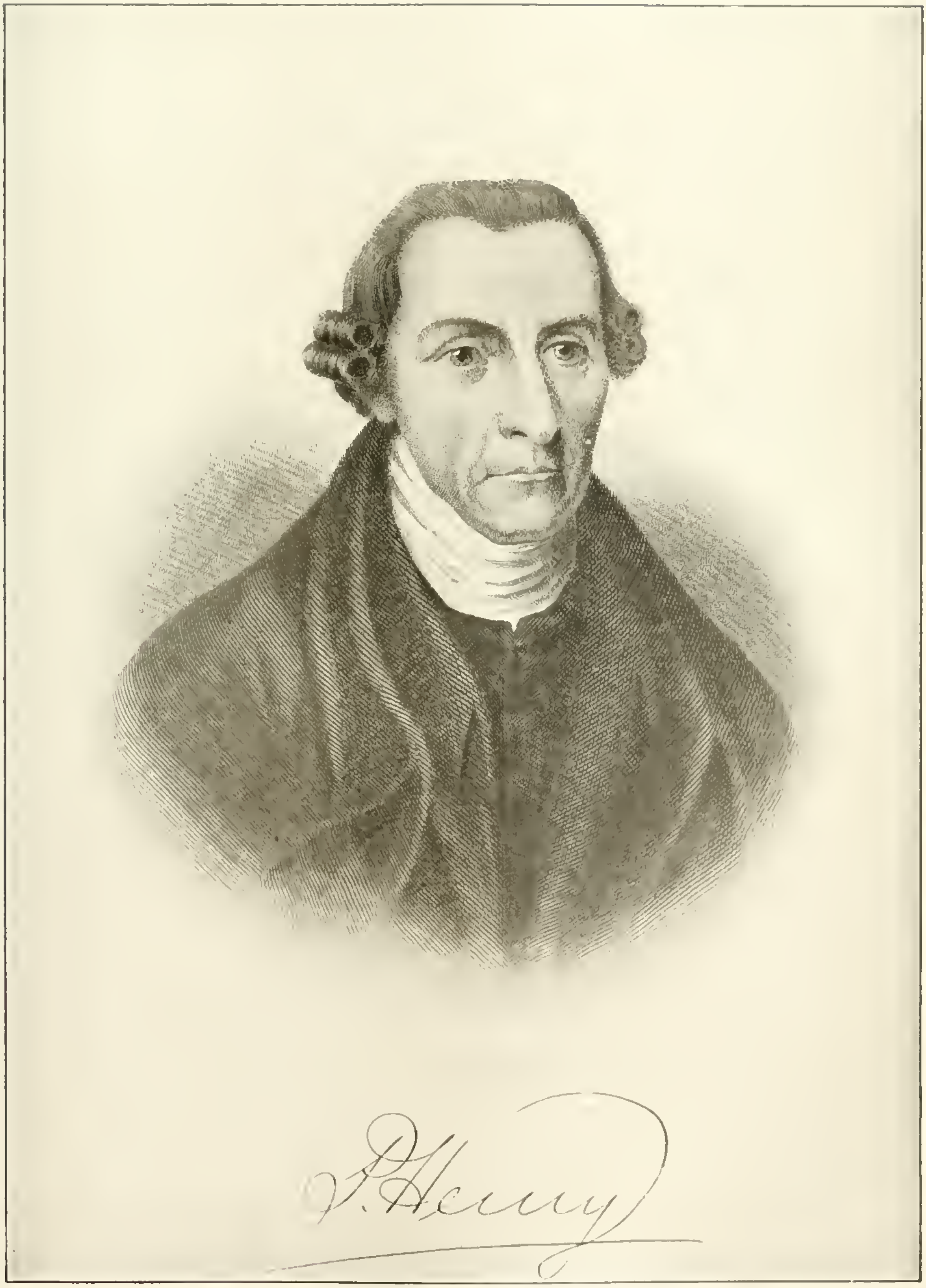
Henry, Matthew, English Nonconformist clergyman: b. Broadoak, Flintshire, Wales, 18 Oct. 1662; d. Nantwich, Cheshire, 22 June 1714. In 1686, having qualified himself for the ministry, he began to preach; and in the succeeding year he was settled as pastor to a congregation at Chester, and continued to discharge the duties of his office for 25 years, when he removed to Hackney, London, where his clerical labors were still more extended. Besides his greatest work, 'Expositions on the Bible' (1710), he was the author of 'A Discourse on Schism'; 'A Scripture Catechism'; 'Family Hymns'; etc.

Henry, Patrick, American orator and statesman: b. 29 May 1736, in Hanover County, Va., within a few miles of the birthplace of Henry Clay; d. 6 June 1799, in Charlotte County, Va. His father, John Henry, was a well-educated Scotchman, presiding judge of the Hanover court. He was a cousin of William Robertson, author of the 'History of the Emperor Charles the Fifth.' Another relative of his was Henry Brougham, the radical Scotch writer, who became lord chancellor of England. Of Patrick Henry's mother, "a portly, handsome dame," a pleasing portrait is left us by William Byrd, of Westover, the genial litterateur of colonial Virginia.

Poor as were the schools in his neighborhood, Patrick seems to have profited little by them. From his uncle, the rector of the parish, he gained a rudimentary knowledge of the classics and mathematics. He was a frolicsome and vagrant youth, fond of hunting and frontier life in general. At 18 years of age, and without money or employment, he married Sarah Shelton, a poor girl of the neighborhood. He kept a store and failed; he tried farming, and failed; then he returned to the store, only to fail again. He now turned to law, and spent a few weeks in reading upon that subject. Having received his license, he began to practise in his native county, while he assisted in the tavern kept by his father-in-law.

In 1763 Henry singled himself out as a born orator by his impassioned plea in "The Parsons' Cause." The king had annulled a statute of the Virginia burgesses, which compelled the clergy to accept the depreciated currency of the colony in payment of their annual salaries, in lieu of 16,000 pounds of tobacco as theretofore, a product which was then selling at a high price. Henry startled the court and the countryside by asserting "that a king, by annuling or disallowing acts of so salutary a nature, from being the father of his people, degenerates into a tyrant and forfeits all right to his subjects' obedience." Henry's utterance on this occasion was in keeping with the bold address, two years previous, of James Otis, who declared that the tyranny lurking in general search warrants had "cost one king of England his head and another his throne."

Henry became a member of the House of Burgesses in May 1765, just at the time of the arrival of the Stamp Act. Unabashed by his rustic appearance and inexperience in legislative matters, he brought forward a series of resolutions to the effect "that the general assembly of this colony have the only sole and exclusive right and power to lay taxes." In the bloody debate which followed he was "opposed by Randolph, Bland, Pendleton, Nicholas, Wythe, and all the old members, whose influence in the House till then had been unbroken," so we learn from Jefferson, then a college student, who was present at the session of the burgesses. In pleading the injustice of the Stamp Act, Henry used the famous words: "Caesar had his Brutus; Charles the First, his Cromwell; and George the Third ['Treason!' shouted the Speaker. 'Treason,' 'treason,' echoed others. After a moment's pause, the orator completed the interrupted sentence in a manner that showed no less defiance than adroitness] and George the Third may profit by their example. If this be treason, make the most of it." As the royal governor of Massachusetts wrote the ministry: "The Virginia resolves proved an alarm bell to the disaffected." By his intrepidity, his oratory, and his intuition, at once patriotic and prophetic, Patrick Henry became henceforth the protag-


P. Henry

onist of the colonial cause, sharing with Otis, Gadsden, and Samuel Adams the high honor of launching the American Revolution.

Henry represented Virginia in the first colonial congress, which met at Philadelphia 5 Sept. 1774, when he gave final expression to the feeling of nationality: "The distinctions between Virginians, Pennsylvanians, New Yorkers, and New Englanders are no more. I am not a Virginian, but an American." With this speech compare Christopher Gadsden's remark nine years before at the Stamp Act congress in New York: "There ought to be no New England men, no New Yorkers, known on the continent, but all of us Americans."

On 23 March 1775, Henry, as a member of the second Virginia convention, which met in St. John's Church, Richmond, moved that the colony be armed, and again electrified the patriots with his eloquence in support of this radical measure. "Gentlemen," said he, "may cry peace, peace — but there is no peace. The war is actually begun! The next gale that sweeps from the North will bring to our ears the clash of resounding arms! Our brethren are already in the field! . . . Is life so dear, or peace so sweet, as to be purchased at the price of chains and slavery? Forbid it, Almighty God! I know not what course others may take; but as for me, give me liberty, or give me death." Col. Edward Carrington, listening at a window in the east end of the church, was so transported by the eloquence of Henry, that he exclaimed, "Let me be buried at this spot," a wish that was respected at his death in 1810. Such was the universal testimony of those present as to the overmastering effect of Henry's speech at that crisis.

On 5 Aug. 1775, Henry was made commander-in-chief of the Virginia troops. In May of that year he had made a dash against Lord Dunmore, on account of the governor's secret seizure of some powder belonging to the colony. Deeming himself slighted by the Committee of Public Safety, which acted during the interim as the executive of Virginia, Henry, with some heat, threw up his military commission, 28 Feb. 1776.

Fortunate was it for the colonial cause that Henry was again at liberty to exert his forensic powers in the councils of the State. Representing Hanover County in the convention which met at Williamsburg 6 May 1776, he contributed greatly to the constructive work of that celebrated body, notably the motion for a declaration of American independence and the framing of a constitution for Virginia. Among the convention papers in the State Library at Richmond were found three endorsed by the clerk, "Rough Resolutions. Independence." William Wirt Henry, after minute comparison of the handwriting of these, concluded that the first was penned by Patrick Henry; the second by Meriwether Smith; and the third by Edmund Pendleton; and that the resolution actually introduced by Nelson was the one written by Henry. On the other hand, Edmund Randolph, who was a member of the convention, says that the resolution declaring for independence "was drawn by Pendleton, was offered in convention by Nelson, and was advocated on the floor by Henry."

On 29 June 1776, the natal day of the commonwealth of Virginia, Patrick Henry was elected governor, took the oath of office 5 July, and served for three annual terms in succession. As governor he commissioned, on 2 Jan. 1778, Col. George Rogers Clark to enlist seven companies of men for the expedition against the British garrisons in the Northwest Territory. After leaving the executive office, Henry settled in Henry County, on an estate of about 10,000 acres, called Leatherwood, where he lived until he became governor for the fourth time, on 30 Nov. 1784. In the Virginia convention of 1788, which was called to ratify the Constitution of the United States, Henry led the opposition on the ground that such a federal government encroached too far upon the rights of the several States. While the arguments of Madison and the influence of Washington happily prevailed on that critical occasion, Henry was a chief agent in securing the amendments which constitute a bill of rights in the national instrument. His objection to the Constitution was stated concisely in his first speech before the convention: "That this is a consolidated government is demonstrably clear; and the danger of such a government is, to my mind, very striking. . . . Who authorized them (the framers) to speak the language of *we the people*, instead of *we the States?* States are the characteristics and the soul of a confederation. If the States be not the agents of this compact, it must be one great, consolidated, national government of the people of all the States." Such was his clear discernment of the real nature of the government established by the Constitution of the United States.

S. C. Mitchell,
Professor of History, Richmond College, Richmond, Va.

Henry, William Arnon, American educator: b. Norwalk, Ohio, 16 June, 1850. He obtained his early education in the Holbrook Normal School at Lebanon, Ohio; studied at Ohio Wesleyan University from 1867–9, and at Cornell University from 1876–80, receiving the degree of B. S. Agr. He was appointed professor of botany and agriculture in the University of Wisconsin in 1881, professor of agriculture in 1883, director of the agricultural experiment station in 1887, and since 1891 has been dean of College of Agriculture in that university. He has had charge, from the beginning, of the agricultural college and experimental station of the University of Wisconsin, which now has buildings valued at $300,000 and 450 pupils. He has written: 'Rush's Special Report on Diseases of Cattle and Cattle Feeding' (Part II. 1892); 'Handbook on Northern Wisconsin' (1895); 'Feeds and Feeding' (1898), etc.

Henry, William Wirt, American historian and lawyer: b. Red Hill, Va., 14 Feb. 1831; d. 5 Dec. 1900. He was educated at the University of Virginia, and took up the practice of law, later being elected to the legislature for four terms. He preferred, however, historical research to his law practice, and spent much of his time in that pursuit. He was president of the American Historical Association and of the Virginia Historical Society. He is chiefly noted for his 'Life, Correspondence, and Speeches of Patrick Henry' (3 vols. 1890–1).

Henry College, a coeducational institution, founded in 1892, in Campbell, Texas. At the close of 1902 there were connected with the school 10 professors and instructors, with 150 students in attendance. The estimated value of the grounds and buildings is $125,000.

Henry Documents, 26 letters of 1809 between John Henry and several British officials — Sir James H. Craig, governor of British North America, his secretary Ryland, and the English foreign secretary Lord Liverpool, with related papers. Tempted by the hostility of the New England Federalists to the Embargo (q.v.), and the threats of secession by the extremists, Craig sent the adventurer Henry in January 1809 to sound the people as to reunion with Great Britain. Henry remained till June, and sent back the most extravagant reports of the secession feeling, but the British ministry not paying him as he thought fitting, he sold the copies of the letters and other documents to the United States government in February 1812 for $50,000. Madison used them to hurry forward the War of 1812, by sending them to Congress on March 9 with a special message, in which he accused Great Britain of attempting to dismember the Union by intrigue and annex the North to itself. So far as the New Englanders were concerned, however, the papers contained nothing incriminatory of secession movements.

Henry Phipps Institute, The, for the study, treatment, and prevention of tuberculosis, was founded at Philadelphia, 1 Feb. 1903 by Henry Phipps. The incorporators were Henry Phipps, George E. Gordon, Lawrence F. Flick, Miss Amy Phipps, and S. P. Harbison. The scientific work of the Institute is in the hands of a medical staff, consisting of a medical director, an assistant medical director, clinicians, bacteriologists, and pathologists. In the Institute's organization there are a number of paid fellowships open to any member of the staff and a number of honorary fellowships open to any person throughout the world who has done distinguished work in the cause of the study, treatment, or prevention of tuberculosis. The eleemosynary work of the Institute contemplated is the care of the consumptive poor in their homes, the care and treatment of consumptives in hospital beds, and the care and treatment of consumptives in a sanatorium. Consumptives in their homes are to be cared for and treated through a dispensary. The patients come to the dispensary where they are prescribed for and given medicines and supplies for the prevention of tuberculosis. They are instructed in preventive measures, and during the intervals between their visits to the dispensary are supervised in the carrying out of these instructions by a visitor from the dispensary. The consumptive who is entirely destitute and who cannot be cared for in his home even with such assistance as can be given is brought into the hospital and treated as a ward of the Institute. The scientific work of the Institute contemplated is education in preventive measures, study of the disease, dissemination of knowledge about the disease among physicians, stimulation of effort on the part of scientific men throughout the world, and encouragement of workers in the cause. This work is to be pursued through lecture courses, laboratory and clinical experiments, distribution of literature, organization of the workers in the cause of prevention of tuberculosis, and public receptions to persons who have done distinguished work. The Institute will seek to aid all workers in the crusade against tuberculosis. It will act as a bureau of information and with this end in view will index literature on the subject of tuberculosis and collect objects of various kinds which have a bearing upon the prevention or treatment of the disease. The Institute has inaugurated an international course of lectures by the foremost workers in the crusade against tuberculosis. One lecture a month is given during the fall and winter months. The Institute will publish annually a report of its work which will be distributed gratuitously to the libraries of the world.

Lawrence F. Flick,
Of the Henry Phipps Institute.

Henschel, Georg, gā-ōrg' hĕn'shĕl, German composer and concert singer: b. Breslau, 18 Feb. 1850. He began his musical education under the pianist Moscheles, the contrapuntist Richter, and the vocal teacher Gosse in the Conservatory at Leipsic. In 1870 he sang with great success at the Beethoven celebration at Weimar, and toward the end of the same year went to Berlin to complete his studies in musical science and vocalization. He met with a brilliant reception in his professional tour through Cologne, Düsseldorf, and the lower Rhine provinces, and his fame spread over all Germany, Austria, Holland, and Russia (1874–7). He was received with immense applause in London, and crossing the Atlantic was appointed musical director in Boston (1883–5); when he returned to London and became teacher of singing in the Royal College of Music. He wrote among his numerous compositions many songs and duets, such as 'Wanderlieder'; 'Duette in Kanonform,' 'Serbisches Liederspiel'; etc. He married in 1881 Lilian Jane Bailey (d. 1901) a well known American singer.

Hens'ley, Sophia Almon, American lecturer and author: b. Nova Scotia 31 May 1866. She studied in England and Paris, and moved to New York in 1889. She has been interested in the study of social problems and actively identified with the work of the "Mother's Congress." She has served as president of the Society for the Study of Life in New York city and as vice-president of the New York City Mothers' Club, and lectures frequently. She is author of 'Woman's Love-Letters' and 'Souls.'

Hen'son, Herbert Hensley, English Anglican clergyman: b. London 8 Nov. 1863. He was graduated at Oxford and elected fellow of All Souls College in that university 1884. He was head of the Oxford House at Bethnal Green, 1887–8, and since 1900 has been canon of Westminster Abbey and rector of St. Margaret's. He has attracted wide attention as a fresh and powerful preacher by his utterances on national topics of social and political interest, and among his published works may be noted: 'Light and Leaven' (1897); 'Cross Bench Views of Current Church Questions' (1902).

Henson, Josiah, American negro slave and clergyman: b. Port Tobacco, Md., 1787; d. 1883. His early life was one of great hardship, but he finally escaped to Canada (1828), where he became a Methodist clergyman with a charge at Dresden, Bothwell County, Ontario. He also lectured in the United States. Upon the story of his slave career was based the character of Uncle Tom in Harriet Beecher Stowe's 'Uncle Tom's Cabin' (1852).

Henty, George Alfred, English writer of novels and stories for boys: b. Trumpington, Cambridgeshire, 8 Dec. 1832; d. Weymouth, Dorsetshire, 16 Nov. 1902. He was educated at Westminster and Cambridge; he went to the Crimea during the war with Russia, and served there in the purveyor's department of the army. Soon afterward he went to Italy to organize the hospitals of the Italian legion. As special correspondent of the *Standard* newspaper he went through the Austro-Italian, Franco-German, Turco-Servian, Abyssinian, and Ashanti campaigns, besides accompanying Garibaldi in the Tyrol. He described two of these campaigns in the works 'The March to Magdala' (1868) and 'The March to Coomassie' (1874). He wrote eight novels, among which are: 'A Woman of the Commune' (1895); 'The Queen's Cup' (1897); and 'Colonel Thorndyke's Secret' (1898); but he is much more widely known as the author of a large number of stimulating stories of adventure for boys, many of them based on famous historical events. Among these are: 'The Young Franc-Tireurs' (1871), a story of the Franco-German war; 'The Young Buglers,' a tale of the Peninsular War (1879); 'In Times of Peril,' a tale of India (1881); 'Under Drake's Flag' (1882); 'The Lion of the North' (1885), a story of Gustavus Adolphus; 'With Lee in Virginia' (1889); 'By Pike and Dyke' (1889), a story of the Dutch War of Independence; 'In the Irish Brigade' (1900); and 'Out with Garibaldi' (1900).

Hepat'ica, a genus of plants, the liverworts, of the crowfoot order (*Ranunculaceæ*), closely related to *Anemone*. The best-known species is *H. hepatica*, found wild throughout North America as well as Europe in woods, and widely cultivated for its attractive and fragrant star-like blue, white, or purple-red flowers, which open in early spring. It is, indeed, the earliest of American spring flowers. Sometimes even under the snow its buds, well wrapped up in a warm down, lie upon the broad, furry liver-shaped leaves, awaiting the first warmth to induce them to open. In the southern Alleghanies its leaves are dried and steeped into a medicinal tea. A more southern species is *H. acuta*.

Hepburn vs. Griswold, 1869: the great case in which the Supreme Court of the United States decided that the government had no power to make its own notes legal tender; reversed through a change in the constitution of the court in Knox *v.* Lee and Juilliard *v.* Greenman. Mrs. Hepburn of Kentucky had given Henry Griswold a note for 11,250 "dollars," payable 20 Feb. 1862; it was not paid when due, and five days subsequently the government passed the act authorizing $150,000,000 in notes (see GREENBACKS), receivable for public and private debts. In 1864 Griswold brought suit in the chancery court of Louisville for principal and interest; $12,270 in greenbacks was tendered in settlement, but refused, on the claim that the act did not extend to debts contracted before its passage. The court decided for Mrs. Hepburn. Griswold carried the case to the Kentucky court of appeals, which reversed the decision; Mrs. Hepburn carried it to the Supreme Court, which on account of the far-reaching importance of the case, and at the request of the attorney-general, laid it over till 1868, when it was reargued, and finally decided in the December term 1869. Chief Justice Chase, for five justices against three, decided that the act extended to all debts, contracted as well before as after its passage, and that the question therefore must be whether the government had the power to make anything but coin a legal tender; that it could not do so, under the Constitution, because at the time of its adoption no money but gold and silver was recognized; that as paper money never rose above coin and almost always fell below it, each particle of depreciation was so much abstracted from the value understood by the parties to the contract, and was therefore an unlawful deprivation of private property; that the power of Congress to use "necessary means" to carry out its power of making war did not convey this right, because this was no more a special means of carrying out war powers than any other powers, and would enable it to issue bills of credit and make them legal tender just as much in the post-office business or the patent business as the war. The minority admitted that it was so impairing the obligation of contracts, but asserted that Congress was given the power to do so; and this is now law. See LEGAL-TENDER CASES.

Hephæstus, hē-fĕs'tus, a god of the ancient Greeks, identified by the Romans with their Vulcanus. He presided over fire, and was the patron of all artists who worked in iron and metals. He was the son of Zeus (Jupiter) and Hera (Juno). Homer says that his mother was so disgusted with the deformities of her son, that she threw him into the sea as soon as born, where he remained for nine years. He afterward returned, but for taking the part of his mother on one occasion against Zeus was thrown down by the latter a second time. He was a whole day in passing from heaven to earth, and fell in the island of Lemnos. He broke his leg by the fall, and ever after remained lame of one foot. He fixed his residence in Lemnos, where he built himself a palace, and raised forges to work metals. The Cyclopes of Sicily were his ministers and attendants; and with him they fabricated not only the thunderbolts of Zeus, but also arms for the gods and the most celebrated heroes. His forges were supposed to be under Mount Ætna, in the island of Sicily, as well as in every part of the earth where there were volcanoes. Aphrodite (Venus) was the wife of Hephæstus. Her infidelity is well known. Her amours with Ares (Mars) were discovered by Phœbus, and exposed to the gods by her own husband. He appears on some monuments with a long beard, disheveled hair, half naked, and a small round cap on his head, while he holds a hammer and pincers in his hand.

Hep'tarchy, seven Anglo-Saxon kingdoms into which England was at one time or other supposed to be divided, although the kingdoms were founded at different times, and at no one time were they all independent monarchies together. In 827 King Egbert of Wessex united them into one kingdom, and claimed the title King of England. See ENGLAND.

Hep'tasophs, Improved Order of, a benefit society, organized in 1878 as an independent branch of the Order of Heptasophs (q.v.). At the time of secession the Heptasophs had not adopted the benefit system. The constitution and ceremonies are identical with those of the parent order. At the close of 1902 it had 722 conclaves, a membership of 52,825, and since its organization had disbursed in benefits nearly seven million dollars.

Heptasophs, Order of, a benevolent society in the United States founded in New Orleans 1852 by Alexander Leonard Saunders, and other Freemasons, originally called "The Seven Wise Men." The ritual of its ceremonial is elaborate: the membership of each chapter is seven, or a multiple of that number. In 1872 the adoption of a death benefit system was agitated, and the discussion led to the secession in 1878 of the Zeta Conclave of Baltimore, which organized the Improved Order of Heptasophs (q.v.). In 1880 the Order of Heptasophs adopted the benefit system. Members must be white males and profess a belief in the Supreme Being. Their number in 18 States amounts to about 4,000.

Hep'worth, George Hughes, American clergyman, journalist, and author: b. Boston 4 Feb. 1833; d. 7 June 1902. He was brought up a Unitarian, and after leaving the Harvard Divinity School held Unitarian pastorates at Nantucket, Boston, and New York. He advocated preaching in theatres and conducted theatre meetings in various cities, but being not wholly at ease in the Unitarian denomination, entered the Congregationalist ministry in 1872. He subsequently quitted the ministry and became attached to the editorial staff of the New York *Herald*. He published: 'The Whip, Hoe, and Sword' (1864); 'The Criminal, the Crime, the Penalty' (1865); 'Starboard and Port' (1876), record of a yacht cruise; a book entitled '! ! !'; 'Rocks and Shoals'; 'Brown Studies'; 'Hiram Golf's Religion'; 'They Met in Heaven'; 'Through Armenia on Horseback' (1899). Consult S. H. Ward, 'George H. Hepworth: the Story of his Life' (1903).

Hera, hē'rā or -rē, a mythological goddess of the Greek pantheon, identified by the Romans with their Juno, the sister and wife of Zeus (Jupiter), and daughter of Kronos (Saturn) and Rhea (Cybele). The poets represent Zeus as a faithless husband, and Hera as a violent, jealous and vindictive wife. She was worshipped in all Greece, but her principal seats were at Argos and at Samos. The companions of Hera were the Graces and Hours. Iris, a personification of the rainbow, which seems to stretch from heaven to earth, was her messenger. Her usual attribute is a royal diadem. The temples built in her honor were called Heræa. The principal one was at Argos, which city was considered to be especially under her protection. She is represented by Homer as taking the part of the Greeks in the Trojan war, being actuated by revenge for the slight passed on her by the Trojan Paris, who gave the golden apple inscribed "To the Fairest" not to her, but to Aphrodite.

Her'acles. See HERCULES.

Heracli'tus, Greek philosopher: b. Ephesus, who flourished about 513 B.C. He traveled in different countries, particularly in Africa. On his return to Ephesus he was offered the chief magistracy, but refused it. He left a work on nature, in which he treats also of religion and politics. Some fragments only of this work remain. He is considered as belonging generally to the Ionic school of philosophers, though he differed from it in important particulars. He considered fire as the first principle of all things, describing it as an ethereal substance, "self-kindled and self-extinguished," from which the world is evolved (not made) by a natural operation. It is also a rational principle, and the source of the human soul. Phenomena exist in a constant state of flux, always tending to assume new forms, and finally returning again to their source.

Heraclius, hĕr-a-klī'ŭs, Roman emperor of the East, from 610 to 641: b. Cappadocia about 575 A.D. He was the son of Heraclius, exarch of Africa, who had gained great renown by his victories over the Persians, the elder Heraclius of the East was applied to by a powerful body of insurgents to claim the throne for himself. This he declined, but sent his son Heraclius to do so. Heraclius the younger therefore ascended the throne, and though he undoubtedly possessed considerable talents, the Roman Empire in the East was tottering to its fall, and nothing he was able to do could save it. Before his death Mohammed had carried his victorious arms on every side, and Syria, Palestine, Mesopotamia, and Egypt had fallen under the dominion of the caliphs. He was permitted, however, to die in peace, and to transmit the succession to his son, who mounted the throne under the title of Constantine III.

Heraldry is the whole group of ceremonial duties discharged by the heralds of a court, an army, a great noble, or the like, with the assistance of their pursuivants, and under the direction of the Earl Marshal, King-at-Arms, the College of Arms, or other chief of the confraternity. These duties are generally divisible into heraldry proper, or the business of regulating ceremonial occasions such as coronations, marriages among princes, proclamations of important events, and the like; and armory, or the art or quasi-science of armorial bearings. In the first of these divisions but little remains of any interest at the present day, for only in Great Britain is the herald of any consequence. There, however, he still has some direction, as at the eventful proclamation of 1 Jan. 1877, when the Queen of Great Britain assumed the title of Empress of India. In the second branch of the subject, the order and marshaling of arms, the Germans are perhaps at the head of modern writers, though the English and Scottish treatises on the subject are more numerous and more widely used. The Germans' thoroughness of investigation has marked their treatment of this subject, which is eminently a branch of mediæval and subsequent history serving to elucidate genealogical research.

Modern heraldry is no older than the tournaments of the Middle Ages. No linking evidences of the science occur during the Dark Ages, although badges and emblems are found on shields and helmets discovered in the ruins of antiquity, while in Biblical times the men of Israel were directed to pitch their tents, every man by his own camp and standard with the ensigns of his father's house. Greek and Roman writers describe devices on shields and helmets; the golden eagle on the shields of the kings of Media; the standards and brilliantly colored shields borne by the ancient Germans in battle. The office of herald is as ancient as that of priesthood. Spartans, Greeks, and Romans had heralds, the Roman officers being divided into three classes: *caduccatores*, heralds of peace; *fetiales*, heralds of war and peace; and *præcones*, judicial criers or messengers. The *caduceator* on a mission carried a wand of laurel or olive (*caduceus*, q.v.), as a symbol of his office and for his security. The *fetiales* are thought to have had a college of 20 members founded by Numa, who formulated the procedure and ceremonies connected with the declaration of war and the making of treaties. The *præcones* were employed to proclaim matters of public interest to the people at religious ceremonies, in the *comitia*, at public sales, judicial trials, in the senate, on the publication of laws which they read, at funerals, at games, in the army when a general wished to address his men, at executions, and at all public meetings. The heralds of the Middle Ages had duties which in part resembled those of the heralds of antiquity. Thus, they carried messages of peace and of defiance, and yet even in the earlier years of feudality their office was an inferior one, they being replaced by ambassadors, diplomats almost in the modern sense, statesmen in whose suite the heralds and pursuivants went to the foreign court. So it was that the chief duty of the herald came to be the care of armories.

The first known tomb or monument with escutcheons in the period of modern history is stated to be the eleventh century tomb in the Church of St. Emmeran at Ratisbon. where are the bearings of Varmond, a count of Vasserburg; but this may be a later addition. Another very old specimen and certainly genuine is the shield at Le Mans of Geoffrey Plantagenet, who died in 1150. The use of coats of arms seems to have first become general in the 12th century. Rolls of arms in England are extant in the reigns of Henry III., Edward I., and Edward II. Surcoats displayed armorial bearings in the reign of Henry III. The Roll of Caerlaverock, a poem in Norman-French, contains the names and armorial bearings of the knights and barons who attended Edward I. at the siege of the Castle of Cærlaverock, Dumfriesshire in 1300, and exhibits heraldry already in a developed form. On coins also, no armorial ensigns are found till the 13th century; but then both coins and the seals of nobles and monasteries display them; the use of arms on the Great Seal of England was introduced by Richard I.

The study of armory became essential when at mediæval tournaments aged knights were appointed, whose duties were to act as arbiters, and to pass judgment on coats of arms and the right of knighthood. Whenever a new knight appeared at a tournament, the herald had to *blasen* — that is to blow — the trumpet, and proclaim and explain the bearing of his shield or coat of arms. Hence to blason (*blasen*) came to mean, to describe and explain a display of bearings. The heralds were also the chroniclers of the times and were present on all occasions of public ceremony. In France the first herald — *roi-d'armes* — was crowned and consecrated with religious ceremonies, and was called *Montjoie*, from the war-cry of the French royal armies. The heralds were united in associations, and their duties formed a branch of science which was communicated only to the members. If any person pretended to the character of a herald, who on examination was found not to belong to the corporation, he was driven away with insults and frequently with violence. The heralds in modern courts are masters of ceremonies. In England there are now three kings at arms; the highest is the Garter king at arms; the second, known as *Clarencieux*, is for the southern counties; the third, styled *Norroy*, for the northern provinces. These three kings at arms with six subordinate heralds and four pursuivants form under the presidency of the Earl Marshal, always the Duke of Norfolk, the herald's college or herald's office, established in 1340. The use of arms by private persons in the British Isles was forbidden by proclamation in the reign of Henry V. All persons who had not borne arms at Agincourt were prohibited from assuming them unless by hereditary descent, or with the sanction of the constituted authorities. Periodical circuits called visitations were held afterwards by the provincial heralds to take cognizance of the arms, pedigrees, and marriage of such as were entitled to the use of armorial bearings. These visitations continued till about the end of the 17th century; their records, many of which are preserved in the British Museum and elsewhere, contain much genealogical information and are still consulted for evidence of the hereditary right to bear arms.

The practice of *blazoning the arms* is frequently referred to in the poetry of the Troubadours of the 12th and 13th centuries. Those knights who asserted a right to appear at tournaments did so by the blazoning of their arms, and from the Germans this custom was transmitted to the French, for tournaments were held in Germany before they became general in France. The French, however, carried to far greater perfection the tournament, and the blazon of heraldry connected with it, as they did the whole system of chivalry; the French language prevailing at the court of England after the Norman Conquest, pure French expressions came to be preserved in British heraldry. German heraldry, on the contrary, contains almost pure German expressions.

The whole display of any person's arms is called an achievement, also spelled atchievement. Only the escutcheon, however, is of vital importance. This is the broad surface upon which the bearings are charged. It is always assumed to be a shield in the case of a man not an ecclesiastic; but churchmen's arms are charged upon an oval or other architectural form, a sort of cartouche, and women's bearings are charged upon a lozenge set vertically. The arms of husband and wife, however, may be charged on a shield divided vertically in the middle, and are then said to be dimidiated or impaled; thus we might say that such an escutcheon bears the arms of Smith impaling the arms of Jones — Smith and Jones standing for the two spouses. It is rare to charge the wife's arms unless she was an heiress, that is to say, the owner of real estate in her own right. These rules, however, are those of Great Britain; they differ widely in other countries.

A single escutcheon may be complete with one simple division. Thus, a horizontal line divides the chief or top of the field at one third of its height from the remainder of the field. If that chief is, say, of gold, while the rest of the field is blue, that by itself makes a very respectable and honorable heraldic statement. The chief is one of the honorable ordinaries, and others are almost as simple. They are the pale, the vertical stripe in the middle of the shield and one third of its width; the fess, a horizontal stripe; the bend, which goes diagonally from the left hand upper corner to the right hand lower part, stopping against the rounded border of the shield; the bend sinister, which is a bend turned the other way (but see below, dexter and sinister); the chevron, which is a pair of stripes meeting in the middle, forming a figure like the letter A without the cross-bar; the cross, the two arms of which are usually of one quarter the width of the escutcheon; and the saltire, which is a diagonal cross. A shield upon which there is any one of these honorable ordinaries and nothing else, is most respectable. In general the simpler shields are the older; thus the old family Erskine, with a black pale on a silver field, or the family of Beauchamp with a gold fess on a red field, occupy the most enviable position in having such a plain escutcheon. There are ordinaries of the second rank, such as the quarter or canton, the orle, and besides these there are very many bearings in common use, especially those which are diminutives of the honorable ordinaries. Thus, the pallett is a smaller pale, and the shield of Aragon has four red palletts side by side on a gold ground. These again may be used to charge upon the greater ordinaries. Thus, the escutcheon of Loreyn bears a blue bend sinister on a gold field and the bend itself is charged with three golden six-pointed stars. That also is a simple and presumably ancient armory.

In describing the escutcheon the side on the left of the spectator is called the dexter and that on his right is called the sinister side; that is because the shield, when carried on the arm with the man-at-arms behind it would be to him so disposed. The escutcheon is supposed to be divided into a certain number of imaginary points or divisions for the fixing and placing of the bearings when they are described in words. When there are nine points, the three at the top following each other from the dexter to the sinister side are dexter chief, middle chief and sinister chief, and a similar nomenclature is used throughout. A modern and fuller arrangement is to give eleven points, the honor point interposed between the top horizontal row and the middle one; and the nombril point spaced between the middle row and the lowermost one. A small bearing as a mullet (a five-pointed star) may be located as being in the dexter chief or the like.

The main business of armory is to present simple patches of bright colors which can be recognized at a great distance. The tinctures used in Great Britain are nine — two metals, *or* and *argent* (gold and silver); five colors, *gules* (red); *azure* (blue), *sable* (black), *vert* (green), *purpure* (purple); though this last is very rare and green is not very common. There are also two furs, which are represented by curious conventional patterns supposed to represent the patchwork of small skins sewed together which make a garment or the lining of a garment. These furs are ermine and vair, but each has many curious variations known by different names. Thus "ermine" shows black tails on a white field, or in modern times a flower-like pattern suggested by the real ermine; but erminois has the same pattern in black on a gold field.

Dimidiation and impaling, mentioned above, are varieties of the great general subject of marshalling. The more elaborate form of marshalling is to divide an escutcheon into quarters. Thus, the son of a married pair who have borne their arms impaled, may divide the escutcheon into four quarters and will put his father's arms on the first and fourth quarters (dexter chief and sinister base) and those of his mother on the second and third quarters. This quartering may be quartered again, and so on indefinitely. Thus, the escutcheon of the Prince of Wales during the reign of Queen Victoria (of him who is now King Edward VII.) is too elaborate to describe fully here. This is because his bearings as Duke of Rothsay, Lord of the Isles, Duke of Cornwall, Baron Renfrew, and the like are all charged together, so that the number of small subdivisions is remarkable. Now, there are different ways of charging these. Those which his escutcheon must bear are the royal arms of England differenced (see differencing above) with the label of the heir apparent, which is a label of three points *argent*, and this escutcheon will bear in the middle a small shield with the arms of Saxony. Even in this the inescutcheon is out of place when we are considering his arms as heir to the crown. It is held by many that the Prince of Wales should display two shields; the first as simple as possible, with only the quarters for England, Scotland, and Ireland; while the second should display all his primary and secondary arms, including those of his wife, who, in the case assumed above, was the Princess Alexandra of Denmark. Again, a system is adopted by which a large shield bears those royal arms upon it, an inescutcheon with the secondary arms of Cornwall, Rothsay, Chester, Dublin, Lordship of the Isles, Carrick, Renfrew, Wales as a principality, and over all a small escutcheon of pretense charged with the arms of Saxony for Saxe-Coburg-Gotha. But even these do not include the arms of the Princess, his wife, which should rightly occupy the sinister side of the shield, while all the achievement described above should be charged upon the dexter side. It is evident, then, that a person whose family has formed many dignified alliances may have an indefinitely great number of quarterings. But let us take the escutcheon of a king of the House of Hanover, as George IV., and we shall find that the four quarters of the shield are filled in this way: the first quarter (dexter chief) in *gules*, bearing three lions *passant gardant*, and the fourth quarter (sinister base) exactly the same. These two quarters are England. The second quarter (sinister chief) is Scotland, a field *or* with a lion *rampant gules*, framed in a *bordure fleur-de-lisée*, also gules. The third quarter (dexter base) is Ireland, the Irish harp *or* on a ground *azure*. Upon this shield is set an inescutcheon, divided in a curious way into three parts, for Hanover, and having above it a royal crown. Upon this inescutcheon is still a second inescutcheon, very small, simply *gules* with a bearing *or*, which is supposed to stand for the imperial crown of Charlemagne, this in commemoration of the electoral dignity of the sovereign of Hanover, who was called the elector until after the Napoleonic wars. It is a rule never to place metal upon metal or color upon color. Thus, if your shield is argent, any bearing put upon it must be in one of the colors — never in *or*. But there is one curious exception: that of the Latin Kingdom of Jerusalem (which lasted only from 1099 to 1187, but which is perpetuated by the addition of its bearings to many private shields) was *argent*, a cross potent between four crosses *or*. This means a large gold cross, at the end of each arm of which is a cross head like the handle of a crutch; and in the little corners left by the cross, four small Greek crosses: all these in gold on a silver ground.

No two persons should bear the same arms at the same time, therefore a distinction is made between the escutcheons of younger children. Even the heir may distinguish his bearings from his father's by a special mark, apart from the quartering described above. The term marks of cadency is used for these distinctions. Many different plans have been followed, and one which has been much accepted is the label. This is a band with pendant strips hanging from it, usually three; and this is laid right upon the escutcheon near its head, and crosses it, partly concealing all the bearings. This label will be plain for the oldest son, differenced by a bearing like a crescent, *or*, a mullet for the second son, another bearing for the third son, and so on.

The practical functions of the herald developed into blazoning, historifying, passing judgment on, and marshalling coats of arms. Blazoning is the methodical description of a bearing. In the first place the shield is described according to its tinctures, figures and partitions. The inferior parts of an escutcheon are then blazoned — the helm with its insignia which are trumpet, wings and plumes, men and animals, or their members; then the wreath and its tinctures; after which the coronet, cap, etc.; finally the supporters, the mantle, the device and other secondary addenda. To historify in heraldry is to explain the history of a coat of arms, its origin, and the changes it has undergone. If the herald is to explain a bearing historically, he must show that this figure is the proper emblem of the family or country. He derives, for instance, from historical sources the proof that the double-headed eagle of the German king was first introduced in the beginning of the 14th century under Albert I., and that previously from the time of Otho II. the royal eagle had but one head; and he records the privilege given to wear that eagle on a private escutcheon. So he shows that the three leopards (lions passant gardant) in the English arms were first derived in 1127 under Henry I. from the Norman house. The marshalling of arms is especially important in the preparation of new escutcheons. In this matter, the herald either follows the orders of the sovereign, or he invents the idea, and makes the plan of the escutcheon according to his own judgment, or he composes a new escutcheon from several coats of arms.

When color is not used, a system of conventional expression is substituted; thus, *argent* is plain white, *or* is white with black dots, *azure* by horizontal black lines on white, *gules* by vertical black lines, *sable* by crossing black lines horizontal and vertical, *vert* by lines from the dexter chief to the sinister base, *purpure* by lines from the sinister chief to the dexter base. The furs have peculiar patterns and surfaces of their own.

The crest is the highest part of an achievement of arms and is set above the escutcheon. It is called crest from the Latin word *crista*, which signifies a comb or tuft, such as many birds have upon their heads. Crests were anciently marks of honor, because they were worn only by heroes of valor and high rank that they might be the better distinguished in an engagement, and thereby rally their men if dispersed; or else they were of the nature of badges worn by all the followers of a chieftain and serving to identify them. They are at present considered as mere ornaments; and they may be assumed without authority; obviously they should not be used by women. Supporters are figures placed on each side of the shield and perhaps originated from the custom of pages in fantastic dresses guarding the achievements of arms of their masters while the latter were taking part in the exercises of the tournament. The scroll is an ornament usually placed below the shield and supporters, containing a motto or short sentence alluding to the crest, or to the bearing or to the bearer's name. The motto had its origin in the war cries of knights, though in some instances mottoes were borne differing from the war cry of the wearer. The badge is not subject to heraldic rule, though it may be a part of the heraldic achievement, used separately. The porcupine was the badge of Louis XII. of France, and the salamander was chosen by Francis I. when he came to the throne, but neither of these was included in the escutcheon or worn as a crest. The reader may consult Palliser, 'Historical Devices, Badges and War Cries' (London 1870). The most recent large and important book on heraldry in English is 'The Art of Heraldry,' by Arthur Charles Fox-Davies, which is based upon the Heraldischer Atlas of H. G. Ströhl. An excellent book for persons who are making a serious study of the matter is Berry's 'Encyclopædia Heraldica,' in three volumes, n. d. (about 1820). The treatise on Heraldry by Woodward and Burnett, two volumes, 1892, is a very full and up-to-date manual. Smaller books are numerous. To name English ones alone Cussan's 'Handbook of Heraldry,' Planche's 'The Pursuivant at Arms,' Worthy's 'Practical Heraldry,' and especially Charles Boutell's two books, 'English Heraldry,' second edition, 1871, and the very remarkable essay, 'Heraldry, Historical and Popular,' third edition, 1864, now scarce, but nevertheless the most suggestive book that can be found.

Revised by RUSSELL STURGIS.

Herat, hĕr-ăt'. Afghanistan, a city in the northwest near the Heri-Rud River, about 370 miles west of Cabul. It is enclosed by a broad deep moat and an earthen mound surmounted by a lofty wall of unburned brick, and defended by a strong citadel. The caravansaries, public baths, and mosques are numerous. The trade, almost entirely in the hands of Hindus, is greatly favored by the situation of the town on the great thoroughfare from India westward. Herat was long the capital of the empire founded by Tamerlane, and was once much larger and more splendid than now. Its possession has been repeatedly contested among the peoples of central Asia, and, being regarded as a key to Afghanistan on the side next Persia and Russia it is of great importance politically. Its capture by Persia in 1856 led to a short war between Britain and Persia. Pop. about 45,000.

Herault de Sechelles, sā'shĕl, **Marie Jean,** French revolutionist: b. Paris 1760; d. there 1794. He became imbued with the teachings of Diderot, but, after his election to the Legislative Assembly in 1791, being rather a philosopher than a revolutionist, he at first paid little attention to the radical element there. He soon, however, joined the extreme left, and later on supported Danton in the revolution of August and September 1792. He was a deputy from the department of Seine-et-Oise to the Convention of 1792 and voted for the king's death. He became a member of the Committee of Public Safety, and as such gained the enmity of Robespierre, who claiming that he had betrayed certain secrets to the army of the Rhine, caused him to be arrested and executed. His best writings were published under the title 'Voyage à Montbard' (last ed. 1890).

Herb Paris, a poisonous plant of the lily family (*Paris quadrifolia*), resembling and related to white hellebore (q.v.), the toxic principle of which is a specific alkaloid called paradin.

Herbarium, a collection of dried plants, leaves, and fruit or seeds, arranged for preservation between sheets of bibulous paper; it is sometimes called *hortus siccus,* "dry garden," and is an indispensable adjunct to the apparatus of the systematic botanist, and microscopist. The most famous public herbariums are those of Kew, London; those of the British Museum and the London Linnæan Society. Those in Paris, Leyden, Berlin, and Vienna are also very full and complete.

In the United States there are three herbaria both copious and of the first order, namely, the Gray Herbarium of Harvard University, the Herbarium of the New York Botanical Garden, and the United States National Herbarium at Washington. The first named contains a vast majority of the older types of American plants, and the last contains the material brought together by the government collectors and many of the most important collections of the early Government surveys. There are also important collections at the Missouri Botanical Garden (Saint Louis) and the Field Columbian Museum (Chicago).

Herbart, Johann Friedrich, German philosopher: b. Oldenburg, 4 May 1776; d. Gottingen, 11 Aug. 1841. His career is evidence of the fact that at least some men may live peaceful lives in stormy times. A student at Jena under Fichte, a tutor in Switzerland, a docent at Göttingen in the theory of education, and after that a professor to the end at Göttingen, at Königsberg, and finally at Göttingen again,—that is the story of his life. But if he took no part in the revolutionary tumults that afflicted his country, he at least became a leader in her intellectual contests. His metaphysics stands at the opposite pole from that of Hegel. His psychology laid the foundations for modern psychophysics and experimental psychology, while his pedagogics is still the source of much of our best educational theory and practice.

Metaphysics.—The turning point between Herbart and Hegel lies in the use to be made of the principle of contradiction. Herbart took the orthodox stand that what contradicts itself cannot be truly real or actual, whereas Hegel boldly incorporated the principle of contradiction as a stage in what might be called his dialectic of evolution, which follows the formula, thesis, antithesis, synthesis. The antithesis is the contradiction of the thesis, but only that the two may come together again in a higher synthesis. A familiar illustration is the relation of (1) being, (2) non-being and (3) becoming, in which the second is thought as the contradiction of the first, while the third is conceived as a higher synthesis of the first two, since becoming has elements both of being and of non-being. Herbart, however, rejects such reasoning as insufficient, and demands that philosophy shall accept the validity of the principle of contradiction, and honestly endeavor to remove the contradictions inherent in our everyday thought of the world. Such contradictions are encountered when we consider a thing and its attributes or the ego, which is both subject and object, or when we trace experience back to matter, in which the notions discrete and continuous are seen to be at variance. The effort to remove the contradictions leads Herbart back to a pre-Kantian method of speculation, for he holds himself ready to accept any sort of a presupposition, rational, or irrational, which promises to resolve the difficulty, even though the principle of explanation should forever resist demonstration as to its reality. In other words, we may assume anything to be true which clears up our thinking. But this is the method of Leibnitz, of Spinoza, and of many others antecedent to the time of Kant (q.v.). The fundamental form in which contradiction appears is that the simple is conceived as manifold. For example, the thing we call water is at the same time thought of as heavy, fluid, colorless, having the quality of quenching both fire and thirst, and as being capable of transformation from a liquid to a solid or to a vapor. The way to overcome this contradiction is to assume a plurality of simple beings, and to explain the manifold as appearances arising from their relations. These simple beings that underlie the phenomenal world are atoms, or monads, or as Herbart prefers to call them, *Reals.* They are conceived to be in mechanical interaction, and to give rise to the manifold we have in experience. Like the atoms of Democritus they are simple and alike in quality, but unlike the monads of Leibnitz they are not points of self-active force, containing an inherent principle of development. Why and how the *Reals* act and interact Herbart does not explain, not even how they get and exercise their one function of *self-preservation.* The inability to explain these things which we most want to know is the penalty attached to this type of metaphysics. Yet it would be unfair to assume that no good results can come from even such pre-suppositions. *The Reals* are not spatial in the ordinary meaning of that term, for space and time as we know them are themselves phenomenal products, but they may be conceived to be in what Herbart calls *intelligible* space, in which the *Reals* exist in a state of partial or total interpenetration. Here they reciprocally "disturb" one another, a "self-preservation" resulting, which is a "state" of the *Real.* When the *Real* which is "disturbed" happens to be a soul, the disturbance, or the state of self-preservation, becomes an *idea,* which is the primary form of mental life. Psychology is, therefore, the science of these self-preservations of the soul-monad, which is like all *Reals* unknowable, but as Herbart thinks a necessary presupposition of our experience. Psychical life is the reciprocal tension of ideas. Consciousness depends upon the degree of this tension. The lowest degree of strength which an idea can have and still be actual marks the threshold of consciousness. If reduced below this degree it remains as "*impulse,*" and may rise again when freed from "*arrest.*" The soul monad has its seat in the brain and is in intimate interaction with a multitude of other *Reals.* Outwardly originating stimuli are conveyed to the brain by the nerves and reach the soul through the medium of the other *Reals* present. Since the idea is the primary form of mental life, feeling and volition must be explained through an examination of the inhibitory relations of the ideas. Pleasure arises when there is a furthering of mental movement, and pain when there is an arrest. Volition arises from desire, a state of feeling, which has a natural impulse to find satisfaction through action. Since mechanical action and reaction of the *Reals* is the source of ideas, it seems a natural conclusion that there may be a statics and mechanics of mental states. This led to Herbart's attempt to work out the calculus of ideas, thus opening the road for the modern quantitative study of mental phenomena, as seen in psychophysics and experimental psychology. Herbart claims to have founded psychology anew upon metaphysics, mathematics, and experience. The third of these bases is treated under the term *apperception,* which has important results for education.

Apperception.—Leibnitz, who introduced this term, employed it in a double sense. Its first meaning is the original power of the mind to unify experiences originating in sensation; this is the sense in which Kant uses the term. The second meaning is the mental assimilation that takes place when we use knowledge already acquired to interpret new knowledge. It is natural that Herbart should emphasize the latter process, for though he could hardly deny the validity of the first form of apperception, yet so slight is the original equipment of the mind —merely the power of preserving itself against the encroachments of other *Reals*—that all the significance of its activity must be found in acquiring experience. This, it may be remarked, is the process most important to teachers, for they can help to supply and order experience, whereas they have no control whatever over the original constitution of the mind. Herbart sees in each new sensation a stimulus to ideas already possessed, an attractive force for the similar, a repelling one for the dissimilar. The new idea therefore at first holds the centre of consciousness, gathering about itself similar ideas, and repelling hostile ones already in consciousness or newly attracted to it by contrast. But this very domination of the new idea is in most cases the cause of its reduction to a subordinate place, for by bringing to consciousness a body of more deeply rooted related ideas, it enables the old to control the new by placing the new in its true relation to older and better ordered experience. In other words, the new is apperceived by the old. Herbart's theory, thus briefly stated, has been extended and freed from contradictions, by subsequent writers, notably Lazarus, Steinthal and Wundt (qq.v.).

Ethics.—All knowledge, feeling, desire, and will, being explained by the various relations into which ideas may come, there is no room in Herbart's system for transcendental will, hence no ethical imperatives antecedent to those developed by experience. Ethics consequently becomes a branch of æsthetics, and ethical judgment is founded upon pleasurable or painful feelings as the case may be. The mind spontaneously approves some will relations and as spontaneously disapproves others. These basal relations refer to five fundamental aspects of conduct, two relating to the self as such, and the remaining three to the relations of the self to others. The first two are *Inner Freedom* (the feeling that arises from good conscience) and *Efficiency of Will* (the pleasure that is aroused by efficient action). The three other ideas are first *Good Will* (subjective attitude toward others), the second *Justice* (the legal basis of rights), and the third *Equity* (the demand that requital shall be adequate to deed).

Education.—Upon the basis of his psychology and ethics as above explained, Herbart built his educational structure. Since there is no source of character but experience, it is to experience, i.e., to organized knowledge or groups of ideas, that we must look for the development of character, which thus has its roots, not in a single department of knowledge as, e.g., that grounded in sacred writings, but in the whole content of the mind. A man must be ethical all over, not in spots only. For this reason the Herbartians speak fondly and proudly of *educative instruction,* meaning thereby such instruction as shall render all ideas contributory to moral character. But since feeling is the bridge between cognition and volition, this bridge the teacher must induce the pupil to cross if his conduct is to be adequate to his knowledge. This leads to the

Doctrine of Interest.—By means of direct interest incited in the pupil for the subject-matter itself, not amusement connected with the subject-matter, as some have erroneously thought, the pupil's permanent attitude of mind toward the circle of thought itself and consequently toward the aspects of life involved will be established. This interest falls naturally into two groups, first that pertaining to knowledge itself, and second that pertaining to intercourse with others. The first group embraces empirical, speculative (causal), and æsthetic interests; the second sympathetic, social, and religious interests. This doctrine of interest, so important in modern educational thought, has been brought into harmony with our more spiritualistic systems of philosophy and psychology by Professor John Dewey ('Interest as Related to Will'). The next important topic arises when we ask how the teacher is to lead the pupil to build his circles of thought adequately, and then to have the right mental attitude toward them. This leads to the subject of

Method.—It is a common experience that faulty methods may easily lead to inadequacy of insight; they may still more easily lead to the wrong attitude of mind, as when the student hates a subject and everything connected with it. The first point to consider is *Attention*, which is either spontaneous or forced. With the young where forced attention is painful, it is better to induce spontaneous attention, for here the ideas rise freely, producing liveliness and pleasure. Apperception has two marked stages, that of *absorption*, in which the mind gives itself up to new impressions; and that of *reflection*, in which the newly acquired elements of knowledge find their appropriate place in the systems of the old. To bring about this twofold process of absorption and reflection most effectively and most agreeably to the mind, we must observe at least four prominent stages of method. The first of these is *clearness*, by which is meant the adequate apprehension of the single object or element as such. The second is *association*, which consists in the progress from one absorption to another related one. The third is *system*, or the step in which each part of that which is learned finds its proper place in relation to other parts. Steps two and three may be said to embrace the process of generalization. The fourth stage is what Herbart calls *method*, by which he understands the well-ordered activity of the pupil in the solution of problems and tasks.

Making due allowance for those parts of Herbart's system that are now of historical interest only, it may be seen that many of its elements are still of importance to the world, for they involve the most potent of modern educational processes and aims.

Herbart's chief philosophical works are 'Lehrbuch zur Einleitung in die Philosophie' (1813); 'Lehrbuch zur Psychologie' (1816); 'Psychologie als Wissenschaft, neu gegründet auf Erfahrung, Metaphysik und Mathematic (1824-25); 'Allgemeine Metaphysik nebst den Anfangen der philosophischen Naturlehre (1828-29); 'Kurze Encyclopädie der Philosophie, aus practischen Gesichtspunkten entworfen' (1831). The complete works of Herbart have been edited in 12 volumes by G. Hartenstein (Leipzi 1850-52). Herbart's aducational works, including the 'Allgemeine Pädagogik' and the 'Umriss Pädagogischer Vorlesungen,' were edited by Dr. Otto Willmann in two volumes (Leipzig 1880). The Psychology is translated and to be found in the International Series (Appletons), while the 'Allgemeine Padagogik' and the 'Umriss' are also found in English, the former under the title of the 'Science of Education,' and the latter under that of 'Outlines of Educational Doctrine.' The Herbartian School has produced a literature in metaphysics, psychology and education too voluminous for mention here.

Charles De Garmo.
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Herbelot, Barthelemy, d', bär-tāl-mē dĕr-blō, French Orientalist: b. Paris 4 Dec. 1625; d. there 8 Dec. 1695. Having gone through a course of study in the university of his native city, he applied himself particularly to the eastern languages, with a view to the elucidation of the Hebrew Scriptures. He visited Italy, and while there commenced his great work, the 'Oriental Library.' Recalled to Paris by Colbert, a pension was given him, that he might be at liberty to proceed with his undertaking. It was his first design to have published his collection in Arabic, and types were cast for the purpose of printing it. But the death of Colbert having interrupted this plan, he recomposed the work in the French language, as likely to prove more generally useful. He was appointed to the royal professorship of Syriac in 1692. His book was published in 1697, under the title of 'La Bibliothèque Orientale.' The best edition of the 'Oriental Library' is that of The Hague (1777), with the supplements of Galland and Visdelou.

Herbert, Edward, Lord Herbert of Cherbury, English philosopher: b. Eyton-on-Severn, near Wroxeter, 1583; d. London 20 Aug. 1648. He was a famous soldier and diplomatist in his day, but at the present is remembered as an author and philosopher. At Paris, in 1624, he printed his famous book, 'De Veritate prout Distinguitur a Revelatione, a Verisimili, a Possibili et a Falso,' the object of which was to assert the sufficiency, universality, and perfection of natural religion, and thereby prove the uselessness of revelation. In 1624 he returned from France, and was created an Irish peer; and in 1629 became an English baron with the title of Lord Herbert of Cherbury. In the civil war he at first tried as far as possible to play a neutral part, but afterwards sided with the Parliamentary party chiefly with a view, it appears, to save his property. The character of Lord Herbert is strongly marked in his memoirs, which show him to be vain, punctilious, and fanciful, but open, generous, brave, and disinterested. The 'De Veritate' was followed by works entitled 'De Causis Errorum' (1645);

and 'De Religione Gentilium' (1663; Eng. trans. 1709). In 1649 was published his 'Life and Reign of Henry VIII.' The English style of Lord Herbert is strong, manly, and free from the quaint pedantry of his age. He was one of the first to attempt a systematic proof of the sufficiency of natural religion. "Herbert's religious doctrine," says Sidney Lee, "starts with the assumption that religion, which is common to the human race, consists merely of the five innate ideas or axioms that there is a God, that He ought to be worshipped, that virtue and piety are essential to worship, that man ought to repent of his sins, and that there are rewards and punishments in a future life. He regards Christianity as on the whole the best religion, because its dogmas are least inconsistent with his five primary articles." His autobiography remained in manuscript till 1764, when it was published by Horace Walpole. There is a recent critical edition by Sidney Lee (1886).

Herbert, Lady Elizabeth, English writer, mother of Sir Michael Herbert, British ambassador at Washington 1902-3. She is well known as an authoress, and has written books of travel in Spain, Algeria, and many other countries, as well as novels and biographies. Among these may be noted: 'Rambles Round the World'; 'Wayside Tales'; 'Cradle-Lands'; 'Impressions of Spain'; 'Algeria, or Search After Sunshine'; 'Love and Sacrifice'; 'Thekla'; 'Edith'; 'Wives and Mothers in the Olden Times'; 'First Martyrs of the Holy Childhood in China'; 'Children of Nazareth'; 'Lives' of Monsignor Dupanloup, Garcia Moreno, Alexis Clerc, General de Stonis, the Archbishop of Braga, Geronimo, Père Eymard, Ven. Clement Hofbauer, Saint John Baptist de Rossi, Saint Cajetan, Mother Teresa Dubouché, Père Peract, etc.

Herbert, George, the best known of English religious poets: b. at the Castle of Montgomery, Wales, 3 April 1593; d. Bemerton, March 1633. His father, Richard Herbert, came of an illustrious Welsh family; his mother, Margaret Newport, also of excellent family, is more remembered for her own noble character. She was of the best type of Renaissance woman, cultured, highminded—the companion and friend of intellectual men. Between her and her poet son was rare sympathy; she guided his life in all things and early destined him to the saintly career in which he came slowly to find his happiness. Upon her husband's death in 1597, the care of her ten children fell to her. The oldest son, Edward, Baron Herbert of Cherbury, himself a poet and the author of the famous autobiography (printed by Horace Walpole in 1764), went to Oxford in 1595; there his mother followed him with her other children, to watch over his career. Here George Herbert was brought up until 1605, when he entered Westminster School. From the first he distinguished himself, partly by his learning, partly by his daring, which showed itself in his attack in Latin epigrams upon Andrew Melville, the noted Presbyterian. In 1609 he was elected scholar of Trinity College, Cambridge, where three years later he took his degree. In 1614 he became a Fellow of Trinity, and won his Master's Degree in 1616. In 1610 he was elected Public Orator, an office he filled until 1627.

Until this election Herbert had looked toward a worldly career. Pride of family and ambition were strong in him; the influence of his relatives and friends at court was great; he knew his own powers. But all that the court favor bestowed upon him was the lay rectorship of Whitford (1623), a sinecure post which Sir Philip Sidney had held; and shortly afterward the death of his most powerful friends darkened the promise of worldly advancement, and aided his mother's effort to turn him to the Church. In July 1626, while yet a layman, he became prebendary of Layton Ecclesia, in the diocese of Lincoln. With the help of his mother and others, he restored the ruined church building—an act more expressive perhaps of the beauty-loving courtier than of the future parish priest.

His mother had married Sir John Danvers in 1609. Her death in 1627 called forth Dr. Donne's famous funeral sermon and her son's 'Parentalia.' This sorrow marks the beginning of George Herbert's nobler life. Shattered in health, and threatened with consumption, he resigned his oratorship and spent the next three years in London and Essex and Wiltshire, communing with himself and with his friends.

In 1629 he married Jane Danvers, a relative of his father-in-law's, and the next year he was presented to the living of Bemerton, with which his name is remembered. The short remainder of his life was remarkably active. In these years he wrote most of his poems and the best of them, and also the charming "Character of the Country Parson." It has been thought that his extraordinary zeal hastened his end. He died of consumption in 1633; the date of his burial was March 3. Later in the same year his famous book of poems, 'The Temple,' was published in Cambridge.

Herbert's life must have seemed to him an elaborate and delayed preparation for the last saintly years at Bemerton—one long turning from high hopes of a career and broad experience of the best of worldly society, to the humble life of the spirit. The wasting of his physical frame paralleled this increasing otherworldliness. Yet in his final achievement his early life counts for more than at first might be guessed; he could turn from such a past less completely than he thought. He owed it to this broad experience of the world at its best that his nature remained normal. His extreme saintliness took no strange outward form, as did the piety of his friend Nicholas Ferrar, nor did it mar his writing with eccentricities of fervor or mysticism: his genius is entirely sane. In no English poet, religious or secular, do the small common-places of life count for more. In such poems as 'The Elixir,' with its famous praise of "Drudgery Divine," he insists on that kind of aspiration which scorns no humble or routine task; and his longest poem, 'The Church Porch'—a series of wise maxims for the familiar discipline of the soul—sums up the moral and religious traditions of the English race, though in his individual way. His genius is for common sense ennobled by lofty faith and passionate devotion. It is this normal quality in him, this quickness to find inspiration along the highway, rather than his frequent reference to ecclesiastical customs and offices, that makes him, as Coleridge said, the representative poet of the English Church.

Herberts' wide fame rests on the substance of his work, rather than on the skill of its expression. But technically in his own field he is an accomplished artist. In a certain striving to crowd too much thought into words or to secure a striking phrase, he must be classed with Donne and the other "fantastic poets," but in him this quality is rarely pressed beyond a charming quaintness. He has the artist's sense of word-values; his verbal felicity, as in the oft-quoted "Sweet day, so cool, so calm, so bright," could hardly be excelled, and in many of his poems the fine openings and cadences recall the best manner of the Cavalier Poets (q.v.), among whom Herbert would naturally have found his place, had he not devoted his genius to sacred poetry. Good illustrations of such qualities, besides the titles already mentioned, are the song "I got me flowers to straw Thy way," the lovely poem with the fantastic title 'The Pulley,' and the more passionate 'When blessed Mary wiped her Saviour's Feet.' In all these verses Herbert's individuality is strong—the quiet depth of his religious nature, and his indescribable sweetness of temper, the fruit of the winning over of his worldly ambition to saintly ideals.

Bibliography. — The best editions are: George Herbert Palmer; Grosart, in the Fuller's Worthies Library and in the Aldine edition; the Pickering edition, with the Life by Isaak Walton. For criticism, consult: 'Introductions' to the above, especially to Palmer's edition; also, for a charming study, consult the essay on Lady Danvers in Louise Imogen Guiney, 'A Little English Gallery.'

John Erskine,
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Herbert, Henry William, "Frank Forester," American author: b. London, England, 7 April, 1807; d. New York 17 May 1858. He was graduated from Caius College, Cambridge, in 1828; removed to the United States in 1831; and until 1839 was instructor in the Greek and Latin languages in a private school of New York. In 1833 he established and until 1836 was editor of the 'American Monthly Magazine,' during a portion of that time with Charles Fenno Hoffman (q.v.) as associate. From 1834 he became largely known as the first important American writer on sports and out-of-door subjects. He wrote also on French and English history, and made excellent translations from Dumas and Sue. His volumes include: 'Cromwell' (1837); 'Marmaduke Wyvil' (1843); 'The Cavaliers of England' (1852); 'The Chevaliers of France' (1853); 'The Puritans of New England' (1853); 'Field-Sports of the United States and the British Provinces' (1848); 'Sporting Scenes and Characters' (1857); 'Horses and Horsemanship of the United States and British Provinces' (1859).

Herbert, Hilary Abner, American lawyer and politician: b. Laurensville, S. C., 12 March 1834. He was educated at the universities of Alabama and Virginia, studied law and was admitted to the bar. He began practice at Greenville, Ala., but served in the Confederate army as captain and colonel of the 8th Alabama regiment; being disabled at the battle of the Wilderness (1864), he retired from the army, and continued the practice of his profession, first at Greenville, then at Montgomery (1872). He was elected to Congress in 1877, and seven times re-elected; in three Congresses he was chairman of the committee on naval affairs. In March 1895, he was appointed secretary of the navy by President Cleveland, an office which he held till 1897.

Herbert, John Rogers, English historical and portrait painter: b. Maldon, Essex, 23 Jan. 1810; d. London, 17 March 1890. He studied at the Royal Academy, where he exhibited as early as 1830; later went abroad and in 1840 became a Roman Catholic, after which the subjects of his paintings were chiefly religious. In 1841 he was elected one of the masters of the government school of design at Somerset House, and in 1846 became a member of the Academy. His principal works are the frescoes in the peer's robing-room in the House of Lords; 'The Appointed Hour' (1834); 'King Lear Disinheriting Cordelia'; 'Sir Thomas More and his Daughter' in the Vernon collection at the National Gallery; and 'Saint Gregory Teaching His Chant.'

Herbert, Sir Michael Henry, English diplomatist: b. England 25 June 1857; d. Davos-Platz, Switzerland, 30 Sept. 1903. He went to Paris as attaché in 1879; was *charge d'affaires* at Washington (1888-9); secretary to the British legation at Washington (1892-3); at The Hague (1893-4); and at Constantinople (1894-7). On 4 June 1902 he was appointed British ambassador to the United States at Washington, in succession to the late Lord Pauncefote, and the following year was compelled by ill health to return to Europe.

Herbert, Victor, American musical director and composer: b. Dublin, Ireland, 1 Feb. 1859. After studying music from his childhood in Germany, he was appointed principal 'cello player in the court orchestra, Stuttgart, from which time he appeared in concerts throughout Europe. In 1886 he took the position of solo 'cellist in the Metropolitan orchestra, New York, and has since been connected as soloist and conductor with the principal orchestras of the United States. Since 1894 he has been bandmaster of the 22d regiment band, New York, was conductor of the Pittsburg, Pa., orchestra from 1898 to 1904, and since 1904 has conducted Victor Herbert's New York Orchestra. As a composer he has written: 'The Captive,' an oratorio; and the comic operas, 'Prince Ananias'; 'The Wizard of the Nile'; 'The Serenade'; 'Cyrano de Bergerac'; 'The Ameer'; 'The Viceroy'; 'The Idol's Eye'; 'The Fortune Teller'; 'The Singing Girl'; 'Babette'; 'Babes in Toyland'; 'It Happened in Nordland'; etc.

Herbiv'ora, a group of mammals characterized by their herbaceous diet; the grazers or ruminants. The term is no longer in use.

Herbs, Culinary, fragrant or aromatic plants used to add flavor to food, especially stews, soups, dressings and salads. They usually owe these qualities to essential oils, which, being readily soluble or easily volatilized by heat, quickly permeate the mass of food in which they are mixed. The seed of some, as caraway, anise (qq.v.) and dill, is employed; the foliage of others, as parsley, sage, thyme, is more frequently used. The former plants are cut and placed loosely upon sheets as soon as the seed reaches maturity; allowed to dry a few days; lightly thrashed and the seed cleaned; still further dried and stored in air-tight packages. The latter are gathered just before the first blossoms would open, because they are then richest in flavor. With parsley the leaves are gathered as soon as mature, several cuttings being made in a season. They are then dried upon trays at a temperature below 120 degrees and in freely circulating air until crisp, when they are rubbed to powder and stored as above. Paper or pasteboard packages are bad, because they allow the flavors to escape. Both seeds and leaves may be used in decoction, being covered with vinegar or alcohol in stoppered bottles. Fresh herbs, which are always preferable to dried or decocted, are especially useful in salads; dried and decocted in dressings, stews, etc., and at seasons when fresh ones cannot be obtained. In the United States the species most in demand are parsley, sage, thyme, savory, marjoram, spearmint, dill, fennel, tarragon, balm and basil (qq.v.) in nearly the order named. Parsley is beyond question the most popular because of its double use as a garnish and flavoring plant but sage is perhaps more frequently used in the latter capacity. It is most esteemed with pork, goose, duck, and similar rich meats. Spearmint is used mainly with roast lamb; tarragon with boiled fish; dill with pickles; and the other kinds mentioned with mild meats, such as turkey, chicken, veal, venison, etc. The kind, quantity and mixture used with each sort of food depends upon personal preference.

In general, herbs are of simplest cultivation. They usually prefer rather light, moderately rich, well drained soil, and sunny exposures. Since the seeds of many are small or slow to germinate they are frequently started in a greenhouse, hotbed or window, and transplanted to the garden when they are large enough and when conditions are favorable. Clean cultivation and the removal of weeds is essential. The perennial kinds, such as sage, are often propagated by stem cuttings, divisions or layers; tarragon always thus because it does not produce seed; spearmint usually by cuttings of the rootstock. The great majority are grown as annuals, being replaced each spring with fresh plants. Commercially they follow such crops as early cabbage, peas, etc., thus permitting a double use of the same soil annually. They are easily grown for winter use in the borders of benches in the greenhouse or in boxes placed in sunny windows.

Consult articles such as *Sweet Herbs* by Kains in Bailey's 'Cyclopedia of American Horticulture' (New York 1900–2).

Herculaneum, hĕr-kū-lā'nē-ŭm, or **Herculanum**, Italy, an ancient buried city, about five miles southeast of Naples. Strabo says it was first occupied by Oscans, afterward by Tyrrhenians and Pelasgians, and then by the Samnites. It took part in the social war against the Romans. In the time of Sulla it was a *municipium* and a fortified town. It was situated between Neapolis and Pompeii, on elevated ground between two rivers, and its port was one of the best on the coast. It suffered in 63 A.D. in the same earthquake that nearly destroyed Pompeii. In the greater irruption of 79 A.D. it was buried under a volcanic tuff formed of sand and ashes, partly consolidated by the agency of water. The site of Herculaneum, though well described, had been long sought in vain, when in 1713 three female statues (now in the Dresden Museum) were found in digging a well at Portici, a village situated on the ancient site. After this discovery further excavation was prohibited by the government, until in 1738 the well was dug deeper, and the theatre of Herculaneum was discovered. In 1750 a long, narrow passage, sloping down into the theatre, was opened, and is still the only way by which travelers descend to examine this structure. The excavations were continued more or less industriously for 50 years; but comparatively little progress was made, as the work was difficult and also dangerous to the houses in the populous villages of Resina and Portici, situated above. As soon as one part was excavated and explored it was filled up with the rubbish from a new digging. The theatre is the only building to be seen underground, and it is encumbered with the supports built to sustain the rock above it. It is a noble edifice, massively built of solid stone, and seated 8,000 persons. Bronze statues of Drusus and Antonia and of the Muses were found in various parts of the building. In a square on the south of the theatre a temple was found which was connected with another temple, to the east of it, by a wide street lined with porticoes. One of these temples, dedicated to the mother of the gods, had been restored by Vespasian after the earthquake of 63 A.D. On the north of the theatre was a basilica 228 feet long and 132 broad, surrounded by a portico of 42 columns, and adorned with paintings. Many beautiful paintings and works of art were removed from these buildings to the museum at Naples. A sumptuous private villa was disinterred, containing a number of statues, and in one of the rooms a quantity of papyrus manuscripts. Some of the statues are excellent as works of art, such as those of Agrippina, Aristides, the Sleeping Faun, and the Mercury. Other precious relics discovered here, and now in the museum, are busts of Plato, Demosthenes, Scipio Africanus, Augustus, Seneca, etc., beautiful mosaics, and articles of furniture. New excavations were carried out in 1828–37, and since 1868. The chief discoveries made were those of the forum, a small and elegant temple, a basilica, a dilapidated building supposed to have been an inn, dwelling-houses, tombs, etc. One of the houses discovered at Herculaneum contained a quantity of provisions, dates, chestnuts, large walnuts, dried figs, almonds, prunes, corn, oil, pease, lentils, pies, and hams, none of which had been disturbed for 18 centuries, for the doors remained fastened, in the same state as they were at the period of the catastrophe which buried the town. The internal arrangement of the house, and the manner in which it was ornamented, proved that it had belonged to a rich family, admirers of the arts; for it contained many pictures, vases, articles in glass, bronze, and terra-cotta. Few skeletons comparatively have been found either in Pompeii or Herculaneum, so that it is probable most of the inhabitants saved themselves by flight. At the door of a villa in Herculaneum were found two, one of which held a key in one hand, and in the other a bag with coins and cameos. Near them were silver and bronze vessels.

Among the most interesting objects discovered here are the papyri above mentioned, over 1,750 of which are now in the Naples Museum. The rolls are of cylindrical form, and much charred. Hardly a third of them have been unrolled. The process presents great difficulties, from the tendency of the MSS. to crumble. One of the works is a treatise by Epicurus on Nature; there are some writings of Philodemus, a Syrian philosopher; but on the whole they are of little value. There have been published 11 volumes of the 'Volumina Herculanensia,' containing engraved transcripts of the unrolled papyri (folio, Naples, 1793–1855), and since 1861 several volumes of a continuation of the same.

Consult: Furcheim, 'Bibliografia di Pompei, Ercolano e Stabia'; Ruggiero, 'Storia degli Scavi di Ercolano.'

Her'cules, hėr'kū-lēz, called by the Greeks Herakles, and also Alcides, al-sī'dēz, after his grandfather, Alcæus: a mythological hero of Greece, typified by poets, sculptors, and artists of later ages, as a model of human perfection, physical and mental. According to the traditions of the heroic age, he united the finest qualities of mind and heart, as understood at that period, with the highest development of bodily vigor, and under a ceaseless succession of labors and sacrifices, strove perpetually after divine excellence. His indomitable perseverance was crowned with victories which showed the triumph of the divine part of man's nature over the earthly, while his death secured him immortality, a seat among the gods, and the homage of divine honors.

The legends relate that he was the son of Zeus or Jupiter, king of the gods, and of Alcmena the Theban, daughter of Alcæus, son of Perseus. Knowing that the child born on a certain day would rule over the descendants of Perseus, Hera or Juno, wife of Jupiter, consumed with jealousy, contrived to prolong the travail of Alcmena, and hasten that of the wife of Sthenelus, another son of Perseus, who gave birth to Eurystheus, subsequently chief of the Persidæ. Hercules was brought up at Tirynthus, or according to Diodorus, at Thebes. Jupiter sought to protect his favorite son in every manner, and to make him worthy of immortality. On one occasion, while Juno was asleep, he laid the infant on her breast, that he might feed on the milk of the goddess. She awoke, and cast the hated babe from her, and the drops that then fell from her are said to have formed the Milky Way. Under the care of Amphitryon, Alcmena's husband, Hercules received the best instruction in all arts. Castor, the son of Tyndarus, taught him how to fight: Eurytus, archery; Autolycus, driving; Eumolpus, singing; Linus, to play the lyre; and under the centaur Chiron, he perfected his training, and became the most valiant and accomplished hero of the age.

In his eighteenth year he slew a huge lion in the neighborhood of Mount Cithæron which had preyed on the flocks of Amphitryon and of the king of Thespis. The king, desirous that his 50 daughters might have children by such a hero, entertained him at his court for 50 days, and Hercules became the father of their sons, the Thespiadæ. Hercules next freed his native city from the annual tribute of a hundred oxen, paid to Erginus, king of the Orchomenians. Creon, king of Thebes, rewarded Hercules by giving him his daughter Megara in marriage, and intrusting him with the government of his kingdom. Subjected to the power of Eurystheus owing to priority of birth, the latter acquainted with Hercules' successes and rising power, ordered him to appear at Mycenæ, and perform the labors which he was empowered to impose upon him. Hercules refused, and Juno to punish him, afflicted him with melancholic madness, during which he killed his own children by Megara, supposing them to be the offspring of Eurystheus. When he recovered he was so horrified by the misfortunes which had proceeded from his disobedience and insanity, that he consulted the oracle at Delphi; he was told that he must be subservient to the will of Eurystheus and perform ten labors imposed by the king, after which he would attain immortality. Hercules thereupon went to Mycenæ, where Eurystheus, apprehensive of so powerful an enemy, commanded Hercules to achieve a number of enterprises, the most difficult and arduous ever known. The favors of the gods, however, had completely equipped him for their performance; from Minerva he had received a coat of arms and helmet, a sword from Mercury, a horse from Neptune, a shield from Jupiter, a bow and arrows from Apollo, and from Vulcan a golden cuirass and brazen buskin with a celebrated brass club.

The first labor was to destroy the lion which infested the forests of Nemea and Cleonæ near Mycenæ, and was invulnerable to mortal arrows. Hercules attacked him with his club, chased him to his den, and after a sharp and fierce struggle choked him to death. He carried the dead beast on his shoulders to Mycenæ, and ever after clothed himself with the skin. The second labor was to destroy the Lernæan hydra, which he accomplished with the assistance of his friend Iolaus, who burnt with a hot iron the root of each head as Hercules crushed it to pieces with his club. The third labor was to catch the hind of Diana, famous for its swiftness, golden horns, and brazen feet. The fourth labor was to bring alive to Eurystheus a wild boar which ravaged the neighborhood of Erymanthus. In this expedition he destroyed the Centaurs, and caught the boar by closely pursuing it in the deep snow. In his fifth labor Hercules was commanded to clean the stables of Augeas, where 3,000 oxen had been kept for many years; this he accomplished in one day by turning the rivers Alpheus and Peneus through the stables, receiving as payment a tenth of the cattle, and concealing the fact that he had been commanded to perform the service. The sixth labor was to destroy the carnivorous birds, with brazen wings, beaks, and claws, which ravaged the country near Lake Stymphalis in Arcadia. In his seventh labor he brought alive into Peloponneseus the wild bull, a gift of Poseidon to Minos, king of Crete, which had laid waste the island. In his eighth labor he was commissioned to capture the mares of Diomedes, which fed upon human flesh. He killed Diomedes, and gave him to be eaten by his mares, which he brought to

Eurystheus. For his ninth labor he was commanded to obtain the girdle of the queen of the Amazons. In his tenth labor, he killed the monster Geryon, king of Gades, and brought to Argos his numerous flocks, which fed upon human flesh. Adjudging the second and fifth labors as unlawfully performed, Eurystheus imposed two others. These were: the eleventh, to obtain the golden apples from the garden of the Hesperides; and the twelfth, to bring from hell the three-headed dog Cerberus. Pluto promised him Cerberus on condition that he should use no weapons but force. Eurystheus, pale with fright when Hercules brought the monster to him, ordered its immediate removal. This ended what are generally known as the Twelve Labors of Hercules, and relieved the hero from bondage.

Besides these, Hercules achieved other labors equally great and celebrated, such as his war with Jupiter against the giants, his expedition with the Argonauts to Colchis, the pillage of Troy, the liberation of Prometheus and Theseus, etc. During three years' slavery, imposed by the Delphian oracle for plundering the temple to avenge supposed neglect, Hercules' mistress, Omphale, queen of Lydia, married him. Hercules afterwards married Dejanira, daughter of Œneus, king of Ætolia, and when Iole, daughter of the king of Œchalia, a princess formerly refused to Hercules, became his captive, Dejanira sent Hercules the tunic given her by the dying centaur Nessus, as having the power to recall a husband from unlawful love. The tunic had been infected by the poisoned arrow shot by Hercules at the centaur, when he offered violence to Dejanira, after carrying her across the river Evenus. When Hercules put the tunic on, the poison penetrated his system and he suffered untold torments; in remorse Dejanira killed herself. In his agony Hercules had himself conveyed to Mount Œta and laid on a funeral pyre which at his commands was set on fire. In the midst of a dark cloud, accompanied by lightning and thunder, his immortal spirit was transported to Heaven, where he took his place among the gods, became reconciled to Juno and married her daughter Hebe.

While the myth of Hercules is of Greek origin, counterparts of the legend appear among many nations. Some scholars regard Hercules as a solar hero, and the twelve labors to represent the 12 zodiacal signs. Artists represent him under a variety of forms, as a child, a youth, and man, in his numerous adventures and exploits. The principal ancient statue is the Farnese Hercules at Naples, by the Athenian Glycon. In the Vatican, the Torso di Michelangelo, so called because that artist studied it during several years, is a remarkable fragment of an ancient statue of Hercules.

Hercules, in astronomy, one of Ptolemy's northern constellations. It is within this constellation that the point toward which the sun, with its accompanying system of planets, is traveling at present is situated. The constellation contains the finest globular cluster of stars in the northern heavens, and the bright double and variable star Ras Algethi.

Hercules-beetle, a very large South American lamellicorn beetle (*Dynastes hercules*). An enormous horn projects from the prothorax of the male, and a smaller one from the head; they act together like a pair of forceps. The length of the male is about six inches, but the female is smaller and lacks the horns. Numerous related species are known, of which *D. tityrus,* found in the southern United States, is 2½ inches long.

Hercules' Club, a North American shrub or tree growing to height of 12 feet and sometimes to 40 feet. See Aralia.

Hercules, Pillars of, name of the Straits of Gibraltar among the ancients. Hercules is said to have erected a pillar on each side of the strait between Europe and Africa, upon the mountains Calpe and Abyla, as the limits of his wanderings toward the west. The earliest Greek writer by whom the Pillars of Hercules are mentioned is Pindar. On the other hand the Phœnicians called the strait the Pillars of Melkant (q.v.), whom the Greeks knew as Melicertes.

Herder, Johann Gottfried von, yō hän gŏt'frēd fōn hĕr'dĕr, German critic and poet: b. Mohrungen, Prussia, 25 Aug. 1744; d. Weimar 18 Dec. 1803. He was the son of a poor schoolmaster, but friends procured him an appointment in Frederick's College, where he was at first tutor, and at a later period instructor. During this period he became known to Kant, who permitted him to hear all his lectures gratis. His unrelaxing zeal and diligence enabled him to become acquainted with science, theology, philosophy, philology, natural and civil history, and politics. In 1764 he was appointed an assistant teacher at the cathedral school of Riga, with which office that of a preacher was connected. In 1769 he went to Paris; he became traveling tutor to the Prince of Holstein-Oldenburg, but in Strasburg he was prevented from proceeding by a disease of the eyes; and here he became acquainted with Goethe, on whom he had a very decided influence. Herder had already published his 'Fragments on the More Modern German Literature,' his 'Critical Woods' (Kritische Wälder), etc., which had gained him a considerable reputation, though he had not published anything of importance in theology; yet, while in Strasburg, he was invited to become court preacher, superintendent, and consistorial counsellor at Bückeburg, whither he proceeded in 1771. He soon made himself known as a distinguished theologian, and in 1776 received an invitation to become court preacher, general superintendent, and consistorial counsellor at Weimar. This appointment was through the influence of Goethe. In 1801 he was made president of the high consistory, a place never before given to a person not a nobleman and was subsequently made a noble by the Elector of Bavaria. As a theologian Herder contributed to a better understanding of the historical and antiquarian part of the Old Testament. His 'Geist der hebräischen Poesie' is highly valued. He did much for the better appreciation of the classical authors, and his philosophical views of human character are full of instruction. His greatest work is his 'Ideen zur Philosophie der Geschichte der Menschheit' (1785 *et seq.*). In poetry Herder effected more by his various accomplishments, his vast knowledge, and fine taste, than by creative power; yet he has produced some charming songs; and his 'Cid,' a collection of Spanish romances into a kind of epic, is one of the most popular poems of Germany.

Heredia, José Maria, Spanish-American poet: b. Santiago de Cuba 31 Dec. 1803; d. Toluca, Mexico, 7 May 1839. He was graduated from the law department of the University of Havana in 1819; for taking part in the attempted revolution of 1823 was banished from Cuba, lived for two years in the United States, and in 1825 removed to Mexico, where he held various civil, judicial, and journalistic positions. His poetic works have been to some extent rendered into other languages. The 'Ode to Niagara' is well known. Heredia has been considered by many the greatest of Spanish-American poets. One of the best editions is that of Ponce de Leon, 'Obras Poeticas de Don José Maria de Heredia' (1875).

Heredity, the transmission of parental characteristics to the offspring. The child possesses the mean between the character of each parent, that is, the father and mother share equally in transmitting their peculiarities. Yet it should be borne in mind that no two individuals are exactly alike, and besides the resemblances to the parents, every child differs in certain respects from the parent. We speak of the force of heredity, and this, whatever be its nature, is very wonderful. Thus the Egyptian of to-day inherits the features and mental characteristics of his ancestors who lived 10,000 years ago. One cause of this is the fact that the physical features and climate of Egypt have remained unchanged for that period. Did heredity act rigidly we should have no modification of type from one geological age to another. The inheritance of one set of characters may, owing probably to profound changes in the environment, lapse, and the original peculiarities be replaced by others. Thus civilized man has thrown off certain habits and tendencies of his savage ancestors, and acquired new and higher culture — modes of action and feeling. Heredity has its limits, and in certain highly specialized types of animals has lapsed or ceased to act as at first. Hurst remarks: "Heredity is merely a likeness of effects due to the likeness of the causes producing them."

There are four types or forms of inheritance: (1) Continuous or normal inheritance, that is, where the children resemble the father and mother. (2) Interrupted inheritance, where the offspring resemble the grandparents. (3) Collateral inheritance, where the offspring inherit the qualities of their uncle or aunt. (4) Atavism or reversion, which is inheritance from a remote ancestor. Thus when individuals of two domesticated races are crossed, the offspring may resemble neither parent, but are like the supposed ancestral or wild species. This is called "throwing back" by breeders. Galton speaks of alternative heredity, and illustrates it by the color of the human eye. "If one parent," he says, "has a light eye-color and the other a dark eye-color, some of the children will, as a rule, be light and the rest dark, they will seldom be medium eye-colored, like the children of medium eye-colored parents." What is called particulate inheritance is common in the color of the hair of horses, dogs, mice, and other mammals, and in the hairs on the leaves of certain plants.

Galton's Law.— We do not know why certain characters are transmitted and others are not, and we cannot foretell, says Bateson, which individual parent will transmit characters to the offspring, and which will not, yet this problem may at some time become solved. From his studies on human stature, and on the transmission of colors in Bassett hounds, Galton has shown that the expectation of inheritance is such that a simple arithmetical rule is approximately followed. He deduced the rule that of the whole heritage of the offspring the two parents together on an average contribute one half, the four grandparents one quarter, the eight great-grandparents one eighth, and so on, the remainder being contributed by the more remote ancestors.

This rule does not in many cases apply, and Galton points out that it takes no account of individual prepotencies. Moreover, says Bateson, there are numerous cases in which on crossing two varieties the character of one variety almost always appears in each member of the first cross-bred generation. For example, the offspring of the polled Angus cow and the shorthorn bull is almost always polled or with very small loose "scurs." Seedlings raised by crossing *Atropa belladonna* with the yellow-fruited variety have without exception the blackish-purple fruits of the type. These are now recognized as instances of Mendel's principle of dominance.

Mendel's Law.— As far back as 1865 an Austrian monk, Mendel, made prolonged experiments in crossing varieties of the pea (*Pisum sativum*). His paper was overlooked until attention to his remarkable results was called by De Vries in 1900: he and also Correns and Tschermak at the same time independently rediscovered Mendel's law. Mendel selected seven pairs of characters, such as the shape of the ripe seed, of the cotyledons, of the seed-pod, color of the seed-skin, length of stem, etc. Large numbers of crosses were made between peas differing in respect of one of each of these pairs of characters. It was found, says Bateson, that in each case the offspring of the cross exhibited the character of one of the parents in almost undiminished intensity, and intermediates which could not be at once referred to one or other of the parental forms were not found. "In the case of each pair of characters there is thus one which in the first cross prevails to the exclusion of the other." This prevailing character Mendel called the dominant character, and to the other he gave the name of recessive character.

This law of dominance has been found by Bateson and by Castle to apply to animals as well as plants, and thus is a most important biological law. Thus when mating occurs between two organisms, whether vegetable or animal, differing in some character, the offspring frequently all exhibit the character of one parent only, in which case that character is said to be "dominant." For example, on crossing white mice with gray mice, Castle found that the offspring are gray, that color-character being dominant. The character which is not seen in the immediate offspring is called recessive, for though unseen it is still present in the young, white in the experiment being the recessive color.

The law of dominance has its exceptions: the hybrid often possesses a character of its own, instead of the pure character of one parent, as is true in cases of complete dominance. The hybrid form often resembles a supposed ancestral condition, when it is usually regarded as a reversion. Examples are the gray hybrid mice, which are indistinguishable in appearance from the house mouse; also slate-colored pigeons resulting from crossing white with buff pigeons.

One result of Mendel's discovery is the purity of the germ-cells. As stated by Castle: "The hybrid, whatever its own character, produces ripe germ-cells which bear only the pure character of one parent or the other." To breeders Mendel's law is of great importance because, as remarked by Castle, it reduces to an exact science the art of breeding in the case most carefully studied by him, that of entire dominance. "No animal or plant is 'pure' simply because it is descended from a long line of ancestors possessing a desired combination of characters, but any animal is pure if it produces gametes (germ-cells) of only one sort, even though its grandparents may among themselves have possessed opposite characters."

The bearings of Mendel's discovery, confirmed by De Vries' experiments, on the origin of species is of great interest and moment. The problem is whether aberrations, sports, or discontinuous variations may not sometimes result in the formation of new species and types, or whether species are all the result of slow, continuous variations. As stated by Castle, "A sport having once arisen affecting some one character of a species, may by crossing with the parent form be the cause of no end of disintegration on the part of any or all of the characters of the species, and the disintegrated characters may, indeed must, form a great variety of new combinations of characters, some of which will prove stable and self-perpetuating.

Mendel's discoveries also explain the principle that new types of organisms are extremely variable, whereas old types are subject to little variation. A new type which has arisen as a sport will cross with the parent form. The offspring, says Castle, will then inherit some dominant character, others latent, and this will result in polymorphism of the race. Thus the suggestion of Galton that species may arise from sports is confirmed, while added cases are afforded by the recent remarkable experiments of De Vries, resulting in the origination of seven new species of primrose by sudden variations, or what he calls "mutations."

Homochronous Heredity.— This is a form of heredity called by Darwin "inheritance at corresponding periods of life." It is exemplified in animals with a metamorphosis, whose larvæ lead a different life and differ greatly in structure and form from the parent. Thus the butterfly inherits in its infancy the caterpillar stage, then the pupa, finally the features of the imago; one character or set of characters appear by heredity, are cast aside, and new features arise, those of the pupa stage, and so on. Each butterfly, beetle, or bee, as well as the fluke-worms, tapeworms, etc., inherit at different periods of their lives stages which have become fixed by homochronous heredity.

The Physical Basis of Heredity.— A number of biologists from Spencer to Jaeger and Weismann have supposed that heredity is due to the transmission from parent to offspring of particles developed in the reproductive cells of the parent, whence arose the theory now generally held that the nucleus of the spermatozoon and of the egg is the bearer of heredity. Even in the protozoa, if one be divided into nucleate and enucleate halves, the portion without a nucleus degenerates, while the part containing the nucleus lives and regenerates the lost parts. The nucleus contains a portion which stains readily with reagents, and is called the "chromatin," which consists of particles called "chromosomes." Now the nucleus of the egg and that of the spermatozoon contain the same number and quantity of chromosomes, to what are called the cleavage-spindles, hence the chromatin, that is, the chromosomes, are regarded as the bearers of heredity, some of these passing down from one generation to another.

Consult: Weismann, 'The Germ-Plasm' (New York 1893); Bateson, 'Mendel's Principles of Heredity' (Cambridge, England, 1902); Castle, 'Mendel's Law of Heredity' (Cambridge, Mass., 1903); with the earlier works of Darwin, Brooks, Galton, Hertwig, and others.

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Hereford, hĕr'ē-fōrd, England, a city and parliamentary borough, capital of Herefordshire on the Wye, 120 miles northwest of London. The chief building is the cathedral, built in 1012–56, rebuilt in 1072, and restored in 1863. It is of early Norman architecture, 335 feet long and 174 feet wide, contains many fine monuments, some as ancient as the cathedral, and its accessory features include a lady chapel, charterhouse, cloisters, an episcopal palace and a library containing valuable MSS., Wyclif's Bible, and a 13th century map of the world. A musical festival of the united choirs of Gloucester, Worcester, and Hereford is given in the cathedral triennially. The see dates from 673; the city was incorporated in the reign of King John. Pop. (1901) 21,382.

Her'esy (Gr. *hæresis*) primitively means a choice or election, and in its application to religious belief is used to designate as well the act of choosing for one's self, and maintaining opinions contrary to the authorized teaching, as also the heterodox opinions thus adopted. In the Acts of the Apostles the word seems to be used of a sect or party, apart from the consideration of its character, whether good or bad; but in the Epistles and in the early Christian writers it is almost invariably used in a bad sense, which is the sense uniformly accepted in all subsequent theological literature.

Even in the apostolic times heresies had arisen in the Church, and before the Council of Nice the catalogue of sects had already swelled to considerable dimensions.

From the very date of the establishment of Christianity in the Roman empire heresy appears to have been regarded as a crime cognizable by the civil law; and Constantine enacted several severe laws for its repression, which were continued and extended by his successors, and were collected into a single title, 'De Hæreticis,' in the Justinian code. The penalties of heresy ordained by these enactments are very severe, extending to corporal punishment, and even to death; and they all proceed on the distinct assumption that a crime against religion is a crime against the state. These enactments of the Roman law were embodied in the various codes of the European kingdoms; in English law heresy consisted in holding opinions contrary to the faith of Holy Church. By common law the offender was to be tried in the provincial synod by the archbishop and his council, and, after conviction, was to be given up to the king to be dealt with at his pleasure. But the statute 2 Hen. IV. chap. 15 (*De hæretico comburendo*) empowered the diocesan to take cognizance of heresy, and, on conviction, to hand over the criminal directly, and without waiting for the king's writ, to the sheriff or other competent officer. This statute continued practically in force, with certain modifications, till the 29 Charles II. chap. 9, since which time heresy is left entirely to the control of ecclesiastical legislation.

The doctrines considered heretical by the Christian Church may be found in the 'Dictionnaire des Heresies,' by the Abbé Pluquet, with the history, progress, nature, and also the refutations of their errors.

Her'etic, in ecclesiastical terminology, one who embraces a heresy. It is evident that the word heretic can have only the relative meaning of heterodox. The early Christian Church always made a distinction between heretics who obstinately persisted in their heresy, and heretics merely through error, or who had been born in heresy. The fathers of the Church declare themselves ignorant of the final condition of the latter. Again, peaceable heretics are distinguished from those whose doctrines produce public confusion and disorder. However, the general view is that all heresies lead, sooner or later, to disturbances and bloodshed.

Hereward, hĕr'ĕ-ward, a Saxon yeoman who flourished about 1070. He was practically the last to withstand the Normans, holding the Isle of Ely against William the Conqueror 1070–1. After William had succeeded in reaching the refuge of the Saxon patriots, Hereward, scorning to yield, fled to the fastness of the swampy fens to the northward. He was commonly styled HEREWARD the WAKE, and his character and adventures form the theme of Charles Kingsley's popular historical romance, 'Hereward.'

Her'ford, Oliver, American humorous author and illustrator: b. England. He is at present on the staff of the 'Criterion.' Among his works are: 'Artful Antics'; 'The Bashful Earthquake and Other Fables and Verses' (1898); 'Alphabet of Celebrities' (1899); 'A Child's Primer of Natural History' (1899); 'Wagner for Infants' (1899); 'Overheard in a Garden' (1900).

Hering, Ewald, German psychologist: b. Altgersdorf, Saxony, 5 Aug. 1834. He studied medicine, and settled at Leipsic as physician in 1860; in 1862 he was lecturer in physiology at the Leipsic University, and in 1865 was professor of physiology and medico-physics in a medical school at Vienna, and in 1870 held the same chair at Prague. Hering is best known for his work in the field of psychophysics, especially for his investigations of visual space perception and for the color theory which he originated. This theory is opposed to the empiristic theory of Helmholtz and is most generally accepted by psychologists at the present time. His writings include: 'Die Lehre vom Binocularen Sehen' (1860); 'Zur Lehre vom Lichtsinne' (1872–4); 'Der Raumsinn und die Bewegung des Auges'; 'Das Gedächtniss als eine allgemeine Funktion der organisierten Materie' (1870).

Her'ing, Rudolph, American hydraulic and sanitary engineer: b. Philadelphia, Pa., 26 Feb. 1847. He was graduated at the Dresden (Germany) Polytechnic School, 1867, and became assistant engineer of Prospect Park, Brooklyn, N. Y., the following year. He was assistant engineer of Fairmount Park, at Philadelphia, 1869–71, and astronomer at Yellowstone National Park in 1872. After serving as assistant city engineer 1873–80 he opened an office for private practice in engineering and has furnished designs for sewerage and water supply for numerous towns and cities in the United States, Canada and South America. He is member of many professional societies both in Europe and America, and has written many published reports on sewerage and water supply of cities.

Heriot, hĕr'ĭ-ŏt, **George**, Scottish philanthropist: b. Edinburgh 1563; d. London 12 Feb. 1624. His father was a goldsmith in Edinburgh, and the son followed his father's profession, and was admitted a member of the Incorporation of Goldsmiths in May 1588. In 1597 he was appointed goldsmith to the queen by a charter from James VI., and on the accession of the latter to the English crown followed the court to England. From the period of Heriot's settlement in London little is known of his history. He died on 12 Feb. 1624, and was buried at St. Martin's-in-the-Fields. By his will he left nearly the whole of his fortune toward the founding and erecting of a school for poor boys in Edinburgh, styled in the bequest a "hospital." The foundation of the present structure, known as Heriot's Hospital, was laid in July 1628; and the expense of the erection exceeded £30,000 sterling. From the rise in value of property the yearly revenue of the hospital has very greatly increased; and the governors were empowered in the reign of William IV. to establish elementary schools within the city for the gratuitous education of poor children, 16 day schools being ultimately established, besides evening schools. In 1885, however, an entirely new scheme was introduced and a great part of the funds are now devoted to the support of Heriot's Hospital School and the Heriot-Watt College. The former is a day school for boys of 10 and upward, and the Heriot-Watt College is a college giving a thorough technical, commercial, and literary education chiefly by evening classes, though there are also day classes. The annual revenue is now about $150,000.

Her'kimer, Nicholas, American military officer: b. about 1715; d. Danube, N. Y., 17 Aug. 1777. He became a lieutenant of militia, served in the French and Indian war, and defended Fort Herkimer in 1758. Promoted brigadier-general of militia in 1776, he directed operations against Sir John Johnson, and when Fort Stanwix was threatened by a combined force of Indians, Tories, and regulars, advanced to its relief. He was ambushed by Col. Saint Leger at Oriskany, and one of the most closely-fought battles of the Revolutionary War followed.

Herkimer having lost a third of his force, was unable to continue, and Saint Leger's army was rendered thoroughly ineffective. Herkimer himself was wounded, and died as the result of an unskilful operation. The town and county of Herkimer, N. Y., were named in his honor.

Herkimer, N. Y., village, county-seat of Herkimer County; on the Mohawk River, the Erie Canal, and on the New York C. & H. R. railroad; about 25 miles east of Utica and 68 miles northwest of Albany. The chief manufactures are flour, furniture, mattresses, knit goods, beds, paper, creamery products, and cigars. The city owns and operates the electric plant and the waterworks. It is the seat of Folts Mission Institute. Pop. (1900) 5,555.

Her'komer, Hubert, English painter: b. Waal, Bavaria, 26 May 1849. His father, a wood carver, went to America in 1851, but returned to Europe and settled in Southampton in 1857. Hubert studied at the School of Art in that city, where he assisted in founding a life school for drawing. In 1867 he exhibited in the Dudley Gallery. From this time he gradually gained recognition as a painter in water colors, and in 1871 was elected a member of the Institute of Water Color Painters. His first picture exhibited at the Royal Academy, 'After the Toil of the Day' (1873), a German subject, attracted attention; and two years later he gained a great reputation by his famous picture representing 'The Last Master — Sunday at the Royal Hospital, Chelsea,' to which a grand medal of honor was awarded at Paris in 1878. Later pictures are: 'Eventide: a Scene in Westminster Union' (1878), "a worthy companion of the other realistic yet more heroic study of old age, which the artist made in his Chelsea Pensioners"; 'Missing: a Scene at the Portsmouth Dockyard Gates' (1881), "a masterpiece in its way"; 'On Strike' (1891), his diploma work; 'Back to Life: a District Nurse Taking out a Child for the First Walk after a Long Illness' (1896); and 'The Guards' Cheer' (1898), representing a scene in the Diamond Jubilee procession. Among many portraits painted by him the best known are those of Wagner, Ruskin, and Tennyson. His best water-color pictures are: 'Im Walde'; 'The Woodcutter's Rest'; 'The Poacher's Fate'; and 'At the Well.' Mr. Herkomer was elected associate of the Royal Academy in 1879, and full member in 1890, and from 1885 till 1895 held the Slade professorship of fine art at Oxford in succession to Mr. Ruskin. He holds a life professorship at Munich, superintends an art school founded by himself at Bushey in Hertfordshire, and for the theatre connected with it has written several plays. Herkomer also occupies a high place as an etcher and mezzotint engraver. He has published: 'Lectures on Etching and Mezzotint Engraving' (1892). See Courtney, 'Life' (1892).

Hermandad, ĕr-män-däťh', a confederation of the cities of Aragon, formed to defend themselves against the usurpations and the rapacity of the feudal nobility. This object was most clearly apparent in the brotherhood (Hermandad) formed about the middle of the 13th century in Aragon, and that formed about 1282 in Castile. In 1295, 35 cities of Castile and Leon formed a joint confederacy for the same object. These fraternities were the model of the later Hermandad of the municipal communities, which was formed in Castile under the reign of Ferdinand and Isabella. It was established in 1486 with the approbation of the king. The city authorities raised a military force, and appointed judges in different parts of the kingdom. Neither rank nor station protected the offender against the tranquillity of the country, nor could he find safety even in the churches. The Santa Hermandad (holy brotherhood) which readers of Don Quixote will be acquainted with, had, like the earlier institution, of which it was a continuation, the object of securing internal safety, and seizing disturbers of the peace and highway robbers, but did not act except in case of offenses actually committed. It consisted of a company of armed police officers, who were distributed in the different provinces of the kingdom of Castile, and whose duty it was to provide for the security of the roads outside of the cities. One of their strictest regulations was not to use their power within the cities. They were subject to the Council of Castile. The principal divisions of the company had stations at Toledo, at Ciudad Rodrigo, and at Talavera.

Hermann, hėr'man, **Alexander**, American conjurer: b. Paris, France, 10 Feb. 1844; d. near Great Valley, N. Y., 17 Dec. 1896. From his brother Carl, Alexander took his earliest lessons in sleight-of-hand and the brothers then traveled in Europe and became widely known as skilled conjurers. Coming to the United States in 1867 they met with great success. The elder presently returned to Europe, but Alexander became a citizen of the United States, made a tour of the world and had few equals in his profession.

Hermann (hĕr'män) **und Dorothea**, dŏr-ō-tā'ä, a pastoral poem by Goethe, published in 1797. It contains about 2,000 hexameter lines. The scene is the broad Rhine plain, and the time the poet's own. The standard English translation is that by Miss Ellen Frothingham (1870).

Hermann, Mo., a town in Roark Township, the capital of Gasconade County, on the south bank of the Missouri River, here crossed by a bridge, 81 miles west of St. Louis, and on the Missouri Pacific railroad. It is in a grape-vine-growing region and manufactures wine, beer, flour, tools and cigars. Pop. (1900) 1,575.

Hermannstadt, or **Nagy-Szeben**, Austria, the capital of a county in Transylvania. See SZEBEN, NAGY.

Hermaph'roditism, the occurence of both kinds of sexual glands in one and the same animal. The differentiation of the sexes begins with the polyps, when for the first time in the animal kingdom we meet with individuals which are male and female. The lower plants and in the animal kingdom the sponges and Hydra (q.v.) are monœcious, that is, sexual cells occur in the same individual. In the more highly specialized animals, the sexual glands exist in different individuals, and the form is said to be bisexual, or diœcious, as opposed to hermaphroditic forms.

True or Natural Hermaphroditism.— This is found in many flowering plants, in sponges, most cœlenterates, many worms, including the earthworm, many mollusks, and in most barnacles, and this appears to be in relation with their more or less fixed mode of life. As a rule testes and ovaries occur in the same animal, but situated in different regions of the body, while in land snails there is a hermaphroditic gland which produces spermatozoa and eggs in the same follicle. Certain animals, or frogs, which are bisexual as adults, pass through an embryonic hermaphroditism. Normal hermaphroditism is very rare in insects and vertebrates: in the latter only two cases are known, that is, a sea-perch (*Serranus scriba*) and the hagfish (*Myxine*).

Abnormal Hermaphroditism.— What in man is called hermaphroditism is a misnomer, as it arises from malformation of the external reproductive organs. In insects occurs lateral hermaphroditism in which one half of the moth or butterfly, for example, is male and the other female. In some of these cases dissection has shown that only male or female sexual glands alone occur in an undeveloped condition. This is called *gynandromorphism*. Abnormal hermaphroditism sometimes occurs in fishes and batrachians where an ovary is found on one side and a testis on the other. It is curious that in a threadworm (*Angiostomum*) and in certain isopod crustacea (*Cymothoidæ*) the reproductive glands are first male, the same gland afterward producing eggs.

Hermes, Georg, gā-ōrg' hĕr'mĕs, German theologian: b. Dreyerwalde, Westphalia, 22 April 1775; d. Bonn 26 May 1831. He studied theology at the University of Münster, became a teacher in the gymnasium of that city, and in 1807 professor of dogmatic theology in the university. When the Prussian government established the University of Bonn, Hermes was appointed to the chair of Catholic theology (1819). Here he began to distinguish himself by his attempts to found a speculative, philosophic, and dogmatic school in the church itself, delivering a series of lectures which caused great sensation by aiming at an alliance between Protestants and Catholics. This attempt to base the positive theology of the church (a doctrine known as Hermesianism) drew around him great numbers of followers. Many of these in time filled chairs of theology and set forth their views in conjunction with their master in a magazine, the 'Zeitschrift für Philosophie und katholische Theologie,' published at Cologne from 1832. The method which Hermes advocated insisted that the truth of revelation and of the Catholic Church should first be tested by reason, and that revelation should then be followed. He did not go so far as to declare that all the dogmas in themselves could be proved *a priori*, but endeavored to found the right of the church to teach them on the ground of reason. Hermesianism was in fact an ingenious effort to base the doctrines of the church on Kant's system of philosophy. It aroused powerful opposition, being condemned as heretical by a papal letter of 26 Sept. 1835. Hermes' scholars stoutly defended their orthodoxy, many of them repeatedly appealing to the pope, but without success.

Hermes, hĕr'mēz (called by the Romans *Mercurius*, and identified with their own god of that name), in Greek mythology the son of Zeus and Maia. According to legend his birthplace was in the mountains of Cyllene, Arcadia. Four hours after his birth he invented the lyre, which he made by killing a tortoise, and stringing the shell with three or seven strings. He then sang to it the loves of Zeus and his mother Maia. Having concealed the lyre in his cradle, he was seized with hunger, went in the dark evening to Pieria, and stole 50 oxen from the sacred herd of Apollo which he drove backward and forward to confound their tracks; then walking backward himself, he drove them backward also; and after having killed two of them near the river Alpheus roasted and sacrificed a part to the gods. He concealed the remainder in a cavern. He also carefully destroyed all traces of them. The next morning Apollo missed his oxen, and went in search of them, but he could discover no traces of them until an old man of Pylos told him that he had seen a boy driving a herd of oxen in a very strange manner. Apollo now discovered that Hermes was the thief. He hastened to Maia, and accused the infant, who pretended to be asleep, and, not terrified by the threat of the god that he would hurl him into Tartarus, steadily maintained his innocence. Apollo, not deceived by the crafty child, carried his complaint to Zeus. Hermes lied even to him. But Zeus perceived him to be the offender; but was not angry with him, and smiling at his cunning, ordered him to show the place where the oxen were concealed. To secure him Apollo bound his hands, but his chains fell off, and the cattle appeared bound together by twos. Hermes then began to play upon his newly-invented lyre, at which Apollo begged the instrument of the inventor, learned of him how to play on it, and gave him a whip to drive the herd, thenceforth belonging to both in common.

They then concluded a contract with each other: Hermes promised never to steal Apollo's lyre or bow; the latter gave him the *caduceus*. The ancients represent Hermes as the herald and messenger of the gods. He conducts the souls of the departed to the lower world, and is therefore the herald of Pluto, and the executor of his commands. His magic wand had the power to close the eyes of mortals, to cause dreams, and wake the slumbering. The qualities requisite for a herald he possessed in the highest perfection, and bestowed them on others — grace, dignity, and insinuating manners. He was also the symbol of prudence, cunning, and fraud, and even of perjury, and was the god of theft and robbery. In the wars of the giants he wore the helmet of Pluto, which rendered him invisible, and slew Hippolytus. When Typhon compelled the gods to fly before him and conceal themselves in Egypt, he metamorphosed himself into an ibis. He is also mentioned by Homer as the patron of eloquence, and still more particularly by Hesiod. Of his inventions Homer makes no mention. Later writers ascribe to him the invention of dice, music, geometry, the interpretation of dreams, measures and weights, the arts of the palæstra, letters, etc. He was also regarded as the patron of public treaties, as the guardian of roads, and as the protector of travelers. He was represented in art as a boy in the prime of youth, sometimes with the caduceus, and sometimes with a winged cap, standing, sitting, or walking. The artists of later times placed him among the youthful and beardless gods. The most prominent traits of his character are vigor and dexterity. In the representation of Hermes of a later date the relations of corporeal beauty and mental dexterity are wonderfully preserved. Artists made the cock his symbol, on account of its vigilance or love of fighting (in allusion to gymnastics); the tortoise, on account of his invention of the lyre; the purse, because he was the god of traffic; a ram and a goblet, because he was the director of religious ceremonies and sacrifices; the trunk of a palm-tree, upon which his statues lean, because he was the inventor of arithmetic and writing (upon palm-leaves); the *harpe* or sickle-shaped knife, because he was the slayer of Argus.

Hermes Trismegistus, trĭs-mē-jĭs'tŭs, the Greek title of the Egyptian moon god, Thoth, one of the most interesting figures in Egyptian mythology. He is represented as Ibis or with the ibis head, and is fully illustrated in the monuments and papyrus rolls from time to time brought to light. He is the god of time and of its divisions; he is the measurer and the god of measurements. He is the conductor of the dead. He is also the god of human intelligence, to whom are attributed all the productions of human art. All the literature of Egypt is attributed to him—all the writings that relate to the different sciences, mathematics, astronomy, medicine, music. These were called by the Greeks the Hermetic Books. Thoth is also credited with the invention of alchemy and magic. The Hermetic art is used to mean alchemy. The secrets of this art were handed on from teacher to pupil orally and in secret and this transmission was termed the Hermetic chain. For these reasons the Greeks identified him with their Hermes, and besides called him Trismegistus, "thrice great." By later writers, Euhemerists, Neoplatonists (q.v.), and Christians, Thoth was considered a great Egyptian king, a teacher of mankind, who had left books of magic and mystery behind him. Numerous books of such a sort once existed in Egypt. Clement of Alexandria knew of 42, and so-called Hermetic fragments are still extant, in the works of Stobæus, Cyrillus, Suidas and Lactantius. The Hermetic books as we know them belong probably to no earlier date than the 3d or 4th century of our era, and are in Greek and Latin.

Her'mit (Gr. *eremitēs*), a solitary ascetic, who, with a view to more complete freedom from the cares, temptations, and business of the world, took up his abode in a natural cavern or a rudely formed hut in a desert, forest, mountain, or other solitary place. Hermits began to appear in the Christian church in the 3d century. The advocates of asceticism (q.v.) were the first to set the example of retiring from cities to rural districts and villages. But the hermits sought to withdraw altogether from mankind, that they might give themselves up to holy contemplation. The earliest hermit is said to have been Paul of the Thebaid (Egypt), who during the Decian persecution fled to the desert (250); there he lived for the rest of his life, dying, 113 years old, about 342. The fame of his sanctity quickly incited others to imitate his mode of life. The most famous amongst these successors was St. Anthony (q.v.). At the time of his death (365) hermit cells existed in considerable numbers in the deserts of Egypt, Syria, and Palestine. The fame of their sanctity drew many to visit these hermits partly out of curiosity, to get religious advice from them, partly also in the belief that diseases were cured by their blessing. Sometimes they returned for a short time to the midst of their fellow-men to deliver warnings, instruction, or encouragement, and were received as if they had been inspired prophets or angels from heaven. But the number of hermits gradually diminished as the cenobite life of convents grew into fashion. Indeed the institution at no time secured the same footing in the Western Church that it did in the Eastern; and perhaps the reason may in part be found in the difference of climate, which renders a manner of life impossible in most parts of Europe that could be pursued for many years in Egypt or Syria. Partial revivals of the practice continued to be made, however, during some centuries, St. Cuthbert (q.v.) being a case in point. See MONACHISM, and Charles Kingsley's 'Hermits' (1869).

Hermit-crabs, crabs that shelter themselves in spiral sea-shells, for the protection of the soft-skinned and unsymmetrical abdomen. They are members of the *Macrura* (see DECAPODA), and have very large and generally unequal claws, one being used to close the entrance of the shell into which the hermit can wholly retract himself. The abdominal appendages are practically aborted, with the exception of those at the tip of the tail, which hold firmly to the spire of the inhabited shell. The hermit-crabs belong to three families, namely: *Paguridæ*, or common marine hermit-crabs; *Parapaguridæ*, or deep-sea hermit-crabs; and *Cenobitidæ*, or terrestrial hermit-crabs. Two species are numerous on the American Atlantic coast running actively about in rock pools and shallows. The little hermit-crab (*Eupagurus longicarpus*) generally inhabits the shells of dog-whelks (*Ilyanassa*), while the larger species (*E. pollicaris*) occupies those of *Lunatia* or sometimes of the winkles and conchs. As they grow they must move to larger and larger shells, and the search for new tenements and dangerous change of abodes in the presence of enemies makes the life of one of these animals more than ordinarily exciting. The habits of these and other hermit-crabs are of great interest, generally, and especially on account of the various hydroids, anemones and mollusca which associate with them as commensals. The palm or robber-crab (q.v.) of the East Indies, and the land-crabs of the West Indies, are good examples of terrestrial hermit-crabs. Consult J. R. Henderson, 'Challenger Report on Anomura'; Verrill, 'Invertebrates of Vineyard Sound' (1875); Arnold, 'Sea Beach at Ebb tide' (1901). See COMMENSALISM, CRAB, CRUSTACEA.

Hermit Thrush. See THRUSH.

Her'mitage, The, Andrew Jackson's home at Nashville, Tenn., from about 1804, when he removed there from Hunter's Hill. In 1819 the house was built in which he lived till his death in 1845. The Hermitage is now the property of the State of Tennessee.

Hermite, Charles, shärl ăr-mēt, French mathematician: b. Dieuze, Meurthe, German Lorraine, 24 Dec. 1822; d. Paris 14 Jan. 1901. He entered the Ecole Polytechnique in 1842, but left it to devote his attention wholly to mathematics. From 1876 to his death he held the chair of higher algebra in the University of

Paris. His principal claim to be considered a great and original mathematician rests on his investigations in the line of functions, and his first important work on this theory won for him election to the Academy of Sciences. He proceeded to make discoveries in the theory of algebraic forms and in the theory of numbers. He finally settled the question of the solubility of the quintic equation, and really led the way to Lindemann's further investigations. For a list of his writings see 'Catalogue of Scientific Papers of the Royal Society of London,' Vols. III. and VII.

Hermosillo, här-mō-sēl'yō, Mexico, capital of the state of Sonora, on the river Sonora, about 60 miles from the Gulf of California, and 78 by rail north from the port of Guaymas, with which it has a large traffic, being the principal entrepôt for the trade with the interior. Large quantities of fruit are grown in the vicinity, especially grapes, from which much brandy is made. Pop. (1903) 17,800.

Hern'don, William Henry, American lawyer: b. Greensburg, Ky., 28 Dec. 1818; d. near Springfield, Ill., 18 March 1891. He studied at Illinois College, was admitted to the bar in 1844, and in the same year formed a law partnership with Abraham Lincoln, which continued formally till the latter's death. He was mayor of Springfield, Ill., in 1855. With J. W. Weik, he wrote the well-known 'Herndon's Lincoln: The True Story of a Great Life' (in a new ed. 1891), which is particularly valuable for the study of Lincoln's personality and the details of his early career.

Herne, James A. (James Aherne), American actor and playwright: b. Troy, N. Y., 1 Feb. 1840; d. New York 2 June 1901. He first appeared in a traveling company, and later in various roles and organizations throughout the United States. Later he was actor-manager at San Francisco, and in 1878 presented his first play, 'Hearts of Oak,' which won immediate success. 'Drifting Apart' (1885), 'The Minute-Men' (1886) and 'Margaret Fleming' (1890) were less favorably received, although the last was highly ranked by the critics. In 1883-4 Herne wrote his most successful work, 'Shore Acres,' which was first performed as 'The Hawthornes' at Chicago in 1892, and in 1892-3 in Boston under its present title. He himself appeared as 'Uncle Nat' Berry. 'Shore Acres' was followed by 'The Rev. Griffith Davenport' (1899), a dramatization of Helen Gardner's 'An Unofficial Patriot,' and 'Sag Harbor' (1900). As both actor and dramatist Herne was a skilful delineator of types of everyday life.

Her'nia (Latin, a rupture, a burst, a descent), a swelling formed by the displacement of a soft part, which protrudes by a natural or accidental opening from the cavity in which it is contained. The three great cavities of the body are subject to these displacements. The brain, the heart, the lungs, and most of the abdominal viscera may become totally or partially displaced, and thus give rise to the formation of hernial swellings. Displacements of the brain and of the organs of the chest are, however, extremely rare, and are in general the result or symptom of some accident or disease. Many parts of the abdominal wall may become the seat of hernias, but they most commonly appear in the front lower regions, which, being destitute in great measure of muscular fibres, and being the site of many of the openings leading from the abdomen to the limbs, offer less resistance to the displacement of the viscera. Hernias are most common in the groin, at the navel, more rarely in the vagina, at the interior and upper part of the thigh, and at its lower and posterior part. They have received different names from their positions. All the abdominal viscera, with the exception of the duodenum, the pancreas, and the kidneys, may form a hernia, but they are not all displaced with the same facility. The omentum and intestinal canal escape easily; the stomach, liver, and spleen rarely form hernias. Most of the viscera, when displaced, push the peritoneum forward before them; this membrane thus forms a covering to the hernia, which is called the hernial sac. If the hernia, with its sac, can be entirely replaced, it is said to be reducible; if, from its size or other cause, it cannot be restored to its former place, it is irreducible.

Among the predisposing causes of hernia may be ranked any circumstance which diminishes the resistance of the abdominal walls, whether natural or accidental; such as muscular weakening of those walls by a forced distention, as in pregnancy, by accidents, by lifting heavy weights, or by excessive standing. Any prolongation of the viscera which tends to bring them in contact with points at which they may protrude, and articles of dress which push the organs toward the weaker parts of the abdominal wall (as corsets), may also produce hernia. The efficient causes of hernia are all circumstances which may break the equilibrium existing between the abdominal walls and the viscera, which react and mutually press upon each other. The simultaneous contraction of the abdominal muscles and of the diaphragm, which takes place on every violent effort, is one of the chief of these cases. Hence sneezing, coughing, leaping, playing on wind-instruments, etc., may be the direct cause of a hernia.

The symptoms of a hernia are the existence of a tumor or swelling at any point of the abdomen, but more particularly in the region of the groin. A reducible hernia is not a very troublesome disease, but may become so by acquiring an increase of size, and by strangulation. A hernia is said to be strangulated when it is not only irreducible, but also subjected to a continual constriction; this constriction may be produced by different causes, but it is generally a constriction at the opening through which the hernia protrudes. As soon as a patient perceives that he is affected with a hernia he should have recourse to medical advice, for the disease is then in its most favorable state for treatment. The hernia is immediately reduced, and must then be subjected to a constant compression. This is done by means of a truss (q.v.). An irreducible hernia must be supported with great care. All violent exercises and excess in diet must be avoided. Strangulated hernia, presenting greater danger, requires more prompt relief. The object of treatment is to relieve the constriction. If the reduction cannot be effected by other means, an operation will be necessary. This consists in dividing the parts which produce the constriction. The longer this operation is delayed, the more dangerous it will become. After the parts are healed, the opening must be subject to compression, as in the case of a simple hernia. Radical operation for hernia is the most advisable form of treatment. It is safe in the hands of a competent surgeon.

Hero, a priestess of Aphrodite at Sestos. The loves of Hero and Leander, a youth of Abydos, on the other side of the Hellespont, are related in a poem by Musæus. No difficulties could discourage Leander. He swam every night across the Hellespont, guided by a torch which shone across the strait from the tower of Hero, and even continued his visits during the winter. On one occasion, however, the guiding light was extinguished, and his strength failed him, and the waves carried his body to the foot of the tower, where Hero anxiously awaited him. Overcome with anguish at the sight, she threw herself from the tower and perished.

Hero of Alexandria (Gr. *Herōn*), Greek mathematician and natural philosopher; fl. perhaps in the 1st century A. D. He seems to have invented a number of machines, among which are "Hero's fountain," and a steam-engine on a principle similar to that of Barker's mill (q.v.). He also made some contributions to pure mathematics. Hultsch edited the remaining fragments of his geometrical works in 1864, and Schmidt began in 1899 an edition of his complete extant writings. See HERO'S FOUNTAIN.

Herod, called THE GREAT, king of the Jews: b. about 62 B.C.; d. 4 B.C. He reigned from 37 B.C. until his death. He was the second son of Antipater the Idumean, who, being made procurator of Judea by Julius Cæsar, appointed him to the government of Galilee. He at first embraced the party of Brutus and Cassius, but after their death reconciled himself to Antony, by whose interest he was first named tetrarch, and afterward king of Judea. After the battle of Actium Augustus confirmed him in his kingdom. As a politician and commander, his abilities were conspicuous. He rebuilt the temple at Jerusalem with great magnificence, and erected a stately theatre and amphitheatre in that city, in which he celebrated games in honor of Augustus, to the great displeasure of the more zealous of the Jews. He also rebuilt Samaria, which he called Sebaste, and adorned it with very sumptuous edifices. He likewise, for his security, constructed many strong fortresses throughout Judea, the principal of which he termed Cæsarea, after the emperor. On his palace, near the temple of Jerusalem, he lavished the most costly materials, and his residence of Herodium, at some distance from the capital, by the beauty of its situation, drew around it the population of a great city. Such, indeed, was his magnificence, that Augustus said his soul was too great for his kingdom. Herod was the first who shook the foundation of the Jewish government, by dissolving the national council, and appointing the high-priests, and removing them at pleasure, without regard to the laws of succession. His policy, ability, and influence with Augustus, however, gave a great temporary splendor to the Jewish nation.

Herod Agrip'pa I., king of Judea: d. Cæsarea 44 A.D. He reigned from 37 A.D. until his death. He was son of Aristobulus. At Rome with Drusus, son of Tiberius, on whose death he left Rome for Idumæa; but returned some years after. On the accession of Caligula 37 A.D. he was honored with the title of king, and received the tetrarchies of Philip and Lysanias, and later that of Antipas. Upon the accession of Claudius his rule was extended to include all the dominions of Herod the Great. It was this Herod who, to please the Jews, caused St. James to be put to death, and St. Peter to be imprisoned. His power and opulence acquired him a great reputation, and he really did much for the benefit of the Jews. His death is described in Acts xii. 20–3.

Herod Agrippa II., king of Judea: d. 100 A.D. He reigned from 53 A.D. until his death. He was son of Herod Agrippa I. He resided much at Jerusalem, and here, together with his sister, Berenice, heard the defense of Paul, addressed to the Roman governor Festus (Acts xxv. 13–xxvi. 32). A great builder, he improved his capital city of Cæsarea Philippi; renamed by him Neronias. It was in his reign that the Temple was completed. Being driven from Jerusalem in the revolt which proved so fatal to the Jews, he joined Cestius, the Roman commander, and, when Vespasian was sent into the province, met him with a considerable reinforcement. During the siege of Jerusalem he was very serviceable to Titus.

Herod An'tipas, tetrarch of Galilee. He reigned from 4 B.C. to 37 A.D. He was son of Herod the Great. This was the Herod who put to death St. John the Baptist (Mark vi. 14–29), in compliment to his wife Herodias, and it is he who is the familiar 'Herod' of the New Testament narrative. Accused of having been concerned in the conspiracy of Sejanus, and of being in secret league with the king of Parthia, he was stripped of his dominions, and sent (39 A.D.) with his wife into exile at Lugunum (Lyons), or, as some say, to Spain, where he died.

Herodes, Atticus. See ATTICUS HERODES.

Hero'dias, a granddaughter of Herod the Great and Mariamne, daughter of Aristobulus and sister of Herod Agrippa I. She was first married to her half-uncle Herod Philip, whom she abandoned to connect herself with his half-brother Herod Antipas. It was by her artifice that Antipas was persuaded to order the death of John the Baptist (Matt. xiv. 3–12; Mark vi. 17–29).

Herod'otus, Greek historian, called the "father of history": b. at Halicarnassus in Asia Minor about 484 B.C. Before writing his history he traveled extensively, visiting the shores of the Hellespont and the Euxine, Scythia, Syria, Palestine, Babylon and Ecbatana, Egypt as far as Elephantine and other parts of northern Africa, everywhere investigating the manners, customs, and religion of the people, the history of the country, productions of the soil, etc. On returning home he found that Lygdamis had usurped the supreme authority in Halicarnassus, and put to death the noblest citizens, and Herodotus was forced to seek an asylum in the island of Samos. Having formed a conspiracy with several exiles he returned to Halicarnassus and drove out the usurper, but the nobles who had acted with him immediately formed an aristocracy more oppressive than the government of the banished tyrant, and Herodotus withdrew to the recently founded colony of Thurii, in Italy, where he seems to have spent most of his remaining life. Here, at an advanced age, we are told by Pliny, he wrote his immortal work, a statement strengthened by the fact that events are noticed in the body of the book which occurred so late as 409 B.C., while its abrupt ending proves almost beyond question that he was prevented by death from completing it. The history is divided into nine books, each bearing the name of a Muse, and is written in the Ionic dialect. The object of the historian is to narrate the conflict between the Greeks and Persians, and he traces the enmity of the two races back to mythical times. Passing rapidly over the mythical period he comes to Crœsus, king of Lydia, of whom and of his kingdom he gives a comparatively full history. The conquest of Lydia by Cyrus induces him to relate the rise of the Persian monarchy and the subjugation of Asia Minor and Babylon. The history of Cambyses and his Egyptian expedition leads him to introduce the valuable details of the history, geography, and manners and customs of Egypt, occupying the second book. The Scythian expedition of Darius causes the historian to treat of the Scythians and the north of Europe; and the subsequent extension of the Persian kingdom affords him opportunity for an account of Cyrene and Libya. In the meantime the revolt of the Ionians breaks out, which eventually brings on the conflict between Greece and Persia. An account of this outbreak and of the rise of Athens after the expulsion of the Pisistratidæ, is followed by what properly constitutes the principal part of the work, and the history of the Persian war now runs on in an uninterrupted stream until the taking of Sestos. There are English translations of his history by Macaulay (1890); Beloe, Cary, and Rawlinson, the last with important notes and dissertations. The 'Life of Homer,' attributed to Herodotus, and printed at the end of several editions of his works, is now universally believed to be a production of a later date. The best editions of the history of Herodotus are by Wesseling (1763); Schweighäuser (1806); Bähr (1855-61); Stein (1871).

Heroin, hĕr'ō-in, $C_{17}H_{17}NO_3(CH_3CO)_2$, the diacetic ester of morphine. It occurs as a faintly bitter, colorless, odorless, crystalline powder, which is nearly insoluble in water. It is soluble in dilute acids, however, and is precipitated by alkalies. Its hydrochloric dissolves freely in water and in alcohol, but is insoluble in ether. Heroin was first prominently introduced to the medical world in 1898.

Herold, Louis Joseph Ferdinand, loo-ē zhō-zĕf fĕr-dē-nań ā-rōld, French musical composer: b. Paris 28 Jan. 1791; d. Thernes, near Paris, 19 Jan. 1833. A pupil of the Conservatoire, he also studied composition under Catel, Mehul, and Cherubini, and in 1812 won the Prix de Rome with the cantata 'Mlle. de la Vallière.' His first opera, 'La Gioventú di Enrico Quinto' (1815) was received by the Neapolitan public with applause. His first serious effort as composer for the French stage was with his comic opera 'Les Rosières' (1817). This very successful work was followed in quick succession by numerous others of varying fortune. At last in 1831 appeared his 'Zampa,' and in 1832 his 'Le Pré aux Clercs,' the operas on which his fame chiefly rests, and which have gained a permanent place, the former especially being still produced with acceptance in the principal cities of the Continent. Consult: Jouvin, 'Herold sa Vie et ses Œuvres' (1868).

Heron, Matilda, American actress: b. Draperstown, near Londonderry, Ireland, 1 Dec. 1830; d. New York 7 March 1877. She was brought to the United States as a child, and appeared on the stage for the first time in Philadelphia as Bianca in 'Fazio.' Her chief parts, in which she met with great success throughout the United States, were Camille in 'La Dame aux Camélias'; and Ulah in 'De Soto.'

Herondas, or **Herodas**, Greek poet, probably flourishing about the latter half of the 3rd century B.C. Little positive information is obtainable concerning the place of his birth, but it was probably in the island of Cos. Prior to 1891 only a few fragments of his verses had been found, but in that year an Egyptian papyrus was found containing several poems (mimes or mimianibi) and these were published by F. G. Kenyon, thus bringing to light a phase of Greek life and times of which the history has been meagre. Seven of the poems are in comparatively complete form, and, besides giving an insight into Heronda's life and work, they picture the every day life of the times in extremely realistic terms, though the satirical portions of them are not personal in their nature. In composition the mimes are in choliambic verse or iambic trimeter and are written in the Ionic dialect. The latest edition containing additions by O. Crusius was published in 1898, entitled 'Untersuchungen zu den Mimiamben des Herondas.' See MIME.

Herons, wading birds of the order *Herodii*, forming, with egrets and bitterns, the family *Ardeidæ*. The family is characterized by a thin, compressed body; a long, thin neck; a straight, narrow, pointed beak; fully feathered head; longish, slender legs; three toes in front, the two outer united by a membrane, the middle claw pectinate; large, blunt wings; extensive development of powder-down tracts; and often by elongated feathers of the top of the head and other parts. Upward of 70 species of herons and their immediate allies are known, of which 14 inhabit North America. The bitterns (q.v.), with 10 tail-quills, form the sub-family *Botaurinæ*, the herons and egrets (q.v.), with 12 tail quills, the *Ardeinæ*. Egrets are simply white herons. The great blue heron (*Ardea herodias*) to which *A. cinerea* of Europe is closely related, inhabits all parts of North America and northern South America. It is a large bird with a length of about four and a spread of nearly six feet, and of beautiful slate-blue color, with the long flowing plumes black. It is to be found by the side of streams, lakes and the seashore, usually alone. Fish form the bulk of its food, but it also devours frogs, small reptiles, insects, and almost any kind of animal which it can capture. It roams in search of food mostly in the morning and evening. The heronry, or breeding-place, is usually found among high trees, and the same breeding-place is used by successive generations if they are unmolested; frequently several species of herons consort together at a favorite breeding-place. The large nest is made of twigs and sticks, and is lined with rushes, grass, and various similar materials. The eggs, usually three or four in a nest, are of a fairly uniform greenish blue color. Many nests are usually found in one heronry, and sometimes the nests are built on the ground or on a cliff. The cry is a sort of "crank, crank," uttered in a hoarse voice. In the North the blue heron is migratory, elsewhere it is resident. The little blue heron (*A. cærulea*) is found in the eastern United States from the Middle States southward and in the West Indies and Central America. It is scarcely more than one half the size of *A. herodias* and exists in two color phases, the one dark slate-blue with purplish reflections on the head and neck, the other white with traces of blue, especially constant on the unfeathered parts. This species formerly bred with other southern species in great heronries, most of which have been decimated by plume-hunters.

The little green heron or fly-up-the-creek (*Butorides virescens*) ranges throughout temperate North America and somewhat beyond southward, breeding nearly everywhere. Northward it is migratory and is the familiar heron about the streams and ponds of the Middle and New England States, where it usually nests in pairs or small communities and mostly in thick bushes or cedar trees; in other localities it sometimes breeds with larger species in heronries. The pale greenish elliptical eggs are from three to six in number. Its foods consist chiefly of small frogs, minnows and snakes, for which it searches by day as well as by night along the shallows of streams, where its harsh cry of alarm is often the first intimation of its presence. The name refers to the beautiful deep bronze green color of the upper parts.

The night-herons (*Nycticorax nævius*, and *N. violaceus*), which are closely related to the *N. grisea* of Europe, are easily distinguished from other herons by the thick, stout beak. The former, known as the black-crowned night-heron or squawk, is common throughout the United States and Canada in summer, and in the winter migrates far into South America, while the latter, or yellow-crowned species, is much less frequent and chiefly confined to the sea-coast of the warm parts of America. The squawk is about two feet long, the young brownish, the adults deep green and blue-gray above with two or three very long filamentous white occipital plumes. The night-herons are more active after dark than any other species, and are seldom seen abroad, except in the dusk or on cloudy days.

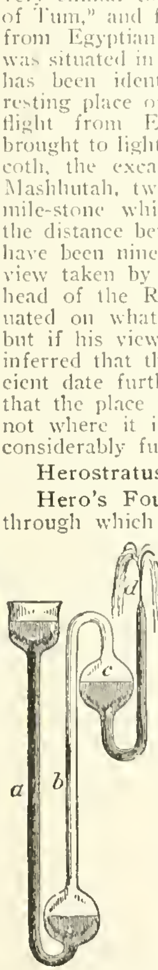
Many species of herons reside in the warm parts of Africa and Asia, among them being the largest of all, the *A. goliath*.

Consult Baird, Brewer and Ridgway, 'Water-birds of North America' (1884); Reichenow, 'Journal of Ornithology' (1877); Job, 'Among the Waterfowl' (1902). See BITTERN; EGRET.

Heroöpolis, an ancient Egyptian city found by excavation in the eastern Delta region. Maps made prior to 1880 generally located the city near the present city of Suez, but the excavations of Naville in 1883 under the auspices of the Egypt Exploration Fund tend to show that the city was farther north. Heroöpolis is given in the Septuagint version of the Old Testament as the meeting place of Joseph and Jacob. The Coptic translation is Pethom, very similar to the Hebrew Pithom, or "House of Tum," and for some time it has been known from Egyptian geographical lists that Pithom was situated in the land of Theku-t. This name has been identified with Succoth, the second resting place of the Children of Israel in their flight from Egypt. The Naville excavations brought to light the old site of Pithom and Succoth, the excavations being made at Tell el-Mashhutah, twelve miles west of Ismailah. A mile-stone which was recovered then showed the distance between Heroopolis and Clysma to have been nine miles. This would confirm the view taken by Strabo that the city was at the head of the Red Sea navigation and was situated on what he called "Heroöpolitan Gulf," but if his view be correct, then it can only be inferred that the Red Sea extended at that ancient date further north than it now does and that the place where the Israelites crossed was not where it is generally supposed to be, but considerably further north.

Herostratus. See EROSTRATUS.

Hero's Fountain, a pneumatic apparatus, through which a jet of water is supported by condensed air. A simple mode of constructing it by means of glass tubes and a glass-blower's lamp is shown in the annexed figure. The column of water in the tube *a* compresses the air in *b;* this presses on the surface of the water in *c*, and causes it to gush out at *d*.



Hero's Fountain.

Herpes, an acute, non-contagious, inflammatory disease of the skin, characterized by an eruption of one or more clusters of vesicles upon a reddened base. Several forms of the disease are recognized by dermatologists, of which the commonest are facial herpes, and herpes zoster. Facial herpes constitutes the common fever blister, or cold sore, and is usually seen about the mouth, though it also occurs on other parts of the face. There is often some slight constitutional disturbance preceding the eruption, which first makes its advent known by a sensation of burning or itching in the part, followed by reddish discoloration of the skin and after a few hours by a number of pin-head to pea-sized blisters filled with clear or turbid fluid. After a few days these dry up and form a yellowish crust, which then falls off, leaving a red spot that soon disappears. The usual duration of the disease is about a week and it shows a strong tendency to recur. Herpes often accompanies febrile conditions such as pneumonia and malaria, and a similar lesion is not rare about the genitals. Herpes occurs mostly in those whose skin is irritable or delicate, and is usually the result of some derangement of the mucous membrane of the respiratory, digestive or genito-urinary tract. It sometimes is the unfailing harbinger of the menstrual period. Cold, mental depression, and injury or irritation of the skin are other causes. The disease belongs to the class of the neuroses, and in some instances its presence can be explained only on the basis of nerve disturbance. In most cases no treatment is required, as the lesions promptly heal of their own accord, but soothing ointments or lotions tend to relieve the irritation. Herpes zoster, or shingles, is a special form remarkable for the fact that the eruption follows the course of certain nerves, and is usually disposed around one side of the body like a half belt. In rare cases it encircles the body. Its onset is preceded by stinging neuralgic pains, and by languor, lassitude, loss of appetite, shiverings, headache, nausea, quickened pulse, etc., after which the eruption appears in irregular patches. The vesicles become enlarged to the size of small peas in twenty-four to thirty-six hours, and fresh clusters occur for three or four days, completing the belt-like appearance. As the eruption recedes, by the fifth or sixth day, the vesicles become white and opaque, and the red margins grow livid or purple. Sometimes the vesicles burst, and several of the patches run together, forming irritable sores, discharging a thin serous fluid, which concretes and forms a crust that falls off as the parts beneath heal. The disease occasionally follows injuries to the nerves, and it is common in damp, cold weather of spring or autumn, when it sometimes occurs in epidemics. It is sometimes produced by sudden exposure to cold after violent exercise, and sometimes follows acute affections of the respiratory organs. The treatment consists in attention to any systematic derangement present and in the local use of soothing applications, and protective dressings to prevent rupture of the vesicles. The duration of shingles is usually from ten days to three weeks. Most cases run a favorable course and second attacks are rare.

Herpestis, a genus of dicotyledonous gamopetalous plants, of the natural order *Scrophularineæ,* of the tribe *Gratioleæ,* native to the tropical sections of both hemispheres. It may be distinguished by its calyx, as the upper segment is large and ovate, and covers the rest, the other lobes narrow or linear, its cylindrical corolla, four stamens, and two or four-valved capsule. The genus comprises about fifty species of small, creeping herbs, having opposite, or toothed leaves, and generally flowering solitary or in axillary clusters of yellow, blue or white flowers. *H. Monniera* is the common water hyssop, and the natives of India find the juice of this plant, when mixed with petroleum, of great benefit to parts of the body affected with rheumatism. *H. colubrina,* a native to Peru, is used, under the name of *yerba de culubra,* as a remedy for the bites of poisonous animals.

Herpetology, hėr-pē-tŏl'ō-jĭ, the study of reptiles. In its earlier days it included under the term "reptile" not only those now properly so named, but the amphibia (q.v.) and some other "creeping things" not in either group. Cuvier's classification, the first approach to a scientific one, put both the true reptiles and the amphibians as co-related groups under *Reptilia;* but their formal distinction was soon perceived. Huxley showed that in their descent, embryology and structural relations, the amphibians were more closely related to fishes than to the reptiles (lizards, serpents and turtles). He therefore united the two in a superior group *Ichthyopsida,* while he joined the birds to the reptiles in a group of similar rank called *Sauropsida.* Thus the limits of herpetology have been restricted to truly scientific limits,— the chordate class *Reptilia,* a definite group distinguished by the following characters:

Reptiles are cold-blooded, the temperature of the body not greatly exceeding that of the surrounding medium: the heart is three-chambered, except in crocodilians, where four chambers first occur; mostly venous blood goes from the heart to the anterior viscera, and mixed blood to the posterior region, only the head and anterior regions receiving purely arterial blood: the body is covered with scales, with which subjacent bony plates or scutes are sometimes associated: the vertebræ are absolutely gastrocentrous (biconcave); the skull articulates by a single condyle with the backbone, and the lower jaw works against the quadrate bone; the great majority are oviparous, while in some the eggs are hatched within the mother.

This characterization unites into the one class, many orders of wholly extinct types, one order represented by a single living example (the tuatara "lizard"), and the existing tortoises and turtles, lizards, snakes, and crocodiles; and none other is a reptile, properly speaking. The group occupies a central position in the vertebrate series. Above it on the scale of organization are the birds and mammals; beneath it the amphibians and fishes. Similarly reptiles stand in a middle position in geological history, as the Mesozoic, or Secondary Period, was that in which the group flourished, and of which the existing forms are, on the whole, the diminished and degraded remnants. In respect to their phylogeny: "On the one hand, there is not the slightest doubt," declares Gadow, "that they are evolved from some branch of the Stegocephali (q.v.), whilst on the other hand the reptiles, probably through some branch of the Theromorpha, have given rise to the mammals; some other reptilian branch, at present unknown, blossomed out into birds."

Classification.—The most recent classification of the reptiles, perfected since about 1875 by the enormous amount of information collected in all parts of the world, and especially in the western United States, in regard to fossil forms (see PALÆONTOLOGY), is that formulated by H. Gadow ('Amphibia and Reptiles,' 1901), expressing substantially the consensus of all specialists, and is as follows:

CLASS REPTILIA.

SUBCLASS I. *Proreptilia.*—Permian reptiles in which the components of the vertebra remain separate; well developed limbs and girdles fitted for a terrestrial life. The fragmentary remains of these animals are hard to separate definitely from the Stegocephali.

SUBCLASS II. *Prosauria.*—Chiefly extinct reptiles with deeply amphicœlous vertebræ whose parts are still unfused; movable chevron bones occur in the tail and frequently, with intercentra, in the trunk.

Order I.—*Microsauri.*—Small Carboniferous and Permian reptiles with dermal armor on the dorsal and ventral side of the trunk and tail; and ribs with head and tubercle. The armor of the skull, and the flat ischia and pubes of the pelvis resemble the condition in Stegocephali.

Order 2.— Prosauri.— Permian to recent, terrestrial, unarmored, generalized reptiles, of which one species (*Sphenodon*, or *Hatteria, Punctatum*) still persists in New Zealand (see TUATARA). This animal is distinguished from the lizards with which it was formerly placed by many skeletal characters, such as the fixed quadrate bone and the broad bony roof of the mouth.

SUBCLASS III. *Theromorpha.*— Fossil reptiles with fixed quadrate bone, only one temporal arch, and having pubes and ischia united ventrally in one broad symphysis. This group has an especial interest because it is probably the one from which mammals sprang, and flourished between the Permian and Triassic ages. See THEROMORPHA.

SUBCLASS IV. *Chelonia.*— Reptiles with an upper and lower bony shield, four feet, and toothless jaws — the turtles. There are two orders, *Athecæ* and *Thecophora*. See CHELONIA.

SUBCLASS V. *Dinosauria.*— Mesozoic reptiles, having a long tail, powerful hind legs, fixed quadrate bones, and bifurcated ribs. It is divisible into several orders. See DINOSAURIA.

SUBCLASS VI. *Crocodilia.*—Four-footed, long-tailed reptiles, with fixed quadrate bone, teeth in alveolæ and confined to jaws; ischia not united by a symphysis. The group had its origin in the Dinosauria, from which it is difficult sharply to separate it, arose in the Mesozoic era, and the early forms were marine. The strict *Crocodilia* first appeared in the lower Jura, and have evolved along two parallel lines of advance, one of which ends in the recent long, sharp-snouted gavials, and the other in the broad, short-snouted crocodiles and alligators (qq.v.). The skin is covered with horny scales or scutes which, in some fossil species formed an osseous armor. The front nasal openings lie on the dorsum of the snout near its apex, and their hinder ends are carried by the broad and deep palate far back into the throat. By this means the alligator can lie submerged with its mouth open so as to bring the nostrils to the surface and thus breath without carrying water into the windpipe. The lungs are large and of complicated structure. The heart has practically four chambers as in mammals. There are three orders: *Pseudosuchia*, early generalized forms, expiring in the Jurassic age; *Parasuchia*, extinct forms of the Jurassic and Triassic periods (See CROCODILE, FOSSIL; BELODON); *Eusuchia*, modern crocodilians. See CROCODILE.

SUBCLASS VII. *Plesiosauria.*—Mesozoic reptiles, with pentadactyle appendages adapted to life in water; fixed quadrate bones, numerous alveolar teeth, and ribs without tubercles. They apparently filled the place of the dolphins of to-day, except that the neck is in most species extremely long. See PLESIOSAURIA.

SUBCLASS VIII. *Ichthyosauria.*— Mesozoic, marine, whale-like, viviparous reptiles, with appendages transformed into paddles. The teeth are conical, lie in a groove and are very numerous. See ICHTHYOSAURIA.

SUBCLASS IX. *Pterosauria.*— Mesozoic aërial reptiles with fixed quadrate and anterior appendages forming wings — the pterodactyls. See PTEROSAURIA.

SUBCLASS X. *Pythonomorpha.*—Elongate marine cretaceous reptiles with movable quadrate bones; appendages shaped like paddles, teeth fused with jaws. Two orders, *Dolichosauri* and *Mosasauri*. See MOSASAURS.

SUBCLASS XI. *Sauria.*— Reptiles with movablt quadrate bones and transverse cloacal opening; the most recent of the reptiles, probably originating in the *Prosauria*. It contains two orders: *Lacertilia* (geckos, lizards, and chameleons); and *Ophidia* (snakes).

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Herrera, Francesco de, frän-thĕs'kō dā är-rā'rä, called EL VIEJO (the Elder), Spanish painter: b. Seville 1576; d. Madrid 1656. He broke with the Italian traditions of Spanish painting and became the founder of the Spanish national school. He also worked in bronze, and it was this probably which gave rise to the charge that he was connected with counterfeiters. He had a disposition so very detestable that his pupils, of whom Velasquez was one, all left him. The Louvre contains some of his works, among others 'The Israelites Gathering the Quail in the Wilderness.' But the best are at Seville, including the 'Last Judgment,' in the Church of San Bernardo; 'Saint Peter,' in the Cathedral; and 'Moses Smiting Water from the Rock,' one of four large canvases in the archiepiscopal palace. His frescoes at both Madrid and Seville have quite disappeared.

Herrera, Francesco de, called EL MOZO (the Younger), Spanish painter: b. Seville 1622; d. Madrid 1685. He studied art under his father, Francesco, called El Viejo (q.v.) (to whom he was very far inferior as a painter), and remained some years at Rome. He was a founder of the Seville Academy (1660), and became its vice-director. Subsequently he was appointed court-painter to Philip IV. In the Seville Museum is his 'Four Doctors of the Church Adoring the Host'; in the Prado Museum, 'Saint Hermenegild.' During his residence in Italy he painted fish with such success that he was known there as 'Lo Spagnuolo dei Pesci.'

Herrera, José Joaquin de, hō-sā' hō-ā-kēn, Mexican military officer: b. Jalapa 1792; d. Tacubaya 10 Feb. 1854. He joined the Mexican army in 1809, and in 1821 was promoted brigadier-general. He aided in overthrowing Iturbide, when the latter became emperor, and was successively minister of war and president of the supreme court. President for a brief period in 1845, he again held office in 1848–51. During the war with the United States, he was aide to General Santa Anna.

Herreshoff, hĕr'rĕs-hŏf, **John B.**, American shipbuilder: b. Bristol, R. I., 1841. Under his management the Herreshoff Manufacturing Company succeeded Edward Burgess in designing and building the fastest yachts in the world. Although he has been blind since the age of 15, he has always been active in business.

Herreshoff, Nathaniel Greene, American shipbuilder: b. Bristol, R. I., 1848. He was educated at the Massachusetts Institute of Technology, and was graduated Sc. M., at Brown University. He is superintendent of the Herreshoff Manufacturing Company, and has designed many torpedo-boats and yachts, notably those sloops which have engaged in the international races of recent years.

Her'rick, Christine Terhune, American writer on domestic economy: b. Newark, N. J., 1859. She has published: 'Housekeeping Made Easy' (1888); 'The Little Dinner'; 'Liberal Living Upon Narrow Means'; 'First Aid to the Young Housekeeper' (1900); 'The Expert Maid-Servant' (1902); 'Consolidated Library of Modern Cooking and Household Recipes' (1905); etc.

Herrick, Clarence Luther, American college president: b. Minneapolis, Minn., 21 June 1858: d. 1903. He was graduated from the University of Minnesota in 1880, and after holding professorships at Denison University, Ohio, and the University of Chicago, became president of the University of New Mexico at Albuquerque.

Herrick, Myron T., American capitalist and politician: b. Huntington, Lorain County, Ohio, 1854. He studied at Oberlin College and Ohio Wesleyan University, went to Cleveland in 1875, and taking up the study of law was admitted to the bar in 1878. He soon gave up the profession of law, however, and organized the Euclid Avenue National Bank, from this time onward being prominent in financial circles. At first secretary of the Society for Savings Bank in Cleveland, he became its president in 1894, and has been connected with various railroad and other large financial enterprises. He has taken a keen interest in national and local politics from a Republican standpoint, in 1903 was elected governor of Ohio, but in 1905 was defeated by John M. Pattison.

Herrick, Robert, English poet: b. London, Aug. 1591; d. Dean Prior, Devonshire, October 1674. His father, Nicholas Herrick, was a goldsmith; through inheritance and training the son was enabled to transfer to the making of verse the exquisiteness of his father's craft. Shortly after Robert's birth the elder Herrick made his will, and two days later he died, under circumstances that suggested suicide. To his wife and his seven children he left a small property.

After a few years, perhaps at Westminster School, and a brief apprenticeship to his guardian uncle, William Herrick, also a goldsmith, the poet entered Cambridge University, at first enrolling himself in Saint John's College. Two years later he removed to Trinity Hall, intending to study law. During his residence he seems, from letters to his guardian, to have frequently needed money, and he left the university in debt. He took his degree of B.A. in 1617, and of M.A. in 1620.

Few facts remain of his next years. He went to London and associated with the poets of the time, admirers of Ben Jonson, and he himself wrote verse. The words of two New Year anthems set to music by Henry Lawes were his; through the friendly influence of prominent men at court, he may have been known to the King and Queen. By 1627, when he was chaplain of the Duke of Buckingham's expedition to the Isle of Rhé, he must have taken orders. Two years later, shortly after his mother's death, he became vicar of Dean Prior in Devonshire.

So little in Herrick's poetry suggests the priestly character that question has been made why he took orders at all; he himself spoke of his Devonshire years as pure exile from London and the world. Yet the traditions of his career at Dean Prior are entirely pleasant. His parishioners remembered him for his good humor and wit. He wrote his best poems in the little vicarage, whether in celebration of Prudence Baldwin, his housekeeper, or of Tracy, his spaniel, or of the village holiday ceremonies and superstitions, recorded with wonderful sympathy. Nothing more particular remains, save the legend of his keeping a pet pig in the house, and of his hurling a missile at an inattentive congregation—his only practical expression of ill-will towards Devonshire.

In 1647, evicted as a loyalist by Parliament, he returned to London, glad to be free of the quiet country, and set about publishing his poems. They appeared that same year, under the title of 'Hesperides, or The Works Both Humane and Divine of Robert Herrick, Esq.' The sacred poems bear the separate title, 'His Noble Numbers; or, His Pious Pieces, Wherein (amongst other things) he sings the Birth of his Saviour; and sighes for his Saviour's Suffering on the Crosse.' Nothing else is known of Herrick until 1662, when Charles II. restored him to his old place at Dean Prior. The parish register records his burial on 15 Oct. 1674.

There is almost no contemporary reference to Herrick's poems, but the frequency with which they were reprinted in collections proves the favor they found. By the end of the century, however, they were forgotten, sharing in the Augustan neglect of Elizabethan and Stuart poetry. A mention of Herrick, with some of his poems, in the *Gentleman's Magazine*, 1796, and Dr. Nathan Drake's essays and quotations in his 'Literary Hours,' two years later, revived his fame.

Herrick's literary master, as he tells us in more than one fine tribute, was Ben Jonson (q.v.). Campion and the poets of the later song-books foreshadow him, but it was through Jonson that he derived the tradition of Horace and the Latin epigrammatists, and he remained Latin in spirit, though his own carefully achieved simplicity is often near to Greek restraint. But it is not only in this literary inheritance that he belongs with Jonson; personally, if the Marshall portrait prefixed to 'Hesperides' is faithful, and if the assault upon the drowsy congregation is no fable, he illustrates with Jonson and other Elizabethans, and with Landor in later days, the paradox of violent and robust temperament reacting in fastidious art.

Herrick is first of all an artist; his merit is almost invariably a virtue of expression; he is master of the inevitable phrase. Many of his lyrics have indeed a larger perfection of form, yet he is most often concerned with the single word. His shortest poems, the numerous two-line fragments in which at first sight he would seem to scatter his genius, are frequently mere experiments in diction, usually for the sake of one word that he coins or discovers, easily recognizable for its curious awkwardness or its complete beauty. For among these trial pieces can be found some unhappy ventures, as well as astonishing verbal felicities.

This gift for language, part of the poetical equipment in general, is more marked in Herrick because of its intensity and its narrowness. It is so narrow as to be quite inflexible; far from exhibiting the Elizabethan faculty for adjusting the style to the most varied matter, Herrick subdues to one manner every subject he treats. The lines to his dying brother, the wedding songs for his friends, the epitaph on his housekeeper, and the recipes for country charms, are uttered alike in one voice and in one rigid though lovely tone. And in his choice of subjects he exercises none of the fine selection that distinguishes his diction; his conscious art is a thing of words only; in his themes he is at once almost the coarsest and the daintiest of English poets. This imperturbable manner, itself exquisite, becomes in the handling of shockingly different themes Herrick's chief limitation; here is felt a certain hardness of character, an ill-proportioned sympathy, or some deep defect of heart. But this impression is partly corrected elsewhere in his work.

The themes of Herrick's secular verse, upon which his fame rests, are given with characteristic confusion in the first poem of his book. He sings of youth and love — a Renaissance motive from which his cheerfulness or his limited sympathy subtracts most of the Renaissance sadness at the passing of beauty. He sings of his own numerous loves in the Horatian manner, leaving his admirers room to ponder whether he ever loved at all. He sings in his kindliest vein of fairy lore, and of country holidays; he identifies Renaissance Springtime motives in the native village ceremonies around him, and gives to the English May festival something of the significance it had in Provence; and he is the first writer to chronicle at length that old English Christmas spirit which Irving and Dickens recovered. No poet who writes of such subjects with such delight can be altogether unsympathetic, and in the verses which are frankly about himself there is a frequent note of human pathos that partly disarms criticism of his less felicitous themes.

It is not surprising that his 'Noble Numbers' are little read; in them as in his secular verse he is the technical experimenter, the conscious artist, where conscious art is out of place. But in the 'Christmas Carols,' in the 'Graces for Chrildren,' in the fine though fantastic 'His Saviour's Words Going to the Cross,' in the epigram 'Riches and Poverty,' and in the lines that Swinburne praised, 'Devotion Makes a Deity,' he shows feeling and thoughtfulness not unworthy of England's tradition of devout country parsons.

Bibliography.— The best editions are those by Grosart, Saintsbury (Aldine), and Pollard, with an introduction by Swinburne, in the 'Muses' Library.' For criticism, consult: 'Introductions' to the above; Gosse, in 'Seventeenth Century Studies'; Aldrich, in 'Ponkapog Papers,' and Ward's 'English Poets.'

John Erskine,
Associate Professor of English, Amherst College.

Herrick, Robert Welch, American novelist: b. Cambridge, Mass., 26 April 1868. He was graduated at Harvard in 1890, and in 1895 became professor of English at the University of Chicago. His literary style displays much finish, while his studies of character are both keen and discriminating. He has published: 'The Man Who Wins' (1895); 'Literary Love Letters and Other Stories' (1896); 'Love's Dilemmas' (1898); 'Composition and Rhetoric' (1899); 'The Web of Life' (1900); 'The Real World' (1901); 'Their Child' (1903); 'The Common Lot' (1904); 'The Memoirs of an American Citizen' (1905); etc.

Herrick, Sophie McIlvaine Bledsoe, American microscopist: b. Gambier, Ohio, 26 March 1837. She was editor of the 'Southern Review' 1875–8, and has since been connected with the editorial staff of 'Scribner's Magazine' and its successor, 'The Century.' She has published 'Wonders of Plant Life under the Microscope' (1883); 'The Earth in Past Ages'; 'Chapters in Plant Life'; 'A Century of Sonnets' (1902).

Herring. The typical fishes of the family *Clupeidæ* (q.v.), to which also belong the shad, alewife, sardine (qq.v.), and other food-fishes, the numbers of which consumed makes this the most important economically of all families of fishes. The true or sea-herrings belong to the genus *Clupea.* The common herring (*C. harengus*) of both sides of the North Atlantic swims in enormous schools containing countless numbers of individuals packed as closely as possible over areas of often 6 to 20 square miles. The herring is a migratory fish, but its movements are so complicated that much mystery still clings to them. The most satisfactory conclusions have been arrived at by a German commission appointed to study the natural history of the Baltic, etc., which concluded that the herrings live in the deep water off the coasts which they approach periodically chiefly for the purpose of spawning; that there exist a large number of distinct races, differing in size, form, times of spawning, and various other peculiarities, and that each of these races swims in separate schools, which move independently and have different seasons and grounds for spawning. Spawning takes place at various seasons, according to locality, some schools spawning in the late winter, others in the spring, and still others during the autumn months. The eggs are small and adhere in masses to seaweeds, stones, etc., on the bottom. Vast numbers are thus deposited in certain favored localities to which haddock and other fishes are attracted for the purpose of devouring them. The number of eggs produced by each fish is not especially large, being from 10,000 to 50,000, but nevertheless the natural productiveness of the herring has been sufficient to overcome inroads caused by the fisheries and the much greater destruction due to the hordes of bluefish, sharks, porpoises, gulls, and other enemies which accompany the schools in order to prey upon them. Having only few and small teeth, the herrings cannot capture active living creatures, but, as they swim with quick, nervous movements, water is being continually taken into the mouth and strained through the gill-rakers. By this means great numbers of copepods and other minute forms of life, especially larval crustaceans, annelids, and mollusks, are retained within the mouth and swallowed.

The herring fishery is of stupendous importance to the countries of northern Europe.

This is especially true of the Scandinavian countries, whose hardy fishermen take from the sea annually not less than 1,500,000,000 pounds. Scotland takes from 150,000,000 to 200,000,000 pounds, and the other maritime nations usually smaller quantities. On this side of the Atlantic the fishery is much less extensive, but is growing, and is no doubt destined to reach a great magnitude, especially in the waters of British America, which furnish each year about 250,000,000 pounds. Although found as far south as North Carolina, the herring has a commercial importance only north of Cape Cod, the New England fisheries, which are chiefly confined to Maine, yielding in 1898 64,589,000 pounds, worth $600,000. Most of these were sold fresh, either for food, or, early in the season, for cod bait; of the remainder, about 7,000,000 were salted and nearly 4,000,000 smoked. A favorite preparation is the partly smoked form of "bloaters." Large quantities of young herrings are packed and sold as sardines. In the prosecution of the American fisheries use is made chiefly of several forms of drift or gill nets and seines; under favorable conditions of great tidal movements, as in the Bay of Fundy, great numbers are captured in weirs.

A closely similar species (*C. pallasii*) is found on the Pacific coast of America, and is the object of a rapidly extending fishery. Of the anadromous river-herrings or alewives (*Pomolobus*), two species are of great commercial importance on the Atlantic coast of the United States, particularly southward, though the fisheries extend from Maine to Florida. They enter the rivers to spawn about the same time as the shad, with which they are caught chiefly in pound nets and seines. In 1896, 2,500 persons were employed in the fishery, the product of which was about 50,000,000 pounds, valued at $460,000. The greater number are smoked.

To the extensive literature of the herring the following references will serve as an introduction: Goode, 'Fishery Industries of the United States' (1884); Smith, 'Alewife Fisheries of the United States,' in Report of United States Fish Commission for 1898; Cunningham, 'Marketable Marine Fishes'; 'Report of the Commission for the Scientific Investigation of the German Seas' (a very important contribution in German); 'Annual Reports' of the United States Commissioner of Fisheries.

Herring Gull, the most numerous and widely spread of gulls, common in the breeding season throughout all the northerly parts of the world, and migrating southward in winter. The silvery sheen of white and pearl-blue plumage are indicated in its technical name (*Larus argentatus*); and its habit of following schools of fishes and picking them up gives it the name of herring-gull. The same name is often given, however, to several others of the smaller gulls. See GULLS.

Herrnhut, hĕrn'hoot, a small town or village in the kingdom of Saxony, in the circle and 18 miles southeast of Bautzen. It is situated at the foot of Hutberg Mountain, 1,054 feet above the level of the sea. It was founded by Count Zinzendorf 1722, for the use of the Moravian Brethren, and it afterward became the metropolis and centre of that sect of Christians, who, from this town, are often called Herrnhuters. (See UNITED BRETHREN.) The town is built with great regularity, and distinguished by the order, cleanliness, and stillness which prevail in it. It has a great variety of manufactures, principally of linen, calico, tobacco, and of articles in gold, tin, leather, etc. The objects of curiosity are the observatory and the burial-ground on a neighboring hill, resembling a garden, and called by the brethren "Garden of Peace." Pop. 1,200.

Her'ron, Francis Jay, American soldier: b. Pittsburg, Pa., 17 Feb. 1837; d. New York 8 Jan. 1902. He was graduated at the Western University of Pennsylvania in 1854 and on the breaking out of the Civil War commanded the Governor's Grays in the First Iowa regiment. In 1861 he was made lieutenant-colonel of the Ninth Iowa regiment. In 1862 he received the commission of brigadier-general of volunteers. Early in 1863 he joined Gen. Grant at Vicksburg and commanded the left wing of the besieging forces as major-general (1862), until the capture of the city. He subsequently captured Yazoo City, with its boats and supplies; commanded the Thirteenth army corps, and broke up the traffic along the Rio Grande, assisted President Juarez against Maximilian's forces, and in June 1865 received the surrender of the Confederate forces west of the Mississippi. In 1873 he took up his residence in New York, where he practised law until his death.

Herron, George Davis, American clergyman and social reformer: b. Montezuma, Ind., 21 Jan. 1862. He was educated at Ripon College, Wisconsin, and also studied in Europe. He became pastor of the Congregational Church in Lake City, Minn., and while there made an address ("The Message of Jesus to Men of Wealth") before a Minneapolis club, which attracted much attention; he subsequently received a number of calls from important churches, and went as pastor to Burlington, Ia. Here he organized a club for the discussion of social questions, which was largely attended, especially by workingmen. In 1893 he accepted the chair of applied Christianity at Iowa College, resigning in 1900 on account of the objection to his teachings; he then organized a religious and socialist movement known as the "social crusade." In 1901 he divorced his wife, and married a second time, an action which aroused much criticism. He has written: 'The Larger Christ' (1891); 'The Call of the Cross' (1892); 'A Plea for the Gospel' (1892); 'The New Redemption' (1893); 'The Christian Society' (1894); 'The Christian State' (1895); 'Social Meaning of Religious Experiences' (1897); 'Between Cæsar and Jesus' (1899).

Herschel, hĕr'shĕl, **Caroline Lucretia**, sister of Sir William Herschel (q.v.), German astronomer: b. Hanover, Germany, 16 March 1750; d. there 9 Jan. 1848. In her 22d year she went to England to reside with her brother, then organist in Bath. When William abandoned his former profession in favor of astronomy she became his helpmate, and when he was appointed private astronomer to George III. she discharged efficiently all the duties of an assistant astronomer, for which she was allowed a small salary. Although these duties were very arduous, she yet found time to conduct a series of observations of her own with a small Newtonian telescope her brother had made for

HERRING GULL (*Larus Argentatus*)

her. She devoted special energy to the discovery of comets, and was so successful as to be entitled to claim the priority of discovery of at least five. Several remarkable nebulæ and clusters of stars included in her brother's catalogue were described from her original observations. In 1798 her valuable work, 'A Catalogue of Stars taken from Mr. Flamsteed's Observations, with Introductory Remarks by W. Herschel,' was published by the Royal Society. On her brother's death in 1822 she returned to her native country, where she died after an unusually protracted life, distinguished by useful scientific labors. The Royal Society recognized the value of her labors by bestowing upon her in 1828 their gold medal, and some time afterward by conferring upon her the privileges of honorary membership.

Herschel, Sir **John Frederick William,** English astronomer; only son of Sir William Herschel (q.v.): b. Slough, near Windsor, 7 March 1792; d. Collingwood, Kent, 11 May 1871. He was educated at Eton and Cambridge. His first publication was 'A Collection of Examples of the Application of the Calculus to Finite Differences' (1820), but it was not until the death of his father that he devoted his special attention to those astronomical researches which have made the name of Herschel so famous. He limited his first exertions to a re-examination of the nebulæ and clusters of stars discovered by his father, and in 1824, with James South, reported to the Royal Society the position and apparent distances of 380 double and triple stars, obtained by more than 10,000 measurements. This memoir attracted the notice of the French Academy, and they voted it their astronomical prize; and two years later the gold medal of the Royal Society was awarded to each of the astronomers. The results of the re-examination were given in 1833 to the Royal Society in the form of a catalogue of stars in order of their right ascension. The catalogue contained observations on 525 nebulæ and clusters of stars not noticed by his father, and on a great number of double stars, between 3,000 and 4,000 in all. His 'Treatise on Sound' appeared in the 'Encyclopædia Metropolitana' in 1830, as did his 'Treatise on the Theory of Light' in 1831, in which year also appeared his well-known 'Preliminary Discourse on the Study of Natural Philosophy,' one of the most charmingly written books on science. In 1831 he was created a knight of the Royal Hanoverian Order. In 1833 Herschel published in Lardner's 'Cabinet Cyclopædia' a 'Treatise on Astronomy,' subsequently enlarged into 'The Outlines of Astronomy,' of which several editions have been published. Before this, however, he had undertaken a private expedition to the Cape of Good Hope for the purpose of carrying out in the southern hemisphere observations similar to those he had made in the northern. Four years were spent near Cape Town (1834–7). His great object was to discover whether the distribution of the stars in the southern hemisphere corresponded with the results of his father's labors, prosecuted mainly on the opposite side of the Galactic Circle. That the observations might be strictly comparable they were made by the same method as Sir W. Herschel, and with a telescope of the same optical power. The whole number of stars counted in the telescope amounted to 68,948, included within 2,299 fields of view. By a computation based on the star-gauges in both hemispheres relative to the Milky Way, Sir John found that the stars visible in a reflecting telescope of 18 inches aperture amounted to 5,331,572; and, more than this, the number really visible in the telescope was vastly greater, for in some parts of the Milky Way the stars were found to be so crowded in space as to defy all attempts to count them. The results of this vast labor were published in 1847, expense being borne by the Duke of Northumberland. On Herschel's return to England in 1838 he was received with every public honor, and on the queen's coronation was created a baronet. In 1848 he was president of the Royal Astronomical Society. He was buried in Westminster Abbey.

Herschel, Sir **William,** Anglo-German astronomer: b. Hanover, Germany, 15 Nov. 1738; d. Slough, near Windsor, England, 25 Aug. 1822. He went to England in 1757, and at first was employed in the formation of a military band. Although enthusiastically fond of music, he devoted his leisure hours to mathematics and astronomy; and being dissatisfied with the only telescopes within his reach, he set about constructing one for himself, in which undertaking he succeeded, having in 1774 finished a reflecting instrument of 5½ feet. Encouraged by his success he proceeded to complete larger telescopes, and from this period gradually withdrew from his musical engagements. Late in 1779 he began a regular survey of the heavens, star by star, with a 7-foot reflector, and after 18 months labor discovered, 13 March 1781, a new primary planet, named by him the *Georgium Sidus*, but now known as *Uranus*. George III. gave him a pension, enabling him to devote the rest of his life to astronomy. At Slough, he commenced the erection of a telescope of the dimensions of 40 feet, and completed it in 1787. Its diameter was 4½ feet, and it weighed 2,118 lbs. With this powerful instrument he continued to prosecute his discoveries, regularly communicating the results to the Royal Society till 1818. In 1783 he thought he had discovered a volcanic mountain in the moon, and from further observations made with his large instrument in 1787 found he was the victim of an optical illusion. He discovered two of the satellites of Saturn, and the fact that his system of rings revolved, and he measured his rotation and that of Venus, announced to the world that there were binary stars in the heavens, etc. Herschel received much assistance in making and recording observations from his sister Caroline (q.v.); and latterly his brother, a skilful optical instrument-maker, lent him valuable aid. In 1802 he laid before the Royal Society a catalogue of 5,000 new nebulæ, nebulous stars, planetary nebulæ, and clusters of stars he had discovered. See 'Herschel, his Life and Works,' by Holden (1881).

Her'schell, Farrer, Lord, English lawyer and statesman: b. London, England, 2 Nov. 1837; d. Washington, D. C., 1 March 1899. He was educated at University College, London, and the University of Bonn. He became a barrister of Lincoln's Inn in 1860; was recorder of Carlisle 1873–80; solicitor-general 1880–5; and lord high chancellor in 1886, and again 1892–5. He was a member of the Venezuela and British Guiana boundary arbitration tribunal in 1897, and was subsequently appointed one of the high joint commissioners from Great Britain, on the Anglo-American Commission, designed to settle existing differences between the United States and Canada, of which he became president. During the sitting of the commission in Washington, D. C., in February 1899, he had a severe fall, from the effects of which he died shortly after.

Hertel, hĕr'tĕl, **Albert,** German painter: b. Berlin 19 April 1843; studied at the Berlin Academy, where he became professor in 1875, and was made a member in 1901. Among his landscapes are 'Olive Harvest in Capri' (1872); 'After the Storm on the Coast of Genoa' (1878); 'Road Between Rapalla and Santa Margherita' (1892); and 'View in the Roman Campagna' (1896).

Hertel de Rouville, ār-tĕl dė roo-vēl, **Francis,** Canadian soldier: b. Three Rivers, Maurice County, Quebec, 1643; d. 1722. He was captured in 1681 and tortured by the Iroquois who were so struck by his fortitude that they adopted him into their tribe, from which he escaped and as one of Frontenac's lieutenants performed some remarkable exploits against the English from whom he captured Falmouth, now Portland. Louis XIV. tardily rewarded him with a patent of nobility.

Herter, Albert, American artist: b. New York 2 March 1871. He studied painting at Paris in the studio of Jean Paul Laurens. He has twice visited Japan and the years spent there have strongly influenced the character of his work. He is member of the Society of American Artists, of the Water Color Club, and of the Water Color Society.

Hertz, Heinrich, hīn'rĭн hĕrts, German physicist: b. Hamburg 22 Feb. 1857; d. Bonn 1 Jan. 1894. He studied at the University of Berlin, and in 1880 became assistant to Helmholtz there. In 1883 he was lecturer on theoretical physics at the University of Kiel; in 1885 was professor of physics at a technical school in Karlsruhe; and in 1889 succeeded Clausius as professor of physics at the University of Bonn. His most important work was his experiments with electricity, by which he proved that electricity can be transmitted in electromagnetic waves with the same rapidity as light, these waves showing the same phenomena of refraction, polarization, etc., as light waves. He thus further developed and attested the truth of Faraday's electro-magnetic theory of light. It is by means of the Hertzian waves also that wireless telegraphy (q.v.) is made possible.

Heruli, hĕr'ū-lī, a Teutonic tribe first heard of in history about the middle of the 3d century, who passed south from the coast of the Baltic and swept with the Goths into the eastern provinces of Rome and founded an empire on the Danube. They appear as reinforcements of Odoacer in his invasion of the western provinces of Rome in 470. Their king Rudolph formed an alliance with Theodoric the Great, but they were afterward conquered by the Longobardi. A part of them were driven toward Scandinavia, a part lingered on the borders of the Roman empire. They did good service to the Byzantine empire, but after encountering the Vandals in Africa, and the Ostrogoths in Italy, they vanished from history.

Herzel, Theodor, Jewish leader of political Zionism: b. Budapest 2 May 1860; d. 3 July 1904. He was educated in Vienna for the law, but devoted himself almost exclusively to journalism and literature. He was at first Paris correspondent and later literary editor of the *Neue Freie Presse*, and wrote comedies and dramas. In 1896 he published his 'Judenstaat,' the English translation of which ('A Jewish State') made him the political leader of the Zionist movement; and his efforts were at once centred in this propaganda. 'Die Welt' of Vienna was established by him in 1897, and in that year he planned and was elected president of the first Zionist Congress held at Basel. At every subsequent congress (the sixth having been held in August 1903) he was unanimously re-elected. In 1898 he inaugurated a series of diplomatic interviews with various sovereigns and statesmen. At the Hague Peace Conference he was received by many of the delegates. In the Zionist movement he was officially the chairman of the Grosses Actions Comité, and of the Vienna executive committee, and a member of the council of administration. Among his further works are: 'Das Neue Ghetto' (1903), directed against the Jewish element that combated his views; 'Altneuland' (1903), a fictional presentation of Zionistic ideas.

Herzegovina, hĕrt-sĕ-gō-vē'nä, Austria-Hungary, a province of the Balkan peninsula nominally belonging to European Turkey, but since 1878 administered along with Bosnia (q.v.) by Austria. It is bounded on the north by Croatia and Bosnia, on the east by Bosnia, on the southeast by Montenegro, and on the south and west by Dalmatia; length, northwest to southeast, 140 miles; breadth, 50 miles; area, 700 square miles. The surface is generally mountainous, covered by ranges belonging to the Dinaric Alps, sloping gradually to the Adriatic, which receives all its drainage chiefly by the Narenta. It contains many fertile valleys, and raises excellent tobacco. The exports consist chiefly of hides, tallow, cattle, wool, wax, and fruit. Mostar is the chief town. The province was conquered by the Turks in 1465. An insurrection, caused by Turkish misgovernment, broke out in July 1875, and was the cause subsequently of war between Russia and Turkey. In accordance with the Treaty of Berlin (1878) the province was occupied by Austrian troops, and is now ruled by an Austrian military governor. Pop. about 250,000.

Hesiod, hē'sĭ-ŏd, Greek poet: b. Ascra, a village of Bœotia, at the foot of Mount Helicon, whence it is called the *Ascræan*. But little is known of Hesiod with certainty. Even the age in which he lived cannot be precisely determined. A very common tradition relates that, in a poetical contest with Homer at Chalcis, he came off victorious. Herodotus calls him a contemporary of Homer, and says they lived 400 years before himself (about 900 B.C.). In his 'Works and Days' (172) Hesiod says that he belonged to the period immediately following the Trojan war; but there are many reasons for supposing that he lived at a later period. Of the numerous works attributed to him three only remain. These are the 'Theogony,' a collection of the oldest fables concerning the birth and achievements of the gods, arranged so as to form a connected whole. It is the most important and difficult of all his works. With it was probably connected the lost 'Catalogues of Women' (or the *Eoiai megalai*), to the fourth book of which the second fragment (the 'Shield of Heracles') must have belonged. This is evidently composed of three distinct parts, only one of which is occupied with the real description of the shield. The third fragment is a didactic poem, 'Works and Days' (*Erga*, or *Erga kai Hemerai*). It treats of agriculture, the choice of days, etc., with prudential precepts concerning education, domestic economy, navigation, etc. The Hesiodic poems are inferior to the Homeric in almost every respect. Hesiod's complete works have been translated into English verse by Elton, and Bohn's Classical Library contains a prose version.

Hesperides, hĕs-pĕr'ĭ-dēz (daughters of Hesperis), the guardians of the gold apples which Ge (the Earth) had given to Hera on her marriage. They were the daughters of Atlas and Hesperis, but their parentage is differently represented by other writers. They were four in number and their names were Agle, Arethusa, Erytheia, Hesperia, or Hesperarethusa. They were assisted in the charge of their garden by the sleepless dragon, Ladon. It was the twelfth labor of Heracles to bring the golden apples of the Hesperides to Eurystheus.

Hesperornis, hĕs-pĕ-rŏr'nĭs, a remarkable extinct form of bird, the remains of which are met with in the cretaceous deposits of Kansas. As described by Prof. Marsh, it possessed small pointed reptilian teeth, which were implanted in a deep continuous groove, somewhat like those of Ichthyosaurus. Its brain was small and more reptilian in type than that of any adult bird as yet examined. It appears to have been a large diving-bird, measuring over five feet from the point of the bill to the end of the toes. Its wings were rudimentary, its legs powerful, and its feet well adapted for rapid progression in water. The tail was broad, could move up and down, and was probably used as a rudder or swimming-paddle. The long slender jaws were united in front only by cartilage, as in serpents, and had on each side a joint which admitted of some motion, so that "the power of swallowing was doubtless equal to almost any emergency." Consult: Lucas, 'Animals of the Past' (1901).

Hesperus, hĕs'pĕ-rŭs, among the Greeks the planet Venus, when it appeared as evening star, personified as the divinity that at weddings leads the bride to the arms of her husband. He is called Phosphorus or Lucifer as a morning star, and is styled the son of Eos (Aurora) and Cephalus. He was also known as son or brother of Atlas, and brother of the Hesperidæ.

Hesperus Peak, an elevation of the La Plata Mountains, in the southwestern part of Colorado. Gold and silver have been mined in the vicinity. This peak is one of a group of high peaks in the vicinity of the State; the height is about 13,135 feet.

Hesse, hĕs, or **Hessia** (German, Hessen, hĕs'sĕn), Germany, an ancient territory inhabited in the time of the Romans by the Catti or Chatti, an old Germanic tribe. Under the Frankish kings Hesse was governed by counts, the principal of whom were the Counts of Gudensberg of the name of Giso. Philip I. the Generous, who succeeded to the sovereignty of the whole country in 1509, and who was the earnest and zealous friend of the Reformation, divided his dominions among his four sons. The eldest, William IV., obtained one half, including the capital, Cassel; Louis IV. one fourth, comprising Marburg; Philip II. one eighth, with Rheinfels; and George I. also an eighth, with Darmstadt. But Philip dying in 1583, and Louis in 1604, without children, there remained only the main branches of Hesse-Cassel and Hesse-Darmstadt (qq.v.).

Hesse, Grand Duchy of, formerly Hessen-Darmstadt, Germany, a state consisting of 13 divisions. Eleven of these are small, six surrounded by Prussian territory, and five on the borders of Baden and Wurtemberg. The other two portions, forming about nine tenths of the whole, are separated by a belt of land stretching east to west, and including part of the Prussian dominions. The more southerly of these portions forms the two provinces of Rheinhessen and Starkenburg. The northern portion, forming the province of Oberhessen, is surrounded by the Prussian province of Hesse-Nassau; area of whole grand duchy, 2,964 square miles. Oberhessen is generally mountainous; Starkenburg and Rheinhessen are also mountainous; in the southwest the Donnersberg, a northern ramification of the Vosges, rapidly subsides to the extensive plains belonging to the valleys of the Main and the Rhine. To the latter river the whole surface of the grand duchy belongs, with exception of a small portion in the north, drained by the Eder and Fulda, affluents of the Weser. The climate is greatly diversified, varying with the altitude. The soil, particularly in the provinces of Starkenburg and Rheinhessen, is fertile, and grain of all kinds is raised in large quantities. Hemp, flex, potatoes, and rape-seed also are extensively grown, and in particular districts tobacco and hops. The vine forms an important object of culture, and fruit is abundant. Horses, cattle, sheep, and swine are numerous. The minerals include iron, coal, lignite, and salt; and there are good quarries of sandstone, limestone, whetstones, basalt, and roofing-slate. The most important manufacturing industry is linen. The principal towns are Darmstadt, the capital; Mainz, Giessen, Bingen, and Worms. The grand duchy is an hereditary monarchy. The constitution dates from 1820, but was somewhat modified in 1856 and 1872. The legislative power is vested partly in two chambers—an upper, composed chiefly of nobility and citizens, appointed for life by the grand-duke; and a lower, composed chiefly of deputies from the towns, villages, and rural districts. About two thirds of the inhabitants are Protestants. Pop. (1900) 1,119,893. The grand-ducal line was founded in 1567 by George I., son of Philip the Generous. By the death of the landgrave of Hesse-Homburg, in 1866, Louis III., grand-duke of Hessen Darmstadt, succeeded to his dominions. In the German war of that year Hessen-Darmstadt joined Austria. Its army was nearly annihilated at Friedberg, and it was deprived of the newly-acquired landgraviate and other districts. In 1870 the grand duchy of Hesse entered the German empire. Louis IV., who succeeded Louis III., died in 1892. He was the husband of Princess

Alice of Great Britain, and their son, Ernest Louis, is now the reigning sovereign.

Hesse-Cassel, hĕs-käs'ĕl, or **Electoral Hesse**, Germany, a former electorate and independent member of the Germanic Confederacy, between Rhenish Prussia and Bavaria, containing 4,430 square miles, with about 850,000 inhabitants, mostly Protestants. It was founded by the eldest son of Philip the Generous, the Landgrave William IV., surnamed the Wise (1567–92). For a long period the history of Hesse-Cassel was a narrative of conflicts between the people for political freedom and the elector for absolute rule. The demands of the people were on several occasions strengthened by appeals to the elector from the Prussian government. On the outbreak of the German war of 1866, the elector joined Austria, and his territory was occupied by Prussian troops. On the conclusion of the war Hesse-Cassel was annexed to the Prussian territories, and now forms part of Hesse-Nassau (q.v.).

Hesse-Nassau, hĕs'näs'â, or **Hessen-Nassau**, hĕs sĕn-näs'sow, Germany, a province of Prussia, which includes the former principality of Hesse-Cassel (except some small districts), the greater part of the former duchy of Nassau, that portion of the former landgraviate of Hesse-Homburg which lies on the right bank of the Rhine, the territory and town of Frankfort, and some small districts ceded by Hessen-Darmstadt and Bavaria. The province is bounded by the Prussian provinces of Westphalia, Hanover, Saxony, and the Rhineland, the principality of Waldeck, the grand duchy of Saxe-Weimar, and the kingdom of Bavaria; area, 6,018 English square miles, divided into the two governments (Regierungsbezirke) of Cassel and Wiesbaden. The greater part of this province has a rugged surface, partly covered by branches of the Harz Mountains. The principal rivers are the Werra, Lahn, Ohm, Rhine, and Main. Arable land is limited, and cultivation is chiefly confined to the narrow valleys and lower hill slopes, amounting to about two fifths of the whole surface. The principal crops are rye, barley, and oats. Potatoes also are extensively grown. Fruit is tolerably abundant, and a great part of the loftier districts is covered with extensive forests, which employ a considerable number of the inhabitants, and furnish one of the most valuable sources of revenue. There are various minerals, and valuable mineral waters at Homburg, Wiesbaden, etc. The manufactures consist chiefly of woolens, cottons, and linens. The principal towns are Cassel, the capital, Wiesbaden, and Frankfort. Pop. (1900) 1,897,310.

Hessen-Darmstadt, hĕs'sĕn-darm'stat. See HESSE, GRAND DUCHY OF.

Hessian Fly. See WHEAT INSECT PESTS.

Hessians in the Revolution, The. In the 18th century Germany was divided into nearly 300 sovereignties, each maintaining a court and a military force. The possible revenue was often very limited, the burdens were almost intolerable, and the princelings were often profligate and cruel; they did not need their forces for home defense, and were glad to make money for themselves by letting out their regiments for hire, though except in one case they remitted no taxes on the people from the receipts. There was also a lingering tradition that soldiering was an honest trade like any other, and that it was useful for helping sovereigns to keep order; especially to put down insurrections, which were wicked. This, however, did not apply to rulers hiring out their troops and pocketing the money; and not only the liberal school of writers and public men, but enlightened despots like Frederick the Great, denounced it. But England had not sufficient army for the American War, and wished drilled troops rather than raw recruits, and after vainly endeavoring to hire 20,000 Russian soldiers, turned to the German princes, with some of whom she had dynastic relations, and all of whom were so eager to sell their wares that two of them offered soldiers for hire immediately after Bunker Hill, without waiting to be asked. Only those which could furnish considerable numbers were worth treating with, and all the German auxiliaries were finally hired from six states; about half being from two Hessian states, and by far the largest (more than three times greater than any other) from one. All were indiscriminately termed "Hessians," as all German immigrants were formerly called "Palatines." The first treaty was made with the Duke of Brunswick, 9 Jan. 1776, for 4,300 troops; reinforcements or replacements were sent year by year, till the total had amounted to 5,723, only 2,708 of whom ever returned. The second was with the Landgrave of Hesse-Cassel, 15 Jan. 1776, for 12,805; finally increased to 16,992, of whom 10,492 returned. The contingents from the others, under various treaties, amounted to — Hesse-Hanau, 2,038; Anspach-Baireuth, 2,353; Waldeck, 1,225; Anhalt-Zerbst, 1,152. Total sent to America, 29,867, of whom 17,313 returned; the rest either died or remained as citizens. There were about 20,000 in America at any one time after 1776. These forces cost Great Britain in subsidies and incidentals about £1,770,000; besides the lump sum, it was obliged to replace the dead, and at least in one case count three wounded men as one dead one.

About 18,000 were shipped in 1776; the commander-in-chief was Lieut.-Gen. Philipp von Heister, a veteran of the Seven Years' War. The first division of some 8,000 landed at Staten Island, 15 August; they included a body of chasseurs and grenadiers under Lieut. E. W. F. von Donop, an able and daring officer. They took a leading part in the battles of Long Island and White Plains, and all the operations for capturing New York; and stormed Fort Washington with a loss of 50 killed and 276 wounded. During this time the second division of about 4,000, under Lieut.-Gen. Wilhelm von Knyphausen, joined them. Washington's surprise at Trenton fell on Col. Rall's brigade of Germans. Rall was a regular officer whose contempt for the ragged Americans surpassed that of the most arrogant Briton, and he refused to take the most elementary precautions; he was mortally wounded. Early in 1777 Heister was superseded by Knyphausen; Howe finding the former intractable, and the Landgrave of Hesse laying the blame of Trenton upon him. Meantime the Brunswickers and a Hanau regiment under Baron von Riedesel had made a clearance of Canada; and in 1777 they were joined to the expedition of Burgoyne, in whom Riedesel had no faith. It was from this division that Baum's detachment was sent off to raid Vermont, and to meet its fate at Bennington, with Breymann's sent to support it; 365 of Baum's 374 Germans did not return, and 231 of Breymann's were killed, wounded, or captured. Riedesel and his remaining men shared in Burgoyne's surrender. Around Philadelphia, at Brandywine and Germantown, Knyphausen's command was of the first importance; and at Red Bank Donop tried to storm the American fort and was mortally wounded, his command losing 82 killed and 229 wounded, besides 60 prisoners. In the three years' occupation of Rhode Island, from the fall of 1776 to that of 1779, about half of the British corps was Hessians; and they liked, and were liked by the inhabitants,— when they departed, all persons, but especially women, were prohibited from appearing at the Newport windows, in fear that the soldiers might not wish to go. In the South, at Savannah, Charleston, Pensacola, Baton Rouge, etc., they left many dead; and shared in the bloody drawn battle of Guilford Court House. Finally, at Yorktown, they bore the brunt of the actual fighting, losing 53 killed and 131 wounded.

The Germans did their duty bravely and faithfully, with loyalty to a service they had been sold into to no profit of theirs. Very few deserted, in spite of constant inducements held out to them; a policy which Washington strongly deprecated. Probably one reason was, that they were at once recognizable from their speech. Nor were they in the least inhumane or rapacious: the charge that they were cruel barbarians was a mere political weapon of the time. In a strange country, they would have run the risk of being murdered in reprisal had they been such; but in fact they appear to have been well-meaning men. Of the 29,867 who came over, only 17,313 returned to Germany. Of the 12,554 remaining, 548 were killed; some of the total 1,652 wounded died; some disappeared; but a great number are known to have remained and settled in the country. Grants were given them in Nova Scotia, but many scattered as chance directed. See Lowell, 'The Hessians in the Revolution' (1884).

Hestia. See VESTA.

Hesychius, hĕ-sĭk'ĭ-ŭs, the author of a Greek lexicon, which has probably come to us in an abridged form, and which he partly collected from former dictionaries, and partly enlarged by many new words and examples from Homer, the dramatic and lyric poets, the orators, physicians, and historians, was a native of Alexandria, and according to the best authorities flourished about the end of the 4th century after Christ. Of the circumstances of his life nothing is known. His lexicon possesses great value, especially of an antiquarian kind, and is the most useful for the study of the Greek language of all the ancient critical writings that are extant. The best editions of his lexicon are Alberti and Ruhnken's (Leyden 1746–66, two vols. folio), and that prepared by Schmidt (Jena, five vols. 1867–68; in a smaller form, two parts, 1864; second edition, 1867).

Hetæra, hĕ-tē'ra (Greek *hetaira*, a female companion), the name given by the Greeks to a mistress, as opposed to a lawful wife. But the word had various shades of meaning, from a mistress, who might be a wife in all but the legal qualification of citizenship, down to a harlot. The beauty and accomplishments of many of the hetæræ occasioned their society to be sought by men of the highest eminence, even Plato and Socrates. No shame was attached to associating with them. Aspasia, the mistress of Pericles, is the most renowned of these hetæræ. (See ASPASIA.) Hetæræ, less intellectually famous, were Lais, whom Aristippus the philosopher loved, Ph .ne, and others. They also became famous for their connection with the works of art. Praxiteles made a marble and gold statue of the latter, and she was also the model for his statues of Aphrodite.

Heterog'amy. See METAGENESIS.

Heterogenesis, hĕt"ĕ rō jĕn'ĕ sĭs, or **Heterogeny.** See METAGENESIS.

Heteropoda, hĕt-ĕ-rop'ō-da, a group of small, pelagic, pectinibranch mollusks, which dwell together in the open sea, have the foot modified into a swimming organ, and are provided with a ventral sucker. The shells are spiral or shaped like that of an argonaut and seem as if composed of thin glass; indeed, the whole animal is beautifully transparent. Heteropods occur in enormous abundance at the surface of the sea in all the warmer parts of the world, and their dead shells sinking to the bottom form a large constituent of the abyssal ooze. They are highly organized, have well developed eyes and other organs of sense, are bisexual, and produce eggs in long cylindrical cords. The young in their development pass through a trochosphere and then a veliger stage. All are predatory, seizing and feeding on the numerous minute forms of life about them. They are most active in the early evening, darting about with twisting motions like worms, usually on their backs. They use the ventral sucking-disk for attaching themselves to any object they may encounter. Three families, containing many species, are known, and their closest affinities are with the pteropods. Consult Kingsley, 'Standard Natural History,' Vol. I. (1885).

Heterop'tera. See HEMIPTERA.

Het'man (Russian, Ataman), chief of the Cossacks, formerly elected by that people. He had the power of life and death, and was head of the army in time of war. Mazeppa in 1708 revolted against Russia, taking the side of Charles XII. of Sweden, and Peter the Great abolished in consequence the power and authority of the hetman. Catharine II. suppressed the office and title in the province of Ukraine; it still exists among the Cossacks of the Don. In Poland the commander-in-chief of the army was styled hetman, and was appointed by the sovereign. The last elective hetman of the Cossacks in Russia was Platorf 1812–14. On his death the grand duke, heir to the throne, was made hetman.

Hetty Sorrel, in **George Eliot's** 'Adam Bede' (1859), a dairymaid whose unfortunate career, condemnation to death, and final reprieve form an important part of the story.

Hevelius, Johannes, yō-hän'nĕs hā-fā'lē-oos, or hē-vē'li-ŭs, known also as JOHANNES HEVEL, Polish astronomer: b. Dantzic 28 Jan. 1611; d. there 28 Jan. 1687. After visiting the principal countries of Europe he settled in his native city, and from 1639 till his death applied himself almost exclusively to the study of astronomy. His 'Selenographia,' or description of the moon, published in 1647, was the first of numerous astronomical works of great value and authority on his favorite science. Halley, who visited Hevelius at Dantzic at the request of the Royal Society of London, of which Hevelius had been elected a member in 1664, reported favorably of the correctness of his observations. In 1661 he observed a transit of Mercury, a triumph confined to Gassendi alone of all preceding astronomers. Hevelius ranks next to Flamsteed among the men of his day as a diligent and accurate observer of the heavens.

Hewes, hūz, **Joseph,** American patriot; a signer of the Declaration of Independence: b. Kingston, N. J., 1730; d. Philadelphia, 10 Nov. 1779. He was educated at Princeton College, and about 1760 he removed to Edenton, North Carolina. He soon became a member of the colonial legislature, and was a delegate to the General Congress at Philadelphia 1774–7 and again in 1779. After taking his seat he was appointed on a committee to "state the rights of the colonies in general, the several instances in which those rights are violated or infringed, and the means most proper to be pursued for obtaining a restoration of them," and aided in the preparation of its report.

Hewett, hū'ĕt, **Waterman Thomas,** American Germanic scholar: b. Miami, Mo., 10 Jan. 1846. He was graduated from Amherst College in 1869 and has been professor of German language and literature at Cornell University from 1870. He has been general editor of Macmillan's 'German Classics' since 1895, and beside frequent contributions to periodicals has published among other works 'The Friesian Language and Literature' (1879); 'History of Cornell University' (1894).

Hewit, hū'ĭt, **Nathaniel Augustus,** American Roman Catholic clergyman: b. Fairfield, Conn., 27 Nov. 1820; d. New York 3 July 1897. He was graduated from Amherst College in 1839 and was for several years in the Episcopal ministry. He became a Roman Catholic in 1846 and joined the Order of Redemptorists. He was later one of the founders of the Congregation of Saint Paul (Paulists) taking the religious name of "AUGUSTINE FRANCIS," and subsequently becoming professor and superior in the Paulist Seminary, New York. He wrote 'Life of Princess Borghese' (1856); 'Problems of the Age' (1868); 'Light in Darkness' (1871); etc.

Hewitt, hū'ĭt, **Abram Stevens,** American manufacturer and politician: b. Haverstraw, Rockland County, N. Y., 31 July 1822; d. New York 18 Jan. 1903. He was graduated from Columbia in 1842 at the head of his class, and in 1843 he was made acting professor of mathematics there; he also began the study of law, and was admitted to the bar in 1845. He did not practise, however, but shortly after went into the iron and steel business with his father-in-law, Edward Cooper. By careful and skilful management he built up the financial success of his firm (Cooper & Hewitt); which was the first to manufacture iron girders and supports for fire-proof buildings and bridges, and also furnished the government with large quantity of material during the Civil War. In dealing with his employees, he was particularly successful, never having any serious trouble; it was his policy to keep the works running and the men employed, at least part of the time during dull seasons, though the business was sometimes carried on at a loss. At the time of his death he was recognized as one of the foremost iron masters in the country, his firm controlling the Trenton Iron Co. and the New Jersey Iron and Steel Co. He organized the Cooper Union Institute (q.v.), and as the secretary of the board of trustees largely shaped and controlled its policy for a number of years. He also gave largely to the institution. He was first active in politics at the time of the reorganization of Tammany Hall after the overthrow of the Tweed Ring. He served in Congress 1874–8, and again 1880–6 and was always especially prominent in all matters pertaining to finance, advocating a low tariff and the gold standard. In 1876 he was chairman of the Democratic National Committee, and immediately after the election issued a proclamation to his party stating that Tilden had been elected; later he supported the policy of Tilden which resulted in the appointment of the Electoral Commission (q.v.). In 1886 he was nominated for mayor of New York by Tammany and other Democratic organizations and after a hard campaign won the election over Henry George and Theodore Roosevelt. As mayor he gave the city a most efficient administration, but his independent policy often antagonized the Tammany leaders, especially his strict enforcement of the excise law. He was not renominated by his party, and was defeated as a candidate on an independent ticket in 1888. While mayor he urged in one of his annual messages the need of improvement of the city's rapid transit, and advocated municipal ownership; though his suggestions were not heeded at the time, he continued his interest in the subject, and it was largely due to his efforts that recent improvements in that direction were undertaken; in recognition of his services the Chamber of Commerce presented him with a gold medal in 1901. In February 1903 a number of prominent citizens of New York set on foot a movement to raise a memorial fund of $500,000 to be presented to Cooper Union as the "Abram S. Hewitt Endowment of the Cooper Union."

Hewitt, John Napoleon Brinton, American ethnologist and linguist: b. on the Tuscarora reserve, Niagara County, N. Y., 16 Dec. 1859. For several years he assisted Mrs. Erminnie Smith (q.v.) in the linguistic researches she was making for the Bureau of Ethnology on the Tuscarora reserve, and he is now employed in linguistic work at the Smithsonian Institution.

Hewitt, Peter Cooper, American capitalist and inventor: b. New York 1861. He is the son of Abram S. Hewitt (q.v.), was educated at Stevens Institute, Hoboken, and Columbia College. He entered business with his father and invented improvements in the processes of the Peter Cooper glue factory, which the Hewitt firm controls. Turning his attention to electricity he invented the Cooper Hewitt lamp and static converter. The lamp in its present form consists of a glass tube of any desired shape with a bulb at one end which contains a small quantity of mercury. All air is exhausted from the tube, which thereupon fills with vapor from the mercury in the bulb. Electrodes are provided at each end of the lamp, the negative electrode in the bulb of mercury and the positive electrode at the opposite end. On passing a direct current through the lamp the vapor which fills the tube is rendered incandescent and gives off a steady, blue-white light. Owing to the great resistance at the negative electrode to the initial flow of current, it is necessary to use a high voltage to start the lamp. This is commonly done by passing a spark from a «choking» coil through the negative electrode, which when once penetrated offers but slight resistance to the flow of current. If for any reason the current is interrupted, the high resistance is immediately resumed and must be broken down again before permitting further flow of current.

The light given off by this lamp is entirely lacking in red rays, and consequently does not reveal the real color of the objects it falls upon. It is, however, of great value as a photographic illuminator being rich in actinic rays, which most affect the photographic plate. Mr. Hewitt is investigating with a view to discover means to turn some of the rays of the incandescent vapor into red rays. This discovery will be a means of great economy, because the Cooper Hewitt lamp is probably the cheapest artificial light in the world. The mercury vapor lamp consumes one half watt per candle-power, as against 3½ watts in the incandescent lamp.

Hewlett, hū'lĕt, **Maurice Henry**, English author: b. London 22 Jan. 1861. He was the son of Henry Gay Hewlett, a writer of some little note, and was educated at the London International College, Isleworth. He was admitted to the bar in 1891, and in 1896–1900 was keeper of the land revenue records and enrolments. His reputation was made as an interpreter of the more recondite phases of the life and thought of the Middle Ages, especially in Italy. His style is a skilful medium for his purpose, but frequently so archaized as to be somewhat difficult. His books are: 'Earthwork out of Tuscany' (1895), a collection of Italian studies; 'The Masque of Dead Florentines' (1895); 'Songs and Meditations' (1897); 'Pan and the Young Shepherd' (1898); 'The Forest Lovers' (1898), his first popular success; 'Little Novels of Italy' (1890); 'Richard Yea-and-Nay' (1900); 'New Canterbury Tales' (1901); 'Fond Adventures' (1904).

Hexam'eter (from the Greek ἕξ, six, and μέτρον, a measure), a verse of six feet. It is the heroic or epic measure of the Greeks and Romans, the finest examples of which are the two poems ascribed to Homer, the Iliad and the Odyssey, and the Æneid of Virgil. The sixth foot is always a spondee (two long syllables) or a trochee (a long and a short). The five first may be all dactyls (one long syllable and two short), or all spondees, or a mixture of both. The scheme of this verse then is —

—⏑⏑, —⏑⏑, —⏑⏑, —⏑⏑, —⏑⏑, — —
— —, — —, — —, — —, — —, — ⏑

with all the varieties which the mingling of the two kinds of feet, as mentioned, affords; as,

—⏑⏑, — —, — —, —⏑⏑, —⏑⏑, — —
Forte sub arguto consederat ilice Daphnis;

or, —⏑⏑, — —, —⏑⏑, —⏑⏑, —⏑⏑, — —
Qui Bavium non odit amet tua carmina, Mævi;

and so on. The variety of which the hexameter is susceptible, its great simplicity, its harmony, and its numerous pauses, constitute the charm of this verse, and adapt it to the most various subjects. A spondee is rarely used in the fifth foot, and then in Latin the word with which the verse ends is generally composed of four syllables, and the fourth foot at least must be a dactyl; as,

Cara deûm soboles, magnum Jovis incrementum.

The prevalence of the dactyl or spondee in the hexameter depends much upon the genius of the language; thus the dactyl is more frequent in Greek than in Latin, and in German than in Greek. It is evident that the hexameter cannot be formed in such languages as Italian, French, Spanish and English, whose prosody is regulated by the accent and not by the *quantity* of the words.

The French and Italian writers, however, early attempted the hexameter, as well as Sidney and Southey in English; but without success. More recent English poets have also tried it, as Clough and Kingsley. Longfellow has made use of the hexameter in his 'Evangeline.' But in no modern European language have hexameters become naturalized, except in German, to which this measure seems as well adapted as to the Greek. Fischart attempted the German hexameter in the 16th century. In the middle of the 18th century it was used by Klopstock, Uz, and Kleist. Goethe's hexameters are very often as poor as their sense is beautiful. John Henry Voss improved the German hexameter by the excellent translation of Homer and his valuable 'Zeitmessung der deutschen Sprache' (Königsberg 1802).

Hexapoda, hĕk-săp'ō-da, a group name for the six-footed arthropods, or true insects (*Insecta*), excluding spiders, myriapods and other forms often included in the term «insects.»

Hexateuch. See PENTATEUCH.

Hexoic Acid, an organic acid having the formula $C_6H_{12}O_2$, or $C_5H_{11}.COOH$, and occurring in fats, in cheese, among the products of the butyric fermentation of sugar, and in the fruit of *Heracleum sphondylium* and in the flowers of *Satyrium hircinum*. It is best prepared by the fractional distillation of crude fermentation butyric acid. It is an oily substance, very clear and mobile, solidifying at about 29° F., and boiling at 400° F. It has a specific gravity of 0.95, and is oxidized by nitric acid to acetic and succinic acids. It is also known as «caproic acid,» and its salts are sometimes called caproates, and sometimes hexoates.

Heyse, Paul, powl hī'zė, German poet and novelist: b. Berlin 15 March 1830. He studied classics in his native city, in 1852 traveled in Switzerland and Italy, and two years later he settled in Munich on the invitation of King Maximilian II. of Bavaria, who granted him a pension. He has lived mainly in Munich ever since, devoted almost exclusively to literature. His first work was 'Jungbrunnen, Märchen eines fahrenden Schülers' (Tales of a Traveling Scholar) (1850); and to the same year belongs his tragedy 'Francesca da Rimini.' 'Die Brüder' (1852) and 'Urica' (1852), were narrative poems, and formed part of the volume entitled 'Hermen' (1854), later 'Novellen in Versen,' which did much to establish his reputation. Heyse's genius has found its most perfect expression in his tales or novelettes (Novellen), and in this department of literature he holds almost a unique place among German writers. His work is almost throughout highly finished and artistic, and shows a rich imagination and great fertility in invention. His tales have been published in more than 20 collections, and a selection appeared in 1890 under the title 'Auswahl furs Haus.' His early successes in narrative verse were followed by such works as: 'Die Braut von Cyperin' (1856); 'Thekla' (1858); 'Rafael' (1863); 'Syritha' (1867); 'Der Salamander' (1879); 'Die Madonna im Ölwald' (1879); 'Liebeszauber' (1889). His best plays are those of his third period, and some of them, especially 'Hans Lange' and 'Kolberg,' have been acted with great success. 'Mary of Magdala' was well received in America. Among them are: 'Die Hochzeit auf dem Aventin' (1886); 'Gott schütze mich vor meinen Freunden' (1888); 'Hans Lange' (1866); 'Kolberg' (1868); 'Die Weisheit Salomos' (1887); 'Weltuntergang' (1889); 'Die schlimmen Brüder' (1891); 'Wahrheit?' (1892); and 'Jungfer Justine' (1893). His larger novels, 'Kinder der Welt' (1873); 'Im Paradiese' (1875); 'Merlin' (1892); and 'Über allen Gipfeln' (1895), have met with great success. Among other works are: 'Skizzenbuch' (1877); 'Verse aus Italien' (1880); 'Spruchbuchlein' (1885); 'Gedichte' (Poems, 5th ed. 1895; and 'Neue Gedichte und Jugendlieder' (1897).

Heyward, hā'ward, **Thomas, Jr.**, American patriot: b. St. Luke's Parish, S. C., 1746; d. there 6 March 1809. He was of much prominence in North Carolina during the Revolution, was a delegate to the Continental Congress 1775–8 and one of the signers of the Declaration of Independence. In later years he was a judge in his native State.

Heywood, John, English dramatist of the first half of the 16th century. He was a paid musician at the court of Henry VIII., with whom he became a favorite on account of his skill in music. Heywood's dramatic works may be classed as interludes, standing between the miracle-plays and the drama proper. The earliest of them, 'A Merry Play between the Pardoner and the Frere, the Curate and Neybour Pratte,' was written before 1521. Another famous piece is 'The Four P's,' an interlude in which figure a Palmer, a Pardoner, a Potycary, and a Pedlar.' His allegory of the 'Spider and the Fly' (1556) fully reveals Heywood's religious proclivities. By spiders, the Protestants are meant; by flies, the Catholics.

Heywood, Thomas, English dramatist b. Lincolnshire. He was educated at Cambridge and appears to have been writing plays as early as 1596. Of all the old dramatists he was the most prolific. We learn from the preface to 'The English Traveller' that down to 1633 he had "had either an entire hand, or at the least a main finger," in the composition of 220 plays" and he continued for some years after that date to write for the stage.

Twenty-four of Heywood's plays have been preserved. The best is 'A Woman kilde with Kindnesse' (1607). His work is usually distinguished by naturalness and simplicity; but he wrote at the beginning of his career one absurdly grandiose play, 'The Foure Prentises of London' (1615), which was parodied in Beaumont and Fletcher's 'Knight of the Burning Pestle.' 'The Rape of Lucreece' (1608) is chiefly noticeable for its songs; 'Love's Maistresse' (1636), dealing with the story of Cupid and Psyche, is fanciful and ingenious; and there is much tenderness in 'A Challenge for Beautie' (1636). 'The Captives, or the Lost Recovered,' an interesting play, acted in 1624, was first published in 1885.

Hezekiah, hĕz-e-kī'a (*Hizkiyah*, generally *Hizkiyahu*, strength of Jehovah), the 12th king of Judah. At 25 he succeeded Ahaz about 720 B.C., about 698 B.C. He had no sonner mounted the throne than he initiated a system of reform, on the injunctions of Isaiah, and broke up the idolatrous customs into which the people had fallen during the life of his father. He also endeavored to repair the injury done by national defeats and losses. He purged, repaired, and reopened the temple with magnificent sacrifices and a splendid ceremonial. So extreme was his indignation against idolatry that he destroyed the brazen serpent which was said to be the one used by Moses in his miraculous healing of the Israelites. With patriotic zeal he assumed the aggressive against the Philistines, and not only rewon the cities lost by his father, but dispossessed them of most of their own. In the 14th year of Hezekiah's reign he had a dangerous illness, which threatened serious complications, and the kingdom was in a difficult crisis, for the king had no heir, Manasseh not being born till long afterward. The greater part of the Scripture records bearing on the reign of Hezekiah is occupied by the two invasions of Sennacherib. Several of the Psalms are supposed to allude to the discomfiture of Sennacherib, for example, xlvi.-xlviii., lxxvi. Hezekiah did not long survive this deliverance, dying after a reign of nearly 29 years. Among the many highly useful works executed by him, the aqueducts of Jerusalem are of especial importance.

Hiawatha, hī-a-wä'ta or -tha, the hero of an American Indian legend known by this name among the Iroquois and among the other tribes. He is mentioned in various works on the aborigines, and in 1855 was immortalized in the poem, 'Hiawatha,' by Longfellow.

Hiawatha, Kan., city, county-seat of Brown County; on the Saint Joseph & G. I. and the Missouri P. R.R.'s; about 70 miles northwest of Kansas City and 55 miles north of Topeka. It is situated in a rich agricultural region. Its chief manufactures are flour, foundry products and agricultural implements. Its trade is principally in wheat, corn, fruit, livestock, flour, and lumber. It has the Morrill Public Library and an academy. The city owns and operates the waterworks and an electric-light plant. Another electric-light plant is owned by a private corporation. Pop. (1900) 2,829.

Hib'bard, George Abiah, American writer of short stories: b. Buffalo, N. Y., 1858. He has written 'Iduna, and Other Stories'; 'Nowadays'; 'The Governor'; etc. His work is marked by finished style and much insight into character.

Hib'ben, John Grier, American logician: b. Peoria, Ill., 19 April 1861. He was graduated from Princeton 1887 and is now professor of logic there. He is author of 'Inductive Logic' (1896); 'The Problems of Philosophy' (1898).

Hiberna'tion, the winter sleep of warm-blooded animals. Under this term is also included the torpidity of frogs, toads, reptiles, certain fishes, insects, the horseshoe crab and snails, which is mainly due to prolonged cold. Among the mammals which hibernate are the bear, dormouse, badger, bat and hamster; a number are incomplete hibernators, as the prairie dog, while squirrels fall into a winter sleep during the coldest weather, but may be seen in warm spells in winter. The males of the black and white bear are more or less active during the winter months, while the females are hibernating. The same species, like the skunk, may in the southern portion of its range not hibernate at all. Neither do the hibernators all retire to their holes or dens or under fallen trees at the same date, but the time varies with the temperature, and different degrees of torpidity are exhibited. It also appears that continuous hibernators do not lay in a supply of food, as do intermittent ones like squirrels; yet the Arctic fox is said to store up a supply of dead lemmings, ermines, geese, etc.

Hibernation is like sleep, and has been compared with trance. During this period the animal functions are nearly suspended, the excretions are greatly diminshed and in the bears the rectum is closed by a resinous plug, called by the Swedes "tappen," and by American hunters "seal." The animal heat is lowered to that or nearly that of the air, the action of the heart being slight; there is an increased muscular irritability, and the animal loses from 30 to 40 per cent of weight.

Snakes, lizards, the toad, frogs, salamanders, and certain fishes hibernate, burying themselves in the earth below the reach of frost, the aquatic forms digging into the mud at the bottom of streams. The few fishes which are known to lie dormant and take no food sink into the mud of streams or of the sea. The horseshoe crab burrows in the mud beyond the reach of oyster dredges in November, remaining in deep water until the middle of spring. Most insects hibernate in the larva or pupa state, a few as moths or butterflies. Caterpillars hide under moss, the bark of trees, etc., but they freeze solid and may be broken into two pieces like an icicle. They gradually thaw out in spring; when the changes are sudden, great numbers die. Spiders and snails hibernate under stones, moss, etc., while slugs bury themselves in the mud, and those mussels and other mollusks living in streams and lakes descend into the mud.

Estivation.— In the tropics there is a corresponding period of torpor during the hot, dry season, when food is scarce, and vegetation is taking a rest. Alligators, snakes, certain mammals, as the tauree, insects and land snails become dormant, the latter closing the mouth of their shells with a membrane-like substance (epiphragm), leaving a small opening in it for the admission of air in breathing, yet after a prolonged shower they become active. Thus it is seen that heat, dryness and the lack of food operate in causing estivation, while cold and famine appear to be the cause of hibernation; though all species are by no means affected alike. Among the lowest organisms the dormant vitality of resting spores, seeds of plants, winter eggs of sponges, of polyzoa, the dormancy of certain adult forms, are connected with a lowered temperature, and a resting period is necessary both in plants and animals. The simultaneous shedding of the leaves of deciduous trees is certainly connected with if not caused by cold, and it is undoubtedly true that changes of temperature as well as lack of food, and the need of rest, cause hibernation and summer dormancy.

Hibernia, the ancient name applied to Ireland (q.v.).

Hiber'nians of American, Ancient Order of, an Irish-American secret society founded in 1836. It has one general or national board, with 2,002 subordinate divisions. There were 139,453 members in 1902. The benefits disbursed the same year amounted to $429,000. National president (1902), J. T. Keating, Chicago, Ill.

Hibiscus, hī-bĭs-kŭs, a genus of plants of the mallow family (q.v.), distinguished by a double calyx and fruit of three or more many-seeded carpels united into a many-seeded capsule. The species are numerous, natives of warm climates, some trees or shrubs, but most of them large herbaceous plants. Many bear very beautiful flowers, much used in the South Sea Islands in wreaths, etc., for personal adornment. The rose-of-Sharon (*Hibiscus syriacus*), a native of Syria and Carniola, has long been in cultivation as an ornamental shrub. Several other species have become favorite hothouse plants. The scarlet hibiscus (*H. coccineus*) and the rose-mallow (*H. moscheutos*) are among the most striking and beautiful of North American wild flowers, glowing among the reeds of marshes in late summer in flame-color and pink. The characteristic mucilaginous and fibrous properties of the Malvaceæ are very strongly developed in this tribe. The fruit of *H. esculentus*, called gumbo, okra, etc., is in general use for food in the East and West Indies and the United States. It is an annual plant, with a soft herbaceous stem, three to five feet high, crenate leaves, axillary sulphur-colored flowers, and pyramidal, somewhat podlike capsules. The fruit is used in an unripe state, and is generally much esteemed, but is disliked by some on account of its viscidity. It enters as an important ingredient into the pepper-pot of the West Indies, or is used in soups. It also produces a coarse fibre. The bark of *H. tiliaceus*, a tree 20 feet high, with a very thick bole, abounds in mucilage. This tree is one of the most abundant trees of the South Sea Islands; and the wood, being light, tough, and durable, is much used for many purposes. From its fibre the Tahitians manufacture matting. Many other species yield fibres, some coarse, some fine and beautiful, which are used in different countries: but the most important in this respect is *H. cannabinus,* the Deccan hemp of western India (see Hemp). *H. sabdariffa* is very generally cultivated in warm countries, on account of its calyx, which, as the fruit ripens, becomes fleshy, and acquires a very pleasant acidity. It is much used for making tarts and jelly, and a decoction of it, sweetened and fermented, affords a refreshing beverage, well known in the West Indies as sorrel cool drink, the plant being called red sorrel; and in Madras it is used for similar purposes, and is named rozelle or rouselle. Musk-seed (*H. abelmoschus*) is cultivated for its seeds, which have a fragrance between that of musk and that of amber. They are much used by perfumers, and are called *graines d'ambrette.* In Egypt and Arabia they are mixed with coffee, and stimulant and stomachic qualities are ascribed to them. The petals of *H. rosa-sinensis* possess astringent properties, and they are also used by the Chinese to stain their eyebrows and their shoes black.

Hic'cup, or Hiccough, is a spasmodic affection of the diaphragm caused sympathetically by the irritation of structures supplied by nerves communicating with the phrenic nerve. Though generally a slight and passing inconvenience, its occurrence in the last stages of acute disease is a grave symptom, indicating general collapse of the nervous system. It may last only a few minutes or may continue for weeks without being capable of being subdued by any kind of treatment. Fasting or a stimulant suddenly swallowed is one of the commonest causes of hiccup, which generally passes off of its own accord. Nothing removes it more effectually than some active emotion of the mind suddenly excited. Hiccup is a common attendant of dyspepsia, and is often observed in abdominal diseases when terminating fatally, and is especially a symptom in some forms of hernia. Many remedies have been suggested for it, such as holding the breath as long as possible, tying a belt tightly round the waist, and the frequent swallowing of small rounded pieces of ice.

Hi h'born, Philip, American naval officer: b. Charlestown, Mass., 1839. In 1869 he entered the United States navy as assistant constructor, in 1875 was made constructor, and in 1881 a member of the naval advisory board. From 1893 until his retirement 4 March 1901, he was chief constructor, and as such was identified with the reorganization and enlargement of the new United States navy. He attained rear-admiral's rank, and published a valuable report on foreign dockyards.

Hich'ens, Robert Smythe, English journalist and novelist: b. Speldhurst, Kent, 14 Nov. 1864. He was educated at Clifton College and the Royal College of Music, and after a short career as a musician turned to journalism. In 1893 he visited Egypt for his health, and there conceived the idea which materialized in the 'Imaginative Man' (1895). 'The Green Carnation' (1894), however, epigrammatic and keenly satirical in tone, first brought him into public notice. Later works of his are: 'After To-Morrow' (1895); 'New Love' (1895); 'The Folly of Eustace and Other Stories' (1896); 'The Londoners' (1897); 'Byeways' (1897); 'The Prophet of Berkeley Square' (1901); etc.

Hick'ey, Emily, English poet: b. Macine Castle, County Wexford, Ireland, about 1845. She was co-founder in 1881 of the Browning Society with F. J. Furnivall (q.v.) and has lectured on English literature. She has published among other volumes 'A Sculptor and Other Poems' (1881); 'Verse Tales, Lyrics, and Translations' (1889); 'Our Lady of May and Other Poems' (1902). Her verse has been highly praised by critics.

Hickey Plot (1776), a conspiracy of the British officials and Loyalists of New York to end the Revolutionary war by the murder or capture of its leaders and the seizure or destruction of its supplies. The heads and probable devisers of it were Governor Tryon, who had fled from the city but remained on a man-of-war in the harbor, and sent supplies of money for bribery, etc.; and Mayor Mathews. The scheme was to kill or seize the patriot generals, and at all events to deliver Washington alive to Sir William Howe, blow up the magazine and secure the passes to the city. Several hundred New York Loyalists were involved. Two of Washington's guard were bought, but a third pretended to accede and revealed the plot. Mathews, a gunsmith named Forbes, and a dozen others were arrested and sent to Connecticut, Mathews carrying the mayoralty flag with him. Thomas Hickey, one of the treacherous guards, was hanged in New York 27 June 1776, the first military execution in the American army.

Hick'man, Ky., town, county-seat of Fulton County; on the Mississippi River, and on the Nashville, C. & St. L. railroad; about 35 miles below Cairo, Ill. It has steamboat connections with the river ports. It is the seat of Hickman College. Its chief industrial establishments are a flour-mill, wagon-factory, two spoke-factories, saw- and planing-mills. Its trade, in addition to its own manufactured articles, is principally in grain and tobacco. Pop. (1900) 1,589.

Hick'ok, Laurens Perseus, American metaphysician: b. Danbury, Conn., 29 Dec. 1798; d. Amherst, Mass., 6 May 1888. He was graduated at Union College in 1820, was licensed as a preacher in 1822, and was pastor successively at Newton and Litchfield, Conn., till in 1836 he was elected professor of theology in the Western Reserve College, Ohio, where he remained eight years. He was professor in the Auburn Theological Seminary 1844–52, and then became professor of mental and moral science, and vice-president in Union College. In 1866 he was formally made president of that institution of which, however, he had been in sole charge for eight years previous. His publications include among other works 'Rational Psychology' (1848); 'Moral Science' (1853); 'Empirical Psychology, or the Human Mind as Given in Consciousness' (1854); 'Rational Cosmology' (New York 1858), in which he attempts to demonstrate *a priori* the laws of the universe; 'Creator and Creation' (1872); 'Humanity Immortal' (1872); 'Logic of Reason' (1875).

Hick'ory (formerly Hickory Tavern), N. C., town in Catawba County; on the Southern railway; near the headwaters of the Catawba

River; about 43 miles northwest of Charlotte and 50 miles west of Salisbury. The chief manufactures are flour, foundry products, wagons, lumber, leather, boots and shoes. It has several private educational institutions: Claremont Female College, opened in 1880; Saint Paul's Lutheran Seminary; Lenoir College, opened in 1891, under the auspices of the Lutheran Church. Pop. (1900) 2,535.

Hickory, a group of trees of the walnut, forming the genus *Hicoria*, and exclusively North American. They are large strong trees, 60 to 80 feet high, with close shaggy bark and large pinnately divided leaves, pistillate flowers on a terminal peduncle and staminate flowers in long, drooping aments. The fruit is a thick-shelled nut in a tough green husk. There are about 10 species, all natives of the eastern United States and Canada except a Mexican species. The best known of these are the following: Shag-bark, shell-bark or white hickory (*H. ovata*), leaflets 5 to 7, whose bark scales off in great plates curving outward at both ends, and whose nuts are sweeter and better than those of any other species; the northerly "big shag-bark" or king-nut (*H. laciniosa*), leaflets 7 to 9, with narrower "shags," darker wood and big nuts in husks often three inches long; white-heart, or fragrant hickory, or mocker-nut (*H. alba*), noted for the hardness and toughness of its wood; the pignut or broom hickory (*H. globra*), leaflets 3 to 7, which represents a group of moisture-loving species whose nuts are thin-husked, elongated and bitter and estringent to the taste. Associated with these is the pecan (*H. pecan*), of the Southern States, whose oblong, thin-shelled nut is one of the most delicious of all nuts, and is now being cultivated in a few places in order to supply the increasing demand. The water hickory (*H. aquatica*) is sometimes called the bitter pecan.

Uses of Hickory-wood.—As timber this wood is of great value for articles requiring great strength with lightness and elasticity; but it is liable to quick decay when exposed to the atmosphere, and for this reason is little used in building, and should be painted. It was the most serviceable of all woods to the aboriginal Americans; and the axe, pick, and tool handles made from it are exported to all parts of the world. It enters into the manufacture of rakes, cradles, and many forms of farm-implements; is largely used in carriage-making, especially for thills, shafts, and the parts of racing-sulkies, the lighter American vehicles owing their acknowledged pre-eminence largely to the availability of this wood. The wood of the various species differs in quality, however; that of the pecan is hard and brittle, and the water hickory soft and comparatively light. The wood of the others is exceedingly strong and tenacious, and weighs about 50 pounds to the cubic foot.

Insect Pests.—A. S. Packard recorded in 1890 170 species of insects attacking the hickories; and Chittenden declared in 1903 that this number could be easily doubled. Hickory appears to be an especial favorite of borers. Prominent among them are the painted hickory-borer, one of the long-horned beetles (*Cyllene picta*); the hickory twig-girdler (*Oncideres cingulata*), twig-pruner (*Elaphidion villosum*), and hickory-bark beetle (*Scolytus quadrispinosus*). This bark-borer is the most important economic species, and during recent years has been the cause of considerable injury in hickory forests in the State of New York. Consult Packard, 'Insects Injurious to Forest and Shade Trees,' published in 1888 as the fifth report of the United States Entomological Commission.

Hickory Shad. See GIZZARD SHAD.

Hicks, Elias, American preacher of the Society of Friends: b. Hempstead, L. I., 19 March 1748; d. Jericho, L. I., 27 Feb. 1830. While a youth he manifested a talent for public speaking, and at 27 was a well known preacher. For many years he labored zealously in advancing the generally accepted doctrines of the Friends; but having as he believed discovered errors in these tenets, put forth views of his own which he defended with energy and ability. To advance these views he traveled extensively in the United States and in the British provinces, attracting large congregations by his oratory. The result was a schism in the body of Friends; those adhering to the old doctrines being specially termed orthodox, while the followers of Hicks were called after him Hicksites. (See FRIENDS.) He was an active abolitionist and with others was instrumental in inducing the State of New York to pass an act which, on 4 July 1827, liberated all slaves within its borders. He was the author of 'Sermons' (1828); 'Observations on Slavery' (1811); 'The Letters of Elias Hicks' (1834); etc. See 'Elias Hicks, Journal of his Life and Labors' (1828).

Hicks, Thomas, American painter: b. Newton, Pa., 18 Oct. 1823; d. 1890. He studied at the Philadelphia Academy, at the National Academy, New York, and afterward in Paris under Couture. Settling in New York he became one of the favorite portrait painters of his day. His pictures in the rooms of the New York Historical Society form an interesting gallery of historic figures, executed with more than ordinary artistic skill.

Hicks, Thomas Holliday, American politician: b. Dorchester County, Md., 2 Sept. 1798; d. Washington, D. C., 13 Feb. 1865. After successively occupying the positions of sheriff, member of the State legislature, member of the State electoral college, and member of the Governor's council, he was in 1858 elected governor of the State. When war was threatened between North and South, although sympathizing with the South and condemning the North's attitude on the slavery question, he sided with the party of neutrality in Maryland and opposed the secession of that State. When there were rumors of a plot formed by 6,000 men of his State to prevent Lincoln's inauguration and seize the city of Washington he suspended the writ of habeas corpus, and planned the arrest of suspected persons. He was the only prominent State official who stood by the Federal government, and at the expiration of his term as governor the new Legislature passed resolutions thanking him for having saved the State from joining the Confederates. In 1862 he was appointed to the senate of the United States and served in it till his death.

Hicks-Beach, SIR Michael Edward, English politician: b. London 1837. He was educated at Eton and Oxford, entered parliament in 1864, and was made chief secretary for Ireland in 1874, and secretary of state for the colonies in 1898. In 1885 he was appointed chancellor of the exchequer and leader of the Conservative party in the House of Commons. He was president of the board of trade from 1888 to 1892. On the fall of the Gladstone ministry in 1895 he again became chancellor of the exchequer. In October, 1902, he caused a sensation by charging the Balfour government with wasteful expenditure of war appropriations, and in 1903 ably defended the British policy of free trade.

Hick'son, Sydney John, English zoologist: b. London 25 June 1859. He was educated at Cambridge and has been professor of zoology at Owens College, Manchester, England, from 1894. He has published 'A Naturalist in North Celebes'; 'The Fauna of the Deep Seas'; 'The Story of Life in the Seas' (1898).

Hidalgo y Costilla, Miguel, mē-gĕl' ē-dăl'-gō ē kōs-tēl'ya, Mexican revolutionist, first leader in the Mexican war of independence: b. State of Guanajuato 8 May 1753; shot in Chihuahua, Mexico, 27 July 1811. He was a priest, and in earlier life was simply a man of great acquirements, anxious to promote industry in Mexico, and noted for conscientious fulfilment of his ecclesiastical functions. He is said to have introduced the silkworm into Mexico, and did much to promote the culture of the vine. This conflicted with the policy of the Spanish government, which was to discourage all manufactures or agriculture which could interfere with the revenue, and the vines Hidalgo had planted were destroyed. This drove him to rebellion. Possessing much influence among the Indians, he formed the plan of a general insurrection, which was to take place 1 Nov. 1810; but the plot having been disclosed by one of the conspirators, some of his party were arrested, and he was obliged to precipitate his movements. On 10 September having been joined by three officers of the garrison of Guanajuato, he raised the standard of revolt. His eloquence had a remarkable effect on the multitude who heard him, and when after his oration he unfurled a rude copy of the picture of Our Lady of Guadalupe, the patroness of Mexico, the war assumed the character of a crusade. On 29 September with an army of 20,000 men, mostly Indians, he captured Guanajuato. He took Valladolid and several small places, and soon after was proclaimed generalissimo of the Mexican army, and advanced against Mexico; but finding himself almost without ammunition, was obliged to retreat. During this war the government party declared that the ordinary rules of warfare need not be observed as regarded the insurgents, while the latter retaliated with the most horrible atrocities. On one occasion Hidalgo is said to have massacred 700 prisoners because they were Europeans. After several defeats the insurgents were left at Saltillo under charge of Rayon, while Hidalgo and others went to the United States to obtain arms and military aid. On their way they were captured by a former friend, and finally shot in Chihuahua. He was after his death regarded as a saint by the people, and within a few years the place of his execution was shown to travelers as a holy spot. The town of Goliad, Texas, was named in his honor, the H, as silent in pronunciation, being omitted and the other letters rearranged. At the founding of the town the name of Hidalgo was still proscribed by the Spanish rulers and the transposition of the letters of his name was made in order to avert the attention of the authorities.

Hid'denite, a yellowish-green or emerald-green, transparent variety of spodumene, discovered by W. E. Hidden, in 1880, in Alexander County, N. C. The emerald-green varieties have been used as gems. They resemble the emerald, but show a greater wealth of color on account of their pleochroism.

Hides and Leather. There are few arts, among the many that are used for the benefit of mankind to-day, that are of such ancient origin as that of tanning. It is only necessary to study the carvings upon the monuments that the modern archæologist has unearthed to ascertain the fact that the old Egyptians were not only acquainted with several processes of tanning and working in leather, but that its preparation was one of the most important branches of Egyptian industry. So far as our knowledge of their methods of work extends, we know that these ancient workmen prepared their tan in earthen vessels and that they were able to preserve skin either with or without the hair attached. Among the Hebrews, who undoubtedly derived their knowledge of the art of preparing leather from the Egyptians, the trade of the tanner was despised, largely because of the bad odor connected with it, and those who followed this source of livelihood were obliged to locate their working places outside the limits of the city. Often they were situated by the side of streams, or on the shore of the sea, as was the case in Joppa, where the building said to have been the house of Simon the Tanner was located on the shore south of the city.

According to the most authentic records the first tannery to be operated in this country was established in Virginia, about the year 1630. A year or two later another tannery was established in New England, in the village of Swampscott, or Lynn, Mass., by Francis Ingalls, a colonist who had learned his trade in Lincolnshire, England. As it was impossible not to recognize the importance of the industry it was greatly encouraged by the colonial authorities, in evidence of which fact there are many laws on the old statute books regulating, not only the manufacture of leather, but the saving of skins needed by the tanners, under serious penalties for noncompliance. For example, a law was passed in Massachusetts, in 1646, prohibiting the exportation of raw hides, or unwrought leather, under heavy penalties which not only affected the shipper, but reacted upon the master of the vessel that attempted to sail with such freight, for these were the days when the small tanners who had shops scattered throughout the country were entirely dependent upon the surrounding neighborhood for their hides, but so effective were the restrictions placed upon importations of skins by the authorities, that leather was relatively more plentiful in the American colonies than it was in England.

One of the most prominent leather manufacturers of the old days was Colonel William Edwards, who sent the first tanned leather to the Boston market in 1794. Beginning his business in Hampshire about 1790, when he was less than 20 years of age, he immediately inaugurated a series of improvements in the mechanical branch of the art, which, as they were afterward adopted and extended by others, were the means of infusing a much-needed spirit of enterprise into the business. In fact, it was the new ideas in mechanism and in the arrangement of the tannery which he evolved that paved the way for the most important improvements which have since been made in the manufacture of leather. The first company in the business to be incorporated also owed its existence to Colonel Edwards' enterprise, for it was his extensive tanneries at Northampton, Cummington, and Chester that were purchased by the men who incorporated the Hampshire Leather Manufacturing Company of Massachusetts, with a capital of $100,000 in 1809. These works then had a capacity of 16,000 full-grown hides per annum.

By 1810, the tanning industry had extended so widely that there were tanneries in operation in almost every portion of the country. Bark was so plentiful that it was much cheaper than in England, and, as the result, it was not long before the exportations of American leather had attained an aggregate of 350,000 pounds per annum, while the importations were confined to morocco, and some peculiar kinds of English leather which could not then be produced in this country. At this time (1810) the value of all the manufactures of hides and skins was stated by the census office to be $17,935,447, but, owing to the fact that the census at that time was so crudely conducted that it was very incomplete, it is safe to say that $20,000,000 would be much closer to the correct figure. From that date, however, the business increased, slowly at times, perhaps, but steadily, until, in 1840, it was reported that there were about 8,000 tanneries in the country, with a capital of $16,000,000, and employment for fully 26,000 hands. By 1850, the capital had increased to more than $20,000,000, while the value of the annual product had reached the quite respectable figure of $38,000,000. In 1860, this product, including the making of morocco and patent leather, had almost doubled, being in excess of $72,000,000, while, in 1870, the 7,569 establishments in the country were employing no less than 35,243 persons, at an aggregate wage of $14,505,775, to produce an annual output that was valued at $157,237,597. At this time the capital invested in this business was reported as being more than $61,000,000.

As the establishments engaged in the making of leather were enumerated very differently by the census of 1890 and 1880, it is quite impossible to obtain a reliable basis of comparison from the published statistics. In preparing the census of 1880, the government's enumerators not only counted all the smaller businesses, but they must have reckoned twice all that were engaged in both tanning and currying, with the result that they were able to make an aggregate of 5,628 establishments. As the later census enumerators have confined their attention solely to the large establishments the discrepancy is too great to be readjusted by estimate. Thus, for example, the 1890 census reports 1,787 establishments, while the 1900 census has but 1,306. The other census figures follow:

THE LEATHER INDUSTRY, 1880 TO 1900.

	1880	1890	1900
Capital	$73,3[illegible],911	[illegible]	$173,977,421
Number of employees	40,282	42,3[illegible]	52,109
Wages paid	$10,5[illegible],826	$21,249,98[illegible]	$22,[illegible]1,092
Cost of material used	156,384,117	132,04[illegible],741	155,[illegible],004
Value of product	[illegible]	17[illegible],130,0[illegible]2	[illegible]4,[illegible]8,127

Among the first patents taken out for the application of any special process in the making of leather was in 1823, when an inventor patented a method of forcing the tanning liquor through the skin by hydrostatic pressure. In 1831, William Drake devised a modification of this method. According to his process two skins were sewed together and the liquid, which was placed in the receptacle thus formed, was permitted to remain until the tanning had been completed. Some years prior to that time a patent had been issued for a method which provided for the suspension of the hides in a closed vessel, in which their conversion into leather would be much accelerated by the removal of

LEATHER PATENTS.

Purpose for which Issued	Date of First Patent	Approximate Total Number of Patents to Date
Processes and apparatus for leaching and making extracts from tan-bark	Aug. 10, 1791	100
Bark-mills	July 19, 1794	100
Processes employing apparatus for tanning leather	July 9, 1808	100
Leather-splitting machine	July 9, 1808	75
Unhairing machine	July 12, 1812	75
For rolling leather	Oct. 19, 1812	25
Scouring and setting machine	Nov. 21, 1831	70
Tanners' vats and handling appliances	Jan. 9, 1834	75
Machines for boarding and graining leather	March 25, 1835	35
Compounds for depilating hides and skins	June 30, 1836	60
For fleshing machines	June 17, 1837	25
Compounds for bating hides and skins	Feb. 3, 1838	40
Whitening, buffing, and shaving leather	May 10, 1838	30
Compounds and materials for tanning and tawing leather and preparing raw hides	July 12, 1838	175
Processes for tanning leather	Aug. 1, 1838	275
For currying leather	Aug. 1, 1838	25
Machines for stoning, polishing, finishing, glassing, glazing, flinting, creasing, and dicing leather	March 15, 1845	75
Compounds for coloring and polishing leather	Oct. 9, 1847	40
Methods for manufacturing enameled, japanned, and patent leather	Jan. 9, 1855	20
For stuffing leather	Feb. 6, 1[illegible]	20
For pebbling leather	May 6, 185[illegible]	30
For employing mineral substances for tawing hides and skins	Aug. 4, 1857	20
For stretching leather	Feb. 8, 18[illegible]	40
Bark-rossing machines	Jan. 9, 18[illegible]	10
For preserving hides	Sept. 11, 18[illegible]	15
Machines for shaving or making leather of uniform thickness	Sept. 24, 1867	5
Apparatus for blacking leather	Sept. 20, 1870	15
Measuring-machines	Aug. 28, 1877	25
Striking-out machines	March 27, 1883	4

all the air by an air-pump. To enumerate all, or even the most important of these inventions within any brief space would be impossible, but the preceding table gives the date when the first patent was issued for each of the details which enter into the manufacture of leather, as well as an estimate of the number of patents that have been issued in each division of the endustry up to the present time.

Hides, as the term is generally accepted today, may be conveniently divided into three classes: (1) Hides proper, which consist of the skins of the larger and more common animals, such as oxen, cows, and horses; (2) kips, which comprise the skins of small, or yearling cattle, which are too large to be classified as calfskins, and (3) skins, including those of calves, sheep, goats, deer, pigs, seal, and the various kinds of fur-bearing animals, many of which, including most of the latter, retain their hair after tanning. The heavy hides are converted into sole, belt, and harness leather; the calfskins are chiefly used for material for the manufacture of the uppers for leather shoes and boots, and are also in much demand by bookbinders; the sheepskins are used for a large variety of purposes, including linings for shoes, aprons, cushions, and covers, gloves, women's shoes, bellows, whips, etc.; the goatskins are used almost exclusively in the making of gloves and ladies' shoes—the morocco leather so extensively manufactured until recent years having now given place to the cheaper and more durable "glazed kid"; the hogskins are utilized in the making of saddle-leather, traveling bags, etc., while dogskins, because of their thin and tough characteristics, are particularly useful in the manufacture of gloves. The durability of the porpoise-skin has recommended its use in the making of shoe-strings, while the buffalo, alligator, kangaroo, deer, elephant, hippopotamus, rhinoceros, walrus, and shark, are among the many other creatures whose skins are utilized in various fields of manufacture after they have left the hands of the tanner.

There is probably no vegetable growth containing tannin that has not been tried by those who are interested in discovering the best and most economical methods of tanning leather, but, while nearly all of them have met with some favor, oak-bark is now held to be the best agent obtainable for this purpose. Among the other tannages that have been utilized with success, however, one may mention hemlock-bark, union, Dongola, alum, chrome, combination, electric, sumac, and gambier.

Practically the only change that has taken place in the tannage process of sole-leather is represented by a slight diminution in the time required for the work, but as experiments are constantly being made along these lines it is believed that the day will come when such leather will be turned out in as many days—perhaps hours—as it now takes weeks. The change that has already been made along these lines in the preparation of the lighter skins has been almost as radical. The introduction of Dongola kid, in 1880, completely revolutionized the manufacture of kid or morocco. It was the discovery of James Kent, of Gloversville, N. Y. The system of tanning, or tawing by the use of chromium compounds, was discovered as early as 1856 by a German chemist, but each of the many experiments which followed this discovery had failed because there was no known method by which the tannage could be made permanent. At last it was found that hyposulphite of sodium contained the long-sought remedy, and by this process the tannage was made lasting. It was due to this discovery, and to its successful application, that some of the largest and best equipped leather manufactories in the world have since been established in the United States.

Hierarchy, hī'ē-rär-kĭ (From Gr. *hieros*, sacred, and *arche* government), sacred government or "the administration of sacred things," first used by the pseudo-Dionysius in the 5th century in his work on the Celestial and Ecclesiastical Hierarchies. It is now generally used to signify the body of officials in the Church organically graduated in their ranks and orders from the supreme head to those in the most subordinate position. In the Roman Catholic Church a threefold distinction is recognized: (1) A hierarchy of divine right, which embraces, under the primacy of the popes, bishops, priests, and deacons. This hierarchy is held by Church to be of divine institution. (2) A hierarchy by ecclesiastical right, consisting of the Roman pontiff and the three original divine orders and of the five minor orders (two in the East), subdeacons, acolytes, exorcists, lectors, and porters (ostiarii). (3) A hierarchy of jurisdiction, which includes all the judicial and administrative authorities, ordinary and delegated, charged with the maintenance of the faith among Christians, its union, its discipline, and its general care and supervision. All its powers proceed from the pope as primate, either expressly or by implication. In this category are ranked cardinals, patriarchs, exarchs, metropolitans, and archbishops, and as deriving their powers from these, archpriests, archdeacons, rural-deans, vicars-general, etc. The Anglican Church also recognizes a hierarchical rank in its body, comprising bishops, priests, and deacons. The other Protestant bodies practically reject hierarchical government.

Hiero, I., hī'ē-rō, king of Syracuse in Sicily: d. Catania, 467 B.C. He was brother and successor of Gelon. Hiero's reign, though less glorious than the preceding, was marked by a peculiar splendor on account of his generous encouragement of learning. Though some blemishes tarnish the first years of Hiero's reign, he compensated for his first faults by the noble actions which signalized the remainder of his life. A long sickness was the main cause of this alteration. Since he could no longer occupy himself with the cares of royalty, he collected around him a society of learned men, and thus becoming acquainted with the pleasures of learning, he never afterward ceased to value it. His court became the rendezvous of the most distinguished men of his time. The names of Simonides and Pindar appear among those of his most constant companions, and when Æschylus left Greece, he betook himself to Hiero, to close his days in his kingdom. He was several times victor in the Grecian games.

Hiero II., king of Syracuse: b. before 306 B.C.; d. 216 B.C. He was the son of Hierocles, a noble Syracusan, who claimed a descent from the family of Gelon. During Hiero's reign began the first Punic war, and he was able, by his adroitness, to preserve the friendship of both Romans and Carthaginians. The glory of Hiero and the prosperity of Syracuse culminated in the period which intervened between the first Punic war and the second; for in that season of peace Hiero enacted wise laws, and was devoted to the happiness of his subjects. His encouragement of agricultural pursuits enriched him and doubled the revenues of the state. He left the crown to his grandson Hieronymus.

Hieronymus. See JEROME, SAINT.

Hieroglyphics, hī″ē-rō-glĭf′ĭks (from Gr. *hieros,* sacred, and *glypho,* engrave), the inscriptions sculptured on buildings in Egypt, with the implication that the writing was confined to sacred subjects, and legible only by the priests. The term has also been applied to picture-writing in general, such as that of the Mexicans and the still ruder pictures of the North American Indians. Two different modes of hieroglyphic writing were used by the ancient Egyptians,, the hieratic, and the demotic. Pure hieratic writing is the earliest, and consists of figures of material objects from every sphere of nature and art, with certain mathematical and arbitrary symbols. Next was developed the middle hieratic or priestly writing, the form in which most Egyptian literature is written, and in which the symbols almost cease to be recognizable as figures of objects. Hieratic writings of the third millennium B.C., are extant. In the demotic or enchorial writing, derived directly from the hieratic, the symbols are still more obscured. The demotic was first used in the 9th century B.C., and was chiefly employed in social and commercial intercourse. Down to the end of the 18th century scholars failed in find a clue to the hieroglyphic writings. In 1799, however, M. Bouchard, a French captain of engineers, discovered at Rosetta the celebrated stone which afforded European scholars a key to the language and writing of the ancient Egyptians. It contained a trilingual inscription in hieratics, demotic characters, and Greek, which turned out to be a decree of the priests in honor of Ptolemy V., issued in 195 B.C. The last paragraph of the Greek inscription stated that two translations, one in the sacred and the other in the popular Egyptian language, would be found adjacent to it. In deciphering these inscriptions the discovery of an alphabet was the first task. The demotic part of the inscription was first examined by De Sacy and Akerblad, and the signification of a number of the symbols ascertained. The hieratic part was next carefully examined and compared with the demotic and Greek. At last after much study Champollion and Dr. Thomas Young, independently of each other, discovered the method of reading the characters (1822), and thus provided a clue to the decipherment of the ancient Egyptian writing.

Cartouche of Cleopatra, i.e. Kleopatra.

Cartouche of Ptolemy, i.e. Ptolemaios.

Hieroglyphic characters are either ideographic, that is, using well-known objects as symbols of conceptions, or phonetic, that is, representing words by symbols standing for their sounds. The phonetic signs are again divided into alphabetical signs and syllabic signs. Many of the ideographic characters are simple enough; thus the figure of a man, a woman, a calf, indicate simply those objects. Others, however, are less simple, and convey their meaning figuratively or symbolically. Water was expressed by three zigzag lines, one above the other, to represent waves or ripples of running water, milk by a milk-jar, oil by an oil-jar, fishing by a pelican seizing a fish, that is, fishing; seeing and sight by an eye; and so on. The nature of the phonetic hieroglyphs, which represent simply sounds, will be understood from an explanation of the accompanying cuts.

(1) The first hieroglyph in the name of Kleopatra is a knee, which is *kne* or *kle* in Coptic, and represents the K of Kleopatra. (2) The second hieroglyph in Kleopatra is a lion couchant, which is *laboi* in Coptic, and *labu* in the old Egyptian, and represents the L of both names. In Kleopatra it occupies the second place, and in Ptolemaios the fourth. (3) The third hieroglyph in Kleopatra is a reed, which is *aké* in Coptic and *aak* in the old Egyptian, and represents the E of Kleopatra. The reed is doubled in Ptolemaios and occupies the sixth and seventh places, where it represents the diphthong *ai* of Ptolemaios. (4) The fourth hieroglyph in Kleopatra is a noose, which represents the O of both names and occurs in the third place of Ptolemaios. (5) The fifth hieroglyph in Kleopatra is a mat, which represents the P of both names, and is the initial of Ptolemaios. (6) The sixth hieroglyph in Kleopatra is an eagle, which is *akhoom* in Coptic, and represents the A, which is found twice in the name of Kleopatra. (7) The seventh hieroglyph in Kleopatra is a hand, which is *toot* in Coptic, and represents the T of Kleopatra, but does not occur in Ptolemaios, where it might be expected to occupy the second place. The second place of Ptolemaios is occupied by a semicircle, which is found at the end of feminine proper names, and is the Coptic feminine article T. The researches of Champollion satisfied him of the existence of homophones, or characters having the same phonetic value and which might be interchanged in writing proper names. (8) The eighth hieroglyph in Kleopatra is a mouth, which is *ro* in Coptic, and represents the R of Kleopatra. (9) The ninth hieroglyph in Kleopatra is the eagle, which is explained in No. 6 above. (10) The semicircle is the T of Ptolemaios, which with (11) the egg found at the end of proper names of women, is a feminine affix. In the name of Ptolemaios there is still the M and the S to account for. The fifth hieroglyph in the cartouche of Ptolemaios is a geometrical figure, consisting of three sides of (probably?) a parallelogram, but now called a hole, because the Coptic *mu* has that signification, and represents the M. The hook represents the S of the word Ptolemaios. Vowels were only regarded by the Egyptians as they were needed to avoid ambiguous writing. There are groups of hieroglyphs of which one element is an ideographic sign, to which a phonetic complement is added to indicate the pronunciation of the ideographic sign. The

words of a text could be written in hieroglyphs in three ways—(1) by phonetic hieroglyphs; (2) by ideographic hieroglyphs; and (3) by a combination of both. According to Ebers, in the perfected system of hieroglyphics the symbols for sounds and syllables are to be regarded as the foundation of the writing, while symbols for ideas are interspersed with them, partly to render the meaning more intelligible, and partly for ornamental purposes. Consult: Brugsch, 'Egyptologie' (1891); Erman, 'Life in Ancient Egypt' (1894); and 'Egyptian Grammar' (1894).

Hierosolyma. See JERUSALEM.

Hig'gins, Anthony, American politician: b. Red Lion Hundred, Del., 1 Oct. 1840. He was educated at Yale and after studying law at the Harvard Law School was admitted to the Delaware bar in 1864. From 1869 to 1876 he was United States attorney for Delaware, and becoming interested in politics was chairman of the Republican State Convention in 1868. In 1881 he secured the vote of the Republican members of the Delaware legislature for the National Senate and in 1884 was defeated as a Republican candidate for Congress. He was United States Senator 1889–95.

Hig'ginson, Ella Rhoads, American novelist and poet: b. Council Grove, Kan., 1862. She was married to R. C. Higginson and has passed her life mainly in the vicinity of Puget Sound, Wash. She has contributed much to periodicals, and her work, which has a distinctly original flavor, has attracted much attention from its vigorous presentation of life on the upper Pacific slope. Her most noteworthy book is 'Mariella, or Out West,' an extremely strong novel (1902); and other works of hers are 'The Flower that Grew in the Sand' (1896); 'From the Land of the Snow Pearls' (1897); 'A Forest Orchid' (1897); and several collections of poems.

Higginson, Francis, English clergyman in colonial America: b. 1587; d. Salem, Mass., 6 Aug. 1630. He was educated at Cambridge, England, and subsequently became rector of a parish in Leicester, but becoming gradually a Nonconformist, was deprived of his benefice, and was employed among his former parishioners as a lecturer. While apprehending a summons to appear before the high commission court, he received an invitation from the Massachusetts Company to proceed to their colony, which he accepted. He embarked in May 1629, and it is related by Cotton Mather that as the ship was passing Land's End, he called the passengers about him and exclaimed: "We will not say, as the Separatists were wont to say at their leaving of England, 'Farewell, Babylon; farewell, Rome!' but we will say, Farewell, dear England! farewell, the church of God in England, and all the Christian friends there. We do not go to New England as Separatists, though we cannot but separate from the corruptions of it. But we go to practise the positive part of church reformation, and propagate the gospel in America." He arrived at Salem 29 June, and on 20 July was chosen teacher of the congregation established there. Subsequently Higginson drew up "a confession of faith and church covenant according to Scripture," which on 6 August was assented to by 30 persons, who associated themselves as a church. He wrote 'New England's Plantations, or a Short and True Description of the Commodities and Discommodities of the Country' (1630), and an account of his voyage, printed in Young's 'Chronicles of the First Planters' (1846). Consult: T. W. Higginson, 'Life of Francis Higginson' (1891).

Higginson, Francis John, American rear-admiral: b. Boston 19 July 1843. He was graduated from the United States Naval Academy in 1861 and served in the United States navy during the Civil War becoming lieutenant-commander in 1866. He was commander of the Massachusetts during the Spanish-American War 1898, was promoted commodore that same year, and rear-admiral in March 1899.

Higginson, Henry Lee, American banker: b. New York 18 Nov. 1834. He was educated at Harvard, studied music abroad and served in the Federal army during the Civil War and was brevetted lieutenant-colonel. He has been long connected with the Boston banking firm of Lee-Higginson & Co., and has contributed large amounts toward the organization and support of the Boston Symphony Orchestra.

Higginson, Mary Thacher, American author, wife of T. W. Higginson (q.v.): b. Machias, Maine, 27 Nov. 1843. She has written 'Seashore and Prairie' (1876); 'Room for One More' (1879); and 'Such as They Are' (1893), poems written in collaboration with her husband.

Higginson, Sarah Jane Hatfield, American writer: b. Philadelphia 15 Jan. 1840. With her first husband, a Dutch jurist, she lived for several years in the Dutch East Indies, and after his death returned to the United States, where she was married to Stephen Higginson, a former American consul in the Dutch East Indies. She has written: 'A Princess of Java: a Tale of the Far East' (1887); 'Java, the Pearl of the East,' a book of travel (1890); 'The Bedouin Girl.'

Higginson, Thomas Wentworth, American author: b. Cambridge, Mass., 22 Dec. 1823. He is descended from Rev. Francis Higginson (q.v.) and was graduated from Harvard in 1841, and from Harvard Divinity School in 1847. He became pastor of a Unitarian church in Newburyport, Mass., in 1847, but resigned from the pastorate in 1850, his anti-slavery views being unacceptable to his congregation. In the year last named he was the unsuccessful "Free Soil" candidate for Congress, and he was pastor of a Free (unsectarian) church at Worcester, Mass., 1852–8. In the interim he had been prominent in anti-slavery agitation, and for his share in the attempted rescue of the fugitive slave Anthony Burns (q.v.), was indicted for murder in 1854 with Wendell Phillips, Theodore Parker and others, but owing to a flaw in the indictment the defendants were discharged. He also aided in the Kansas Free State efforts, and during the Civil War was captain of the 51st Massachusetts regiment of volunteers, becoming colonel in November 1862, of the 1st South Carolina volunteers, the earliest regiment of freed slaves in the Federal service. He resigned from the army in October 1864, by reason of disability, and has since given his attention to literature, residing at Cambridge, Mass., since

1878. He has been almost a life-long advocate of woman suffrage and of the higher education of woman, and was a member of the Massachusetts legislature 1880–1, serving on the State board of education, also, 1881–3. He is a polished, graceful speaker, and has frequently appeared on the lecture platform, his latest appearance being as Lowell lecturer on American literature in Boston in 1902. As an after-dinner or occasional speaker he is especially happy, his felicitous sentences being almost always illuminated by the play of a very delicate humor. He is president of the Round Table, a social Boston club, and vice-president of the Boston Authors Club, as well as a member of many other organizations, social and literary. He has been for a generation a constant contributor to periodicals of the highest class and has figured in literature as essayist, novelist, poet, and historian. His principal work in fiction is 'Malbone' (1869), in which his first wife is outlined as Aunt Jane. As an essayist he is perhaps seen at his best, the essay form seeming peculiarly adapted to his genius. Among collections of essays by him may be cited: 'Outdoor Papers' (1863); 'Atlantic Essays' (1871); 'Women and Men' (1887); 'The New World and the New Book' (1891); and 'Concerning All of Us' (1892). His 'Young Folks' History of the United States' (1875) has been widely popular, and other histories by him are 'Larger History of the United States' (1885); 'English History for Americans' (1893); 'Massachusetts in the Army and Navy, 1861–5' (1895–6). His verse is included in 'The Afternoon Landscape' (1889); 'Such as They Are' (1893). Yet other important works by him are 'The Monarch of Dreams,' a strikingly original sketch (1886); 'Army Life in a Black Regiment' (1869); 'Cheerful Yesterdays' (1898); 'Old Cambridge' (1899); 'Contemporaries' (1899); and lives of Margaret Fuller (1884); Francis Higginson (1891); Henry W. Longfellow (1903); John Greenleaf Whittier (1903); 'History of the United States' (1905). He translated the complete works of Epictetus (1865, revised edition 1891). With Samuel Longfellow (q.v.) he completed a well-known anthology of seaside verse, 'Thalatta' (1853), and with Mrs. E. H. Bigelow 'American Sonnets' (1890). Several of his works have been translated into French, German, Italian, and even modern Greek. He was the friend of very many of the older New England writers and has been especially helpful to many of the younger ones, not a few of whom owe him much in the way of kindly criticism or suggestion, the fruit of ripe scholarship.

High Church, a term applied to a faction in the Church of England. It was applied first to the younger clergy during the latter part of the reign of Elizabeth who asserted that Calvinism was inconsistent with the ancient doctrine and constitution of the primitive church, and who claimed a divine right for episcopacy. Bishop Andrews was the chief writer of this faction, and Laud became its most active leader. The term now generally refers to those who exalt the authority and jurisdiction of the church, and attach great value to ecclesiastical dignities and ordinances, being more or less identified with the ritualistic party. See RITUALISM.

High Bridge, Engagement at. See FARMVILLE.

High-Frequency Oscillating Current. This term is especially applicable to electrical currents, the high frequency interruptions of which are obtained by means of condenser discharges in contradistinction to those produced by a disrupted static current, without the interposition of a metallic condenser in series with one or both terminals. The latter differs in several characteristics and is essentially a high potential current, 10,000 to 50,000 volts, with a minimum amperage, usually about .0005.

To generate a high-frequency current it is usual to charge two Leyden jar condensers with a high potential current, the source of which may be a static machine or induction coil, shunting the two wires with a spark-gap for the purpose of disrupting the current. The external armatures of the condensers are short-circuited through a solenoid or helix consisting of a few turns of coarse copper wire (D'Arsonval). The helix may be substituted by a straight copper bar (Sheldon). By prolonging the helix from 50 to 100 turns, this constitutes the resonator of Oudin. The upper part of the helix resonates in unison with the lower, when properly in tune, as would a tuning-fork resonate with another of the same pitch. The office of the extended helix is to amplify the current.

Another arrangement is after Tesla: The primary of a specially constructed induction coil is energized by an alternating current. The secondary terminals, giving a potential of 15,000 volts, are connected, one to each side of a suitable condenser. From each of these terminals a shunt is taken. One leads to one end of the primary of a Tesla coil; the other, broken by a spark-gap, is connected to the second terminal of the primary. The frequency obtained from the Tesla apparatus is fabulously high — millions a second. The potential may be hundreds of thousands or millions of volts. The amperage is sufficient to light to full candle-power several incandescent lamps. The primary of the induction coil consumes 15 to 25 amperes. For maximum high frequency effects this type of apparatus seems to be essential. The brush discharge from the terminals may be 20 or even 50 inches in length. There are many modifications of this apparatus.

The one characteristic of the high-frequency oscillating current is its lack of power to excite the motor, and, aside from a slight sensation of warmth, the sensory nerves at the point where the electrode touches the body. The accepted explanation for this fact is, that the nerves respond to certain frequencies of stimulus; for the motor nerves, reaction takes place up to about 5,000 frequencies; if these are gradually increased muscular contraction diminishes and finally ceases. This theory is in line with reasoning as to the cause for action of the special senses — sight and hearing.

At the terminals of a working high-frequency apparatus is seen a beautiful brush discharge or effluve of a peculiar blue color, which will leap to any object brought near it. Interpose a plate glass one half inch thick (or more), and the effluve will penetrate it. If the object be a vacuum tube it will glow almost as brightly as if nothing intervened. It is an ideal current for igniting Geissler and low-vacuum X-ray tubes; only one terminal need be connected.

The high-frequency discharge is a rich ozone generator, and, applied to unhealthy granulations and various skin diseases, acts as an oxidizer, antiseptic, and disinfectant. Applied to the skin before incision, it will render the site aseptic.

For general effect the patient is placed upon an auto-condensation couch or in the centre of an auto-conduction cage. In the treatment of sub-acute and chronic rheumatism, sciatica, neurasthenia, etc., it is most useful.

John M. Garratt, M.D.

High Priest, the head of the Jewish priesthood. In the books of Moses the holder of this dignity is simply designated the priest, the epithet high occurs on one or two occasions, but as a distinctive epithet it appears to have been added subsequently. The formal consecration of Aaron, the brother of Moses, together with his sons, to a hereditary priesthood, is recorded in Ex. xxviii. The high-priesthood continued in the line of Aaron, sometimes in one, and sometimes in another branch of it, until the coming of Christ. After the subjugation of the Jews by the Seleucidæ, the Ptolemies, and the Romans, it was often arbitrarily conferred by the foreign masters. The dignity of the priest's office is indicated by the splendor and costliness of his garment, which was among the most beautiful works of ancient art. To the high priest belonged the regulation and superintendence of the worship of God, the declaration of the oracles of Jehovah to the people (he alone being permitted to consult them on important public occasions), and the preservation of the national sanctuary. Although the administration of justice was committed to particular judges, yet to him the last appeal was made in difficult cases, even in temporal affairs, and nothing important in war or peace could be undertaken without his assent.

High Schools, the term applied in the public school system of the United States to the institutions for secondary and higher education preparatory to a college course. They were generally established at public expense between 1820 and 1850, to correspond in grade to the academies or schools maintained by endowment or at private expense in which young men were prepared for college.

The European representatives of the American high schools are the public schools and colleges of Great Britain, the lyceums of France, Spain, and Italy, and the gymnasia of Germany; the universities in Germany are officially called high schools (Hochschulen).

The term 'high school' was applied as early as the 16th century to a celebrated educational establishment of a liberal character, a grade below the university, in Edinburgh, Scotland.

In 1647 the Massachusetts Colony enacted a law that every town of 100 families should maintain a school, the teacher of which should be "able to instruct youth, so far as they may be fitted, for the university." This law, though imperfectly obeyed, introduced very early into Massachusetts and New England a small number of classical schools, and subsequently prepared the way for the endowment of a few academies in which young men were prepared for the colleges. Of these especially endowed academies, many of which rendered eminent service, the more notable are the Hopkins Grammar Schools of Hartford and New Haven, Conn.; the Hopkins Academy in Hadley, and Phillips Academy at Andover, Mass.; Phillips Exeter Academy at Exeter, N. H., and Amherst Academy, Mass. Among the public schools of the country, the Boston Latin School, a colonial foundation, was for a long time almost the only classical school supported by public taxation at which students could be prepared for college. It was pre-eminent alike for the thoroughness of the education which it gave, and the freeness with which this was proffered to all the residents of Boston. In 1821 the English High School, supplementary to the Latin School, was established in Boston. In Philadelphia the corresponding institution still bears the name of the Central High School, while in New York city the original Free Academy has developed into the College of the City of New York. With the reorganization of the public school systems of the older States, and the foundation of such systems almost simultaneously with the redemption of the soil from the forest and wild prairie in the newer States, provision was made for a system of high schools, to give a thorough preparation for the college curriculum. These high schools are now in vigorous operation from one end of the United States to the other. See Education, Secondary.

High Seas. Among maritime nations both in ancient and modern times the necessity for some international regulations to govern their communications by sea has been found a necessity. The views of jurists on this subject have fluctuated between two opposite principles. Nations possessing a powerful marine, are disposed to push their privileges to the utmost, and to claim exclusive accession to, or a superiority and protective rights over, extensive tracts of the ocean highway. The weaker maritime nations, on the other hand, and the commercial rivals of these most especially privileged, have contended for the liberty of the seas. The most memorable instance of this controversy occurred in connection with the claims arising out of the great maritime discoveries of the Portuguese at the close of the 15th century. Under the grant of Pope Alexander VI. the Portuguese claimed the right to exclude other nations from the seas between the eastern coast of Africa and the coasts of India. Against this claim Grotius wrote his celebrated treatise, the 'Mare Liberum,' which appeared in 1609. The English, who had their own claims of jurisdiction, were not then, or for long after, prepared to admit the liberty of the seas. The general principle of international law now accepted is that the jurisdiction of maritime nations extends only for three miles, or within cannon range of their own coasts; the remainder of the seas being high seas, accessible on equal terms to all nations. Inland seas and estuaries, of course, are excepted.

High Treason (Fr. *trahison*, betrayal), is defined in English law as the most heinous of all offenses against the law, and consists in imagining or devising the death of the ruling monarch, or proposing to kill, maim or restrain the king or queen; or levying war against him; adhering to his enemies; killing his wife or eldest son, or heir; violating his wife, or daughter, or heir's wife; killing the lord chancellor; killing the chancellor of the exchequer, or a justice in office. High treason against the United States consists in levying war against them; adhering to their enemies, or giving their enemies aid and comfort. Treason against a State is generally defined as hostility to a State only. The former punishment of treason in English law was death by hanging, drawing and quartering. The penalty is now hanging or imprisonment. This crime is punishable in the United States according to the act of 1862 by death or imprisonment with hard labor for a period of not less than five years, a fine of not less than $10,000 and a perpetual disability to hold any office under the United States. The act of 1862 adds: "No person shall be convicted of treason unless on the testimony of two persons to some overt act, or on confession in open court. The Congress shall have power to declare the punishment of treason, but no attainder of treason shall work corruption of blood (q.v.) or forfeiture except during the life of the person attainted."

Highbinders, a name given to a secret organization among the Chinese in the United States which has caused much bloodshed in the Chinese quarter of San Francisco, Cal., necessitating intervention on the part of the authorities. The Chinese call these societies "hatchet" societies, and the members "hatchet men." The organization seems to be an offshoot of the Six Companies (q.v.), though some claim that it is merely a revival of one which originated over 200 years ago in China.

Higher Criticism, The. The higher criticism is a science whose aim is the determination of the literary history of books and writings. It sets forth the facts and principles by which we must determine, in the case of any writing, its literary form, its unity, its date, the place of its composition, its authorship, the method of its composition or construction, its integrity, and the amount and character of any subsequent editing it has received, so far as these matters can be discovered by the use of such internal evidence as is presented in the writing itself. It is thus the science for ascertaining the literary form and the literary history of any writing by means of internal evidence. These same matters may also be determined, in part or in whole, by external evidence in many cases; that is, by history or tradition. This latter method will not necessarily be either better or worse than the method which employs internal evidence. The greater probability of the result, in every case, will depend upon the amount and the character of the evidence which is attainable. Sometimes external evidence may be more abundant and trustworthy than the internal evidence, and sometimes the reverse may be true.

The science under consideration is termed higher criticism to distinguish it from the related science of lower, or textual, criticism. This latter science has for its object the ascertaining of the history of writings as the work of penmen and printers. It seeks to determine just the words and the letters which the author himself wrote, and what are the changes which his work has suffered in transmission. Since the literary history of a writing is, on the whole, of more importance than the history of the written or printed text, the science of the literary history is justly termed the higher criticism.

The higher criticism is a science which is equally applicable to all literatures. It may be used to determine the literary history of a writing of any age, language, or people. But, of late, it has been especially brought into notice in its application to the literature of the Bible. On this account, it is sometimes spoken of as if it were a science belonging to Biblical study only. But the fact is that Biblical higher criticism is only one department of higher criticism in general.

As employed in Biblical study, higher criticism adopts the following method: (1) it sets forth the principles by which, according to the teachings of general literary criticism, we may correctly determine the literary form, the unity, the date, the place of composition, the authorship, the method of composition or construction, the integrity, the amount and character of subsequent editing, of each of the Biblical books and writings; (2) it then presents the evidential facts to be found in each of the Biblical books and writings, to which these principles will apply; and (3) finally it gives the conclusions which result from the application of these principles to the evidential facts. In practice, however, different schools of Biblical higher critics come to very different conclusions upon the same basis of evidential facts, while using the same principles of criticism. This results from the varying opinions held by these critics in relation to the value and significance of the evidential facts, due to their differing views about the history of Israel, and their philosophical convictions concerning the place of the supernatural in that history. Those critics who refuse to allow the existence of any supernatural element in the history of Israel, and hold that this history was the product of only those forces which shape and determine all human history, so that it was exactly like the history of every other people, cannot put the same value and meaning upon the historical testimony and references to be found in the Biblical books, as those critics must who believe that the history of Israel was, to no inconsiderable extent, a supernatural history, and, therefore, different from the history of every other people. In the case of the Old Testament, for example, some critics hold, because of their philosophical opinions in regard to the supernatural, and the universality of the working of the evolutionary forces of history, that the historical material of the Old Testament, as we now have it, is not to be accepted as the true basis of Old Testament history, and that this history must be constructed out of this material, under the guidance of some philosophical theory. Other critics accept the historical material which is now to be found in the Old Testament, as furnishing in itself the true Old Testament history. Since the evidential facts used in higher criticism receive their value and meaning from their evident relation to a previously determined history, it is clear that each of two so different histories cannot be a basis for the same critical conclusions. But it is to be noted that the determination of the histories is not a work of higher criticism, but is a matter which results from the philosophical opinions held by historians. The consequence of these facts is that the only results which have thus far been reached by Biblical higher criticism, which all schools of critics would accept, seem to be: (1) The existence of different documents in the Pentateuch, which have been used in its compilation, although there is, among critics, quite a little difference of view in relation to the age of these documents and the time of their compilation into the Pentateuch: (2) the plural authorship of the books of the Old Testament known as the books of Isaiah and Zechariah: and (3) the fact that older sources have been used in the making of the synoptic gospels and the book of Acts. From all that has been said, it will be seen that it is not the duty of higher criticism to assert or deny anything in relation to the inspiration of the Scriptures, or their authority for belief or conduct. With these matters this science has absolutely nothing to do.

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Higher Law, a famous phrase used by William H. Seward (q.v.) 11 March 1850, in the United States Senate, on the admission of California as a State, which was held up by the Southern element to force the Congress to admit it as a slave State, or at least to divide it on the line of the Missouri Compromise (q.v.). Seward denied that the principle of compromise applied only to slavery, which was only one of many institutions, and held it equally applicable to the Territories, which were a possession to be enjoyed and administered in common by the States; and declared that the older States had no arbitrary power over them. He went on: "The Constitution regulates our stewardship; the Constitution devotes the domain to union, to justice, to defense, to welfare, to liberty. But there is a higher law than the Constitution, which regulates our authority over the domain, and devotes it to the same noble purposes. The territory is a part . . . of the common heritage of mankind, bestowed upon them by the Creator of the universe. We are his stewards, and must so discharge our trust as to secure in the highest attainable degree their happiness." And to Webster's assertion that it was absurd to re-enact the laws of God, he answered that "there is no human enactment which is just that is not a re-enactment of the law of God." It was his first set speech in the Senate, and at once made him the recognized leader of the radical section. The conservatives denounced it as treasonable, implying that no one was under any obligation to support the Constitution if he believed it in opposition to the law of God, and making the execution of any laws impossible.

Higher Plane Curves. See Curves, Higher Plane.

High'land Cattle, a variety of small, rough-coated, usually red or black cattle, with upturned horns, kept half wild upon the moors of the Scottish Highlands, and believed to represent in part the cattle of the aboriginal Britons, which are replaced in the south of Great Britain by the short-horned breeds introduced by the Roman conquest. Compare White Cattle.

Highlanders, Scotch, in the United States. After the Jacobite risings in England in 1715 and 1745, in favor of the Old and Young Pretenders, which were zealously supported by the Highlanders (who indeed formed their backbone), the English government exerted itself to drain their strength by colonizing them elsewhere: and many who were in danger of vengeance came to America voluntarily. The chief movement was after 1745, when the government thoroughly reorganized the Highlands, broke up the clans, and deported large numbers to the colonies: but after 1715 many, in bands or as individuals, had come over, especially to the Carolinas. Some settled in western South Carolina, as farmers or Indian traders; a considerable body near Fayetteville, N. C., where their descendants still speak Gaelic in preference to English, and have their church ministrations in that language; and a number of different colonies in the future Georgia, where Oglethorpe found them when he came over in 1733 with a patent for a new colony. Especially he won the hearts of a settlement at Darien, under a Capt. Mackay. These Highlanders gave him priceless help in his incessant fights with the Spaniards and constant negotiations with the Indians: but they strongly opposed the slave trade or the introduction of slaves into Georgia. Some Highland companies sent to the Mohawk Valley, during the French and Indian war, were disbanded there, and remained as settlers, a recognizable element during the Indian troubles of the early Revolution.

Hil'da, Saint, Anglo-Saxon abbess: b. about 614; d. 680. She was consecrated as a nun by Bishop Aidan, and was successively head of the abbey of Hartlepool, and of the famous monastery founded by her in 657 at Whitby, Yorkshire. This continued for several centuries a religious house of great power and influence, in the time of its founder perhaps the strongest in Great Britain. Cædmon (q.v.), the Anglo-Saxon poet, was attached to the monastery during her rule, and it was there that the celebrated synod took place in 664 in which the Celtic ritual was condemned. Consult: Bede, 'Ecclesiastical History.'

Hil'debrand. See Gregory VII., Pope.

Hil'dreth, Richard, American historian: b. Deerfield, Mass., 22 June 1807: d. Florence, Italy, 11 July 1865. He was graduated at Harvard in 1826, studied law at Newburyport, entered practice in Boston, and abandoned it in 1832 to become editor of the 'Boston Atlas.' In this position a series of articles by him in 1837, relative to the separation of Texas from Mexico, did much to stimulate the resistance which that movement encountered in the free

States. In 1834 his anti-slavery novel, 'The Slave,' was written. This work was republished and favorably received in England, and in 1852 an enlarged American edition appeared under the title of 'The White Slave: Memoir of Archy Moore' (1837). In 1837–8 he was Washington correspondent of the 'Boston Atlas,' and resumed his editorial post as an advocate of the election of General Harrison, of whom he wrote a campaign biography. He then abandoned journalism, and in 1840 published, under the title of 'Despotism in America,' a volume on the political, economical, and social aspects of slavery, to which in the edition of 1854 was appended a chapter on the 'Legal Basis of Slavery.' In 1840–3 he resided in Demerara, British Guiana, and at Georgetown edited two free labor newspapers. Later, for several years, he was a member of the New York *Tribune* staff, and in 1861 was appointed United States consul at Triest. His best known work is his 'History of the United States' (1849–56), which extends from 1492 to the end of President Monroe's first term. The author sought an authentic presentation of the conspicuous figures of earlier American history. His work is accurate and careful, though with a Federalistic viewpoint; but so uninteresting in manner as to be ill-adapted for continuous reading. Hildreth also wrote: 'Theory of Morals' (1844); 'Theory of Politics' (1853); 'Japan as it Was and Is' (1855); and 'Atrocious Judges' (1856).

Hilgard, hĭl'gärd, **Eugene Woldemar,** German-American chemist and geologist: b. Zweibrücken, Bavaria, 5 Jan. 1833. He came to the United States in 1836, returned to Europe for purposes of study and was graduated (Ph. D.) at Heidelberg, 1853. In 1858 he became State geologist of Mississippi, in 1873 was appointed professor of geology and natural history in the University of Michigan, and in 1875 was made professor of agricultural chemistry and director of the agricultural experiment station in the University of California. He received the Liebig medal from the Munich Academy of Sciences in 1894, and his investigations into the chemistry and physics of soils have done much to promote agricultural science.

Hill, Adams Sherman, American educator: b. Boston, 30 June 1833. He was graduated from Harvard College 1853 and Harvard Law School 1855, and in 1875 became Boylston professor of rhetoric and oratory at Harvard University. He has written: 'Principles of Rhetoric' (1878); 'Our English' (1889); 'Foundation of Rhetoric' (1892).

Hill, Ambrose Powell, American military officer: b. Culpeper County, Va., 9 Nov. 1825; d. 2 April 1865. He was graduated at the United States Military Academy 1847; served in the Mexican War, but resigned from the army in March 1861, and was made colonel of the 13th Virginia regiment of the Confederate army. Having distinguished himself in service, he was promoted major-general in May 1862, and lieutenant-general 20 May 1863, and placed in command of one of the three corps of the army of Northern Virginia. He led his corps at Gettysburg and later at Bristow Station and the assault on the Weldon railroad in 1864. He was killed in the attack on Petersburg, Va.

Hill, Benjamin Harvey, American legislator: b. Jasper County, Ga., 14 Sept. 1823; d. 16 Aug. 1882. He was graduated at the State University of Georgia in 1844 and chose law as a career. In 1851 he was elected to the State legislature. He in vain attempted to withstand the secession sentiment of his State, but at last yielded to the movement, and was elected to the Provisional Confederate Congress, and from the assembly promoted to the Confederate Senate. He supported Greeley for the presidency in 1872, and was defeated for the United States Senate the following year, but after being elected to the House of Representatives in 1875, was given a seat in the United States Senate 1876 and held it for the remainder of his life.

Hill, Daniel Harvey, American military officer: b. Hill's Iron Works, York district, S. C., 12 July 1821; d. Charlotte, N. C., 24 Sept. 1889. He was graduated at the United States Military Academy in 1842, and served in the Mexican War; became professor of mathematics and military tactics in Washington College, Va., in 1849, professor of mathematics in Davidson College, N. C., in 1854; and was made president of the North Carolina Military Institute in Charlotte in 1859. At the outbreak of the Civil War he entered the Confederate army as colonel; was promoted to lieutenant-general in 1863, and commanded a corps at the battle of Chickamauga. After the close of the war he resumed his educational work, and in 1877 became president of the Arkansas Industrial University, where he remained until shortly before his death.

Hill, David Bennett, American lawyer and politician: b. Havana, N. Y., 29 Aug. 1843. He entered a law office in Elmira, N. Y., as clerk and student in 1862, and after admission to the bar in 1864, rapidly built up a law practice and was an acknowledged leader of the local bar. He was active in politics, and acquired a leadership there also, through his genius for organization. He was a member of the State assembly 1870–1, and president of the Democratic State convention in 1877 and 1881. In 1882 he was elected mayor of Elmira, and lieutenant-governor in the same year, with Cleveland as governor. In 1885, when Cleveland resigned to take up his duties as President, Hill became governor. He was subsequently twice elected governor, serving till January 1892, when he took his seat in the United States Senate. During his first administration as governor, the legislature was Republican, and he was involved in a number of partisan struggles. As senator, he opposed on some issues the policy of President Cleveland; he was also opposed to the income tax clause of the Wilson Tariff Bill. In 1892 he was a prominent candidate for the presidency at the Democratic National convention, and at the convention of 1896 was one of the chief leaders of those who favored the gold standard and were opposed to radicalism in the party. In 1894 he was again candidate for governor of New York State, but was defeated by Levi P. Morton. In 1902 he practically dominated the Democratic State convention, and was active throughout the campaign.

Hill, David Jayne, American educator and diplomat: b. Plainfield, N. J., 10 June 1850. He was educated at Bucknell University, where he became professor of rhetoric 1877–9, and then president of the institution. He was elected president of Rochester University, N. Y., in 1888, resigning to spend three years in Europe studying international law and diplomacy. He became first assistant United States secretary of state in October 1898, and in 1903 was appointed United States minister to Switzerland. He has written biographies of 'Washington Irving' (1879); and 'William Cullen Bryant' (1879); 'Principles and Fallacies of Socialism' (1885); 'International Justice'; 'A Premier of Finance'; etc., and several school and college text-books.

Hill, Frank Alpine, American educator: b. Biddeford, Maine, 12 Oct. 1841; d. Brookline, Mass., 12 Sept. 1903. He had long been prominent among New England educators, and after being head-master of high schools in Milford, Chelsea, and Cambridge, Mass., became secretary of the Massachusetts State Board of Education in 1894. He was a trustee of the Massachusetts Institute of Technology, of the State Agricultural College at Amherst, and of the Boston Museum of Fine Arts, as well as a commissioner of the State School Fund.

Hill, Frank Pierce, American librarian: b. Concord, N. H., 22 Aug. 1855. He was graduated from Dartmouth in 1876. In 1881 he became librarian of the Lowell public library, and in 1885 he organized the first free public library in New Jersey at Paterson. He also organized the Salem public library, and the Newark library in 1889. At Newark a new building was erected under his administration and the library brought to a high degree of efficiency so that it is recognized as one of the model public libraries. In 1901 he was appointed chief librarian of Brooklyn, under the new system established upon the receipt of Mr. Carnegie's gift.

Hill, Frederic Stanhope, American sailor and author: b. Boston, 24 Aug. 1829. He went to sea when a boy, and during the Civil War was an officer in the United States navy. He was with Farragut at the capture of New Orleans and Vicksburg, and was also in command on the Texas coast and in the Mississippi squadron. He has written: 'Twenty Years at Sea' (1893); 'Story of the Lucky Little Enterprise'; 'Twenty-six Historic Ships' (1903); and has been editor of the Cambridge 'Tribune.'

Hill, George Birbeck, English educator and author: b. Tottenham, Middlesex, 7 June 1835; d. Hampstead, London, 24 Feb 1903. He was a nephew of Sir Rowland Hill (q.v.), was educated at Oxford, and was head-master of Bruce Castle School 1859–76. Since the latter date he had devoted his attention to literature and was well known in the United States through his 'Harvard College, by an Oxonian' (1894). Other works by him are: 'Talks about Autographs' (1896); 'Dr. Johnson: his Friends and his Critics' (1878); 'Life of Sir Rowland Hill' (1880); 'Foot-steps of Dr. Johnson in Scotland' (1890); 'Memoirs of the Life of Edward Gibbon' (1900).

Hill, Henry Wayland, American lawyer: b. Isle La Motte, Vt., 13 Nov. 1853. He was graduated from the University of Vermont in 1876, was principal of Swanton, Vt., union school 1877–9, and of Chateaugay, N. Y., academy 1879–83. He was admitted to the bar at Albany, N. Y., in 1884, and entered upon the practice of his profession at Buffalo. He was a member of the New York assembly 1896–1900, and has been State senator since 1901, representing each time a constituency in Buffalo. He is the author of several constitutional provisions and of several general statutes now in force. During his public career he has secured for Buffalo large State appropriations for the new 74th and 65th regiment armories, for the Historical Society building, for harbor improvement and other public purposes. He also advocated measures designed to provide home rule for cities, reform in election methods, etc., and many important State measures, such as the Primary Election law, the Civil Service law, the Franchise Tax law, the Pharmacy law, and the Canal Improvement referendum of 1903. He has made a study of waterways in this and other countries, and contributes the article on that subject in this encyclopedia. He is the author of 'The Development of Constitution Law in New York,' and a contributor to the 'Bibliophile Edition of the Odes and Epodes of Horace.'

Hill, James J., American capitalist: b. near Guelph, Ont., 16 Sept. 1838. At 18 in the village of St. Paul, Minn., he became check-clerk and caretaker of freight at the steamboat landing. At that time there was not a mile of railroad in the State. In 1862 the first 10 miles of railroad were finished from the levee in St. Paul to the riverside in St. Anthony, and known as the St. Paul and Pacific railroad, of which Hill later became the agent. After the Civil War, Hill clearly discerned the great resources and possibilities of the Red River country — Western Minnesota and Eastern Dakota. He went East, contracted for his boilers and machinery, and on the bank of the river built a flat-bottomed steamer called The Selkirk, which in the summer of 1870 began to run between Winnipeg and the head of navigation, to rival the line operated by the Hudson Bay Company. The same year, 1872, Hill consolidated his transportation interests with those of the Hudson Bay Company, forming the Red River Transportation Company. The St. Paul and Pacific railroad now reached the western boundary of the State at Breckenridge. For several years the St. Paul and Pacific system of railroads, consisting of 437 miles of completed track, was in poor condition. The stockholders, mostly Holland capitalists, were weary with delay and misfortune. Because of his faith in the future of the region Hill formed a syndicate of five persons which soon gained possession of the road, and in June 1879, the system was consolidated into a single ownership as the St. Paul, Minneapolis and Manitoba Railroad Company. In 1880 the road was extended to the Pacific coast, traversing vast tracts of land without human habitation. The track was well laid, but the stations were often only freight cars, remote from one another, and from other human settlements. The road is now known as the Great Northern. Coal fields were discovered, a branch road carried their product for the use of the main line and settlements formed for preparing the lumber for shipment. To ship valuable lumber eastward was an excellent plan: but to send empty cars after it was out of the question; and Hill conceived the idea of shipping grain for the Japanese steamers to carry to the Orient. An agent was sent to China and Japan to find out what the price of wheat must be to compete with rice, and the result was that the Japanese Navigation Company, the third largest steamship company in the world, began to carry large shipments of grain to China and Japan. Large docks for these steamers were built at Seattle, Wash., the western terminus of the road. The original 437 miles of completed road of which Hill took charge as manager, developed into the Great Northern system of 6,000 miles. In 1883 he became president of the company. The road extends from Puget Sound to St. Paul, or during the season of navigation to Duluth and Superior, where it connects for Buffalo with its own steamers. A fleet of six freight vessels are added to these. The grain ships moving through the "Soo" give that canal rank over the Suez in point of tonnage.

In developing this scheme the plan increased enormously in the process. Besides laying the foundation of a great fortune, it opened a very rich and vast new country, reached out to new markets for many American products, and brought benefit to great numbers of people. All along the line of the road Hill encouraged the most diversified and productive farming, and introduced new methods and labor-saving devices.

Hill, Octavia, English social reformer: b. about 1838. She began work among the London poor under F. D. Maurice (q.v.); and in 1864, supported by Ruskin, began her great work of improving the homes of workingmen in the slums of London. Her methods were based upon the principle of teaching the people to help themselves, by inculcating in them right notions of cleanliness, order, and self-respect. Her efforts have been crowned with great success; the houses which have been improved yield a good percentage on the money spent in effecting the improvements; and through her hundreds have been helped to lead more comfortable and better lives. She has written 'Homes of the London Poor' (1875); 'Our Common Land and other Essays' (1878).

Hill, Robert Thomas, American geologist: b. Nashville, Tenn., 11 Aug. 1858. He was graduated from Cornell University in 1886; and was immediately given a position on the United States Geological survey. He was also a lecturer in the school of economics at the University of Michigan, and professor of geology at the University of Texas for two years, which position he resigned to return to the United States Geological Survey. He has been engaged in geological and geographical explorations in the southwestern States, Mexico, Central America, and the West Indies. His work in the two last-mentioned localities has been the investigation of the origin of the land forms, and the problem of the union of the continents. Among his most valuable contributions to geological science have been the proof of the existence of the lower cretaceous formation in the United States and the announcement of the possibility of artesian wells in Texas. In May 1902 he was sent by the National Geographical Society at the head of the expedition to investigate the volcanic eruption of Mount Pelée in Martinique. His publications include 'On Occurrence of Artesian and Other Underground Waters in Texas' (1892); 'Cuba and Porto Rico with other Islands of the West Indies' (1898); and numerous contributions to the bulletins of the geological survey and periodicals.

Hill, Rowland, English popular preacher: b. Hawkstone, Shropshire, 13 Aug. 1744; d. London 11 April 1833. He was ordained in the Anglican Church, but embracing the views of the Calvinistic Methodists, soon began to preach in barns and meeting-houses, and when they were too small or too distant, or not to be procured, in streets, fields, and highways. In 1783 he laid the foundation of Surrey Chapel, Blackfriars Road, London, where he preached with great success every winter for about 50 years, making summer excursions to the provinces, where his eloquent but eccentric preaching attracted immense crowds. He published sermons and other theological works, of which the best known are his 'Village Dialogues.'

Hill, Rowland, Viscount, English soldier: nephew of Rev. Rowland Hill (q.v.); b. Prees, Shropshire, 11 Aug. 1772; d. near Shrewsbury, England, 10 Dec. 1842. He entered the army in 1790 and served with distinction from Toulon to Waterloo. In 1812 he was made a K. B., and in 1814, a peer by the title of Baron of Almaraz and of Hawkstone. At the battle of Waterloo, Lord Hill commanded the right wing of the British. In 1828 he was appointed general commanding-in-chief of the British army. This important office he continued to hold under several successive ministries, and only resigned it a few months before his death. He was made a viscount in 1842. He was often styled "the right arm of Wellington." See Sidney's 'Life of Lord Hill' (1845).

Hill, Sir Rowland, English postal reformer: b. Kidderminster, 3 Dec. 1795; d. 27 Aug. 1879. He was engaged as a schoolmaster till 1833, shortly after which he was appointed secretary to the commissioners for the colonization of South Australia. In 1837 he published a pamphlet recommending the adoption of a low and uniform rate of postage throughout Great Britain and Ireland. The scheme was approved by a committee of the House of Commons, and early in 1840 the penny postage system, which seems to have been originally proposed by James Chalmers of Dundee, was carried into effect with the assistance of Rowland Hill, who, for this purpose, received an appointment in the Treasury. In 1846 he received a public testimonial of the value of upward of £13,000. In 1846, he was made secretary to the postmaster-general, and in 1854 chief secretary to the Post-office. In 1860 he became K. C. B.

Hill, Thomas, American Unitarian clergyman and mathematician: b. New Brunswick, N. J., 7 Jan. 1818; d. Waltham, Mass., 21 Nov. 1891. Left an orphan at 10 years; at 12 he was apprenticed to the printer of the 'Fredonian' newspaper, where he remained four years. He then entered an apothecary's shop, after a year's attendance at school, and served in it several years. He was graduated from Harvard College in 1843; and from the Divinity School in 1845, and was settled as pastor at Waltham the same year. He was president of Antioch College, Ohio, 1859–62. He accompanied Agassiz on his expedition to South America and was pastor of the Unitarian Church at Portland, Maine, 1873–91. He published 'Elementary Treatise on Arithmetic' (1845); 'Geometry and Faith' (1849); 'First Lessons in Geometry' (1855); 'Treatise on Curves' (1855); 'The Natural Sources of Theology' (1875); 'In the Woods and Elsewhere', verse (1888); etc.

Hill, Thomas, American painter: b. Birmingham, England, 11 Sept. 1829. He came to the United States in 1841. Returning to Europe he studied under Paul Mayerheim for several months, but is practically a self-taught artist. He painted the 'Yosemite Valley' which was chromo-lithographed by Prang. He has continued to confine himself to the grander aspects of American scenery, and notable among his productions are 'The Home of the Eagle'; and 'Grand Cañon of the Sierras.'

Hill, Walter Barnard, American lawyer and educator: b. Talbotton, Ga., 9 Sept. 1851; d. Athens, Ga., 28 Dec. 1905. He was graduated from the University of Georgia in 1870, and from the law school in 1871, with the degree of A.M. He was admitted to the bar, and practised law in Macon, Ga., from 1871 to 1899. He was a member of the Georgia Bar Association, and was its president in 1888; a member also of the American Bar Association and the chairman of the committee on judicial administration. He also was actively interested in educational progress, being trustee of Vanderbilt University at Nashville, Tenn. In 1899 he was appointed chancellor of the University of Georgia; as an educator he strongly approved the work of the Tuskegee and similar institutions for the negro. He wrote articles on legal and educational subjects and compiled the law code of Georgia (1873, 1882).

Hill, Walter Henry, American Roman Catholic priest and educator: b. near Lebanon, Ky., 21 Jan. 1822. He was graduated from St. Mary's College in 1843, was tutor there for a time, and also studied medicine at St. Louis University. In 1847 he became a member of the Jesuit order, taught at St. Joseph's College and at St. Louis University and completed his theological studies. In 1861 he was ordained a priest; in 1865–9 he was president of St. Xavier College at Cincinnati; he was socius of the provincial at St. Louis University in 1869 and professor of mental and moral philosophy there in 1871. From 1884 to 1896 he was pastor of the church of the Sacred Heart in Chicago, and in 1896 retired from all active duties. He has written 'Elements of Philosophy, comprising Logic and Ontology' (1873); 'Ethics of Moral Philosophy' (1877); 'Historical Sketch of St. Louis University' (1879); and valuable contributions to the 'American Catholic Quarterly.'

Hill River. See HAYES RIVER.

Hillard, hil'ard, **George Stillman,** American author and lawyer: b. Machias, Maine, 22 Sept 1808; d. Boston 21 Jan. 1879. He was graduated from Harvard in 1828, and from the Harvard Law School four years later. He was a member of the Massachusetts senate in 1850, where his policy as a legislator was warmly commended by Daniel Webster; a member of the Massachusetts constitutional convention in 1853; and United States district attorney in 1866–70. Though successful as a lawyer his tastes were largely literary; he was well known as a lecturer; was editor of the 'Christian Register' with George Ripley, and associate editor of the Boston *Courier;* wrote 'Six Months in Italy' (1853); 'Life of George Ticknor' (with Mrs. Ticknor); 'Life of George B. McClellan' (1864), and edited a series of school readers which bore his name, and the works of Spenser.

Hillebrand, Karl, kärl hĭl'lĕ-bränt, German critic and historian: b. Giessen, 17 Sept. 1829; d. Florence 19 Oct. 1884. For participation in the insurrection in Baden (1849) he was imprisoned, but escaped to France, where he was graduated at the Sorbonne, and in 1863 became professor of foreign languages at Douai. On the outbreak of the Franco-Prussian War, he removed to Italy and passed the remainder of his life there. Among his publications in French, German, Italian, and English, are: 'On Good Comedy' (1863); 'Contemporary Prussia' (1867); 'Italian Studies' (1868); 'Times, Peoples, and Men' (1875–85); 'History of the Government of Normandy' (1863–73); 'Public Instruction in the United States' (1869); 'Lectures on German Thought during the Last Two Hundred Years' (1880). Consult Homberger, 'Karl Hillebrand' (1884).

Hil'legas, Howard Clemens, American journalist and author: b. Pennsburg, Pa., 30 Dec. 1872. He was graduated from Franklin and Marshall College, Lancaster, Pa., in 1894, and after being connected with several Pennsylvania journals was war correspondent of the New York *World* in South Africa 1899–1900. He has published 'Oom Paul's People' (1899); 'The Boers in War' (1900); 'With the Boer Forces' (1900).

Hillern, Wilhelmine von, vĭl-hĕl-mē'nė fōn hĭl'ĕrn, German novelist: b. Munich 11 March 1836. In early life she was an actress at Coburg, and in 1857 married Baron von Hillern who died in 1882. Her novels began to appear in 1862 and became rapidly popular. Among them are: 'Double Life' (1865); 'A Physician to the Soul' (1869); 'The Geyer-Wally' (1873). Translations of her novels have been widely circulated in America. Her efforts as a dramatist have not endured, but one or two of her novels have been adapted for the stage.

Hill'house, James, American politician: b. Montville, 21 Oct. 1754; d. New Haven, Conn., 29 Dec. 1832. He was graduated in 1773 at Yale, of which institution he was treasurer from 1782. He studied law, and took an active part in the struggle of the Revolution; was a Federalist member of Congress in 1791, and in 1795–1810 a member of the United States senate. He was also a member of the Hartford Convention of 1815. It was chiefly through his initiative in the planting of trees that New Haven came to obtain the title of 'Elm City.'

Hillhouse, James Abraham, American poet: b. New Haven, Conn., 26 Sept. 1789; d. near there 4 Jan. 1841. He was the son of James Hillhouse (q.v.). He was graduated at Yale College in 1808, entered commerce in New York, and published in London his drama of 'Percy's Masque,' reprinted in New York with changes in 1820. In 1822 he removed to a country seat near New Haven, where he passed the remainder of his life. In 1825 he published his second drama, 'Hadad'; and in 1839 a collected edition of his writings appeared under the title of 'Dramas, Discourses, and other Pieces.' His dramatic writings, once greatly praised, now appear grandiose and dull.

Hilliard, hĭl'yard, **Henry Washington**, American lawyer: b. Fayetteville, N. C., 4 Aug. 1808; d. Atlanta, Ga., 17 Dec. 1892. He was graduated at South Carolina College in 1826, was admitted to the bar in 1829, in 1831–4 was a professor in the University of Alabama (Tuscaloosa), in 1838 was chosen to the Alabama legislature, in 1842–4 was United States *chargé d'affaires* in Belgium, and in 1845–51 represented an Alabama district in Congress. Though opposed to secession, he became a brigadier-general in the Confederate army. He was United States minister to Brazil, in 1877–81. He wrote: 'Speeches and Addresses' (1855); 'De Vane, a Story of Plebeians and Patricians' (1865); and 'Politics and Pen Pictures' (1892).

Hillis, hĭl'ĭs, **Newell Dwight**, American Presbyterian clergyman: b. Magnolia, Ia., 2 Sept. 1858. He was educated at Iowa College and Lake Forest University, studied theology at McCormick Theological Seminary, entered the ministry of the Presbyterian Church, and held pastorates at Peoria, Ill. (1887–90), and Evanston, Ill. (1890–4). In 1894 he was appointed pastor of the Central Church, Chicago, an independent congregation, and in 1899 of Plymouth Church of Brooklyn. He became known also as a lecturer, and has published: 'The Investment of Influence'; 'A Man's Value to Society'; 'How the Inner Light Failed'; 'Foretokens of Immortality'; 'Great Books as Life Teachers'; 'The Influence of Christ in Modern Life'; 'The Quest of John Chapman' (1904); and many other books.

Hills'boro, Ill., city, county-seat of Montgomery County; on the Cleveland, C., C. & St. L. railroad; about 45 miles south by west of Springfield, and 52 miles northwest of East Saint Louis. Its chief manufactures are flour, furniture, woolen goods, carriages and wagons, and dairy products. There is a coal-mine nearby. It is the commercial centre of an agricultural section of the State. Pop. (1900) 1,937.

Hillsboro, Ohio, village, county-seat of Highland County; on the Norfolk & W. and the Baltimore & O. S. R.R.'s; about 60 miles southwest of Columbus and 50 miles east by north of Cincinnati. It is in an agricultural and stock-raising region. The chief manufactures are furniture, foundry products, flour, lumber, dairy products, and cigars. It is the trade centre for a large part of Highland County. It has a public library containing about 8,000 volumes, and a number of fine public and private buildings. The city owns and operates the waterworks. Pop. (1900) 4,535.

Hillsboro, Texas, city, county-seat of Hill County; on the Missouri, K. & T. and the St. Louis S. R.R.'s; about 52 miles southwest of Dallas and 38 miles north of Waco. It is situated in an agricultural and stock-raising region. Its chief manufactures are cottonseed-oil, cotton goods, hosiery, flour, candy, men's clothing, agricultural implements, and lumber. The trade is largely in live stock, cotton, hides, grain, hay, and lumber. It has cotton-gins, cotton-compresses, planing-mills, and hay presses. The city owns and operates the waterworks. Pop. (1890) 2,541; (1900) 5,346.

Hills'dale, Mich., city, county-seat of Hillsdale County; on the Lake Shore & M. S. railroad; about 88 miles southwest of Detroit and 60 miles west of Toledo, Ohio. The first permanent settlement was made about the year 1840. It is situated in a rich agricultural region in which are raised large quantities of fruit. The chief manufactures are flour, fur garments, screens for doors and windows, wagon-wheels, tables, furnaces, furniture, and canned fruits. The trade, in addition to the manufactures, is chiefly in grain, fruits, vegetables, and live-stock. Baw Beese Park, outside the city limits, is owned by the city. Hillsdale is the seat of Hillsdale College (q.v.). The electric-light plant and the waterworks are owned and operated by the city. Pop. (1900) 4,151.

Hillsdale College, a coeducational institution founded in 1855 under the auspices of the Free Baptist Church, in Hillsdale, Mich. Since its establishment it has graduated about 1,000 students. The number of professors and instructors in 1903 was 24, the number of students 350. Special attention is given to the classical and scientific work, but the modern languages are not neglected.

Hilo, hē'lō, Hawaii, town on the Hilo Bay, on the eastern coast of the island; about 38 miles from Mauna Loa, 36 miles from Mauna Kea (the highest peak of the group), and 28 miles from Kilauea. Hilo is the second town in size in the Hawaiian Islands. It has the best harbor belonging to the group. The lighthouse in the harbor can be seen many miles. Large lava-fields are near; on the northwest side of the town and in the vicinity are extensive forests. The craters of Loa and Kilauea, the largest in the world, are visited annually by many tourists who land at Hilo. The inhabitants of the town include many races; but people from the United States who have engaged in business in Hilo are quite prominent. Hilo has good schools to which attendance is compulsory. The population of the town, which is co-extensive with the district of the same name is (1900) 19,785.

Hilongos, hē-lŏng'ōs, Philippines, pueblo of Leyte, on the southwest coast at the mouth of the Salog River, 62 miles southwest of Tacloban. It has a good harbor. Pop. 13,813.

Hilprecht, Herman Volrath, hĕr'män fōl'-rät hĭl'prĕHt, American Assyriologist: b. Hohenerxleben, Germany, 28 July 1859. He was graduated at Leipsic in 1883 and was curator of the Semitic section of the museum of the University of Pennsylvania, to which he presented the greater part of the 27,000 original cuneiform inscriptions which it contains. He was made professor of Assyrian and Comparative Semitic philology in the same institution 1886. In 1888–89 he was Assyriologist and scientific director of the University of Pennsylvania's expedition to Nippur, Babylonia, and editor-in-chief of its publications. Among his works may be mentioned: 'Old Babylonian Inscriptions, chiefly from Nippur'; 'History of the Babylonian Expedition of the University of

Pennsylvania to Nippur'; 'Recent Researches in Bible Lands'; 'Explorations in Bible Lands during the 19th Century' (1903).

Hilton Head, an island, at the mouth of the Broad River, off the southeast coast of South Carolina; a part of Beaufort County. Fort Walker, a Confederate fortification, was erected here during the Civil War. On 5 Nov. 1861, the fort was attacked by a Union fleet, under Commodore Dupont; Commodore Tatnall, with a Confederate flotilla, or "mosquito fleet," assisted Fort Walker, but it was captured by Dupont. The reports gave Union loss 8 killed and 23 wounded; Confederates, 10 killed and 10 wounded.

Himalaya, hĭm-ā'lā-ya or hĭm-a-lā'ya (from the Sanskrit signifying the abode of snow), a mountain system of Asia containing the highest peaks in the world, the principal mass of which is near the southern edge of the central section of the continent, between lon. 65° and 110° E., and lat. 28° and 37° N. The system extends approximately from northwest to southeast for about 2,000 miles, while its breadth varies from 100 to between 500 and 600 miles. The elevated plateau of Tibet, between the Himalaya proper and its extension, the Kuen-Lun range, is the widest part of the system. While the term Himalaya is usually confined to the range forming the northern barrier of India, the Hindu-Kush, on the northwest, and the Karakoram with the Kuen-Lun to the north are not distinct chains as frequently represented, but are all portions of the same connected mountain mass, having very little to distinguish them from the rest of the elevated system to which they belong. The Himalaya is connected on the east with the mountains of China and the Indo-Chinese peninsula, and on the west with the mountains of Baluchistan and Afghanistan. The Pamir Plateau described as a "huge boss or knot" north of the Hindu-Kush connects the Himalayas with the Thian-Shan, another mountain system which extends northeastward for about 1,200 miles. From the Ganges-watered plain of northern India which has an elevation of about 1,000 feet above the sea, the Himalayas ascend by successive slopes. The transition from this plain to the ascent of the range is marked in the northwest by a belt of dry, porous ground, broken up into numerous ravines. East of this is the "Terai," a belt of sloping marshland covered with forest and jungle, very malarious and crowded with wild animals. Beyond this lies the "Bhabar," a belt of gravelly and sandy nature covered with forests of valuable timber trees. The "duns," "marls," or "navars," longitudinal valleys partly cultivated and partly yielding forest growth, occupy the space between the Bhabar and the slopes of the Himalayas. The principal passes are the highest in the world and include the Ibi-Gamin pass in Garhwal 20,457 feet, the Mustagh 19,0[illegible]0 feet, the Parangla 18,500 feet, the Kronbrung 18,313 feet, and the Dora Ghat 17,750 feet. The greatest elevations of the Himalayan system are Mt. Godwin-Austen 28,250 feet in the Karakoram range, and in the Himalayas proper the Gaurisankar or Mount Everest 29,002 feet, the highest peak in the world, Kunchinjinga 28,170 feet, and Dhawalagiri 26,826 feet. On the north the limit of the snow line is 17,400 feet, on the south 16,200 feet. From the southern slope of the central portion of the great chain flow the various streams which unite in the Ganges; from the southern slope of the northwestern portion spring the rivers of the Punjab or "Five Waters," which unite to swell the Indus which rises on the northern slope and flows southwestward to the Arabian Sea; also on the northern slope not far from the source of the Indus springs the Brahmaputra which flows east, southwest, and south to the Bay of Bengal; and also from the plateau of Tibet north of the main Himalayan range flow the Salwin, Mekong and other rivers of the Indo-Chinese peninsula, the Yangtse, Hwang-ho, and other rivers of the Chinese Empire. The whole system is of granitic formation associated with gneiss and mica-slate, followed in descending by metamorphic and secondary rocks, until the alluvial deposits are reached. Minerals abound; copper and lead have been mined from ancient times, iron more recently, coal is found at the foot of the mountains, gold in the beds of the mountain torrents, zinc, sulphur, plumbago and salt are also obtained, and there are numerous mineral springs. The vegetation is luxuriant; rhododendrons are in rich profusion, and there are forests of pine, spruce, silver-fir and deodar cedar at varying altitudes. Consult Schlagintweit, 'Scientific Mission to India and High Asia'; Waddell, 'Among the Himalayas.'

Hinckley, Thomas, American colonial governor: b. England, about 1618; d. Barnstable, Mass., 25 April 1706. In 1635 he emigrated to America, and settled at Scituate, but four years later removed to Barnstable. He was deputy governor of Plymouth Colony in 1680 and afterward governor.

Hincks, Sir Francis, Canadian statesman: b. Cork, Ireland, 14 Dec. 1807; d. Montreal, 18 Aug. 1885. He went to Canada in 1831, set up in business at Toronto, and there became editor of the 'Examiner.' In 1841 he entered the first United Parliament as a prominent Liberal. He undertook the editorship of the 'Pilot' of Montreal in 1844. From 1851 to 1854 he was Canadian premier, and as such developed the railway facilities and mining resources of the country, and negotiated a treaty of commerce with the United States. In 1855–62 he was governor of Barbadoes, in 1862–9 of British Guiana, later minister of finance, and from 1873 editor of the Montreal 'Journal of Commerce.' Among his publications are: 'Canada: Its Financial Position and Resources' (1849); 'The Political History of Canada between 1840 and 1855' (1877); 'The Boundaries Formerly in Dispute between Canada and the United States' (1885).

Hind, hīnd, **John Russell**, English astronomer: b. Nottingham 12 May 1823; d. Twickenham 23 Dec. 1895. In 1840 he obtained a situation in the Royal Observatory at Greenwich. He was a member of the commission appointed to determine the exact longitude of Valencia (1844), and on his return was appointed the observer in Bishop's Observatory, Regent's Park. There he calculated the orbits of more than 70 planets and comets, noted several new variable stars and nebulæ, and discovered 10 minor planets. In 1851 he obtained from the Academy of Sciences at Paris the Lalande medal, and was elected a corresponding member; and in 1852 received the Astronomical

Society of London's gold medal, and a pension of $1,000 a year from the British government. In 1857–91 he was director of the 'Nautical Almanac,' and in 1880 president of the Royal Astronomical Society. He wrote: 'The Solar System' (1846); 'Astronomical Vocabulary' (1852); 'The Comets' (1852); 'Elements of Algebra' (1885); 'Introduction to Astronomy' (1871), and other works.

Hindman, hīnd'man, **Thomas Carmichael,** American soldier: b. Tennessee 1818; d. Arkansas 1868. He studied law, entered practice in Mississippi, fought in the Mexican War as a lieutenant of Mississippi volunteers, and in 1858–61 was a Democratic representative in Congress. Not long after the outbreak of the Civil War, he was commissioned brigadier-general, was defeated at Newtonia and Prairie Grove, was promoted major-general at Shiloh, and later served in Arkansas.

Hin'doos, in American history, a nickname given in New York State in 1854 to the American (q.v.) or Know-Nothing Party, from a charge that its candidate for governor, Daniel Ullmann, was born in Calcutta. He was in fact a Delaware man and a graduate of Yale.

Hinduism, in its widest sense, the religion and religious philosophy of the inhabitants of Hindustan, which is professed by nearly half of mankind. Hinduism, historically considered, presents three periods of development. The first is the Vedic age. The Vedas (q.v.) are hymns of worship, and the study of them reveals very clearly the nature worship of primitive Hindustan. In these hymns the elements of nature are addressed as divine beings. Agni, fire, lightning; Surya, the sun; Indra, the cloudless firmament; Maruts, the winds; Ushas, the dawn, are the principal deities of this poetic pantheon. They are addressed in high and sometimes beautiful language, as the senders of temporal blessings. Offerings of delicious viands are made to them; but they are not to be propitiated by bloody sacrifices of beasts, much less by human sacrifices. Libations are poured to them of soma, an exhilarating drink, made from the fermented juice of the soma (q.v.) or milk-plant. Throughout the Vedic hymns runs the under-notion of a supreme being, the creator and ruler of all. This is less discernible in the Brahmana or the Veda than in the Upanishads (q.v.). The Brahmana is a later class of Vedic hymn in which the henotheism suggested in the Upanishads has given place to a highly artificial classification of the divine powers, with a careful estimate of the rank of each. In the Upanishads, Agni, Indra, and Surya become symbols whose united significance may help the mind to understand the existence of one supreme and absolute being, and in this class of Vedic hymn we see the principles of the most enlightened form of native religion in India. The one world soul, in all its manifestations, is reflected in the soul of man, whose destiny is to be reunited with it. The moral responsibility of man, and the judgment of the supreme being against wrong-doing, are plainly taught in these hymns; but there is no trace in them of the later doctrine of moral purification through reiterated metempsychosis.

The second period in the development of Hinduism may be called the epic period. It receives full illustration in the great epic poems, the Ramayana, and the Mahabharata. Side by side with the pictorial teaching of these poems, in which an attempt is made to present the working of the divine economy in relation to specific human lives, there rises a philosophical system, rudimentary indeed, but laying foundations for the later Sankhya, Nyaya, and Vedanta systems. In the Mahabharata, with all its episodes and fantastic incidents, is vividly put forth the doctrine that the union of the human soul with the great, divine soul of the world is aided and expedited by penances of various sorts, such as are detailed with systematic prolixity in the Yoga. In the epic period the doctrine of metempsychosis is clearly enunciated. The soul, after the death of its temporary possessor, must be born again in some material semblance, in order that it may complete the work left unfinished in some previous state of existence, and must repeat the same experience until its task be accomplished and perfection be attained. A decided change is apparent in the popular Hinduism of the third or Puranic period (see PURANAS; TANTRAS). In the Puranas there is almost a Götterdämmerung discernible; no longer do peace and concord prevail in the pantheon where Brahma, Vishnu and Siva still reign supreme, but all is discord, confusion, and destruction. The legends of the epic poems are amplified with childish variations. The simple ideas of the Vedic hymns have vanished. The unbridled imagination of imitators and commentators has overstepped the limits of reverence, dignity, and even poetic beauty in the Puranas, which do not show any advance even in philosophical earnestness, acuteness, or profundity. Worship has become an empty ceremonial. The Vedanta philosophy is now the intellectual creed of the thoughtful and learned (see VEDANTA), and this philosophy is a sort of Deistic agnosticism, only slightly more definite than that of Herbert Spencer, as propounded in his 'First Principles.' For it is the main tenet of the Vedanta that there is one supreme divinity, but, however imagination and speculation may seek to invest this first principle with all the perfections which the human mind is capable of conceiving, the essence of the one divine being lies far beyond the grasp of human thought.

The philosophical creed and henotheism of the educated Brahmin is a sort of esoteric Hinduism which has not supplanted among the general people the influence of a wild polytheism. While it is said that the inferior gods of India make up a pantheon of 330,000,000 divinities, the most important among them are but few in number. These are styled "Guardians of the World," and comprise the elemental gods worshipped in the Vedic hymns. Next in rank to Vishnu, Siva, and Brahma, the supreme triad, are Indra, Agni, Yama (the god of hell), Surya, Varana (the god of water), Purana (the god of wind), Kuvesa (the god of wealth), Soma or Chandra (the moon god), etc. Among sacred animals are bulls: snakes, whose union with the demigods produced monkeys, and some birds, such as the ganada. Among trees, the banyan is held to be divine.

The sects of Hinduism are numerous, and their existence illustrates a principle which is found to have prevailed in the mythological religion of Greece. Each of these sects worships a particular divinity, and teaches that this divinity possesses all the attributes of a supreme being. Thus polytheism does not mean in India, generally, the worship of many gods by each devotee, but very often merely the worship of one god under many names. For example, the Saivas worship Siva; the Sauras, Surya the sun; the Ganapatyas, Ganesa, the god of wisdom, and so on to an almost indefinite length. They ask from each of these gods the same gifts, and the exercise of the same powers. Other sects are Buddhists, Jainas (q.v.), and Sikhs (q.v.). These last profess a pure theism, yet blended with all the absurdities of Hindu mythology and the monstrous fables of Islam; nevertheless they despise Hindus and Mussulmans alike and do not recognize the distinctions of caste. They reject all the Hindu sacred books and look upon warfare as a religious deity. This sect was founded at the beginning of the 16th century A.D. by Nanak Shah.

The philosophy of Hinduism is almost altogether occupied with those questions for which a religious solution is generally sought, namely, the origin and destiny of man, and his relation to the supreme being or the absolute. There are six schools of this philosophy, namely, the Nyaya, Vaiseshika, Sankhya, Yoga, Mimansa, and Vedanta. They all agree in essential points. Their object is to prescribe rules by which man may be delivered from the bondage of ignorance, and be absorbed into the deity. Their doctrine of the soul as something eternal and inextinguishable, distinct from mind, senses, and body, yet sharing in the merit or guilt of good or bad deeds, the latter of which are caused by ignorance of what is best and highest, is identical. They all teach the doctrine of metempsychosis and accept the authority of the Vedas. There is complete agreement among them as to how ignorance is to be gradually illuminated and right apprehension acquired: to this end the Scriptures must be studied and clearness of intellect and heart secured by sacrifices, alms giving, pilgrimages, the repetition of sacred words. The Sankhya are atheistic in their belief, but all the other schools teach the existence of one supreme being.

Consult: Wurm, 'Geschichte der Indischen Religion' (1874); Vergaigne, 'La Religion Védique d'apres les Hymnes du Rig-Veda' (1878–83); Barth, 'Les Religious de l'Inde' (1879); Muir, 'Original Sanskrit Texts'; Colebrook, 'Essays on the Religion and Philosophy of the Hindus' (1858); Mullens, 'Religious Aspects of Hindu Philosophy' (1860).

Hindustan, hĭn-doo-stän', **Hindostan**, hĭn-dō-stän', or **Indostan**, signifying "the land of the (river) Indus," a word of Persian derivation, formerly applied to India (q.v.).

Hingham, hing'am, Mass., town in Plymouth County; on Massachusetts Bay, and on the New York, N. H. & H. railroad; about 15 miles southeast of Boston. In the town are the villages of South Hingham, West Hingham, and Hingham Centre. The first permanent settlement was made in 1633, and it was then called Barecove. In 1635 it was incorporated under its present name. Its chief manufactures are awnings, cordage, wooden-ware, toys, boot-heels, furniture, leatherette and upholstery. It has a meeting-house which was built in 1681. It contains a public library and is the seat of Derby Academy. Some of the noted people who have lived in Hingham are John A. Andrew, John D. Long, Benjamin Lincoln, and James Hall, the famous geologist who for a number of years was State geologist of New York. Joshua Hobart, the Puritan ancestor of the Hobarts of New York State, lived in Hingham. Pop. (1900) 5,059. Consult: 'History of the Town of Hingham.'

Hink'son, Katherine Tynan, Irish novelist and poet: b. Dublin, Ireland, 3 Feb. 1861. She was educated in a convent at Drogheda and since her marriage to H. A. Hinkson in 1893, has lived in Ealing, a suburb of London. She is a voluminous writer of prose and verse, and her books are well known in the United States. Among them may be named: 'Shamrocks,' verse (1887); 'The Way of a Maid' (1895); 'Oh! What a Plague is Love' (1896); 'Three Fair Maids' (1900); 'That Sweet Enemy' (1901).

Hinman, Russell, American editor of text-books: b. Cincinnati 23 Jan. 1853. He was educated at Antioch College, Ohio, went into business as a civil engineer; and later became editor of geographical text-books for Messrs. Van Antwerp, Bragg & Co. of Cincinnati. Since 1890 he has been in charge of the editorial office of the American Book Co. He has written 'Eclectic Elementary Geography'; 'Eclectic Complete Geography'; 'Eclectic Physical Geography.'

Hinoyossa, hē-noi-ōs'sä, **Alexander d'**, Dutch colonial governor in America: b. and d. Holland. He came to America in 1650 as lieutenant in a small military force sent to accompany 150 immigrants. In 1659 he became director of Nieuer Amstel, a Dutch colony on the eastern bank of the Delaware River. Although, owing to disagreements and illness, this colony was not at first a success, it was greatly developed by Hinoyossa's wise rule. Hinoyossa was for a time involved in a conflict of authority with Director Petrus Stuyvesant of New Amsterdam, who had general superintendence of the commissioners constituting the government of Nieuer Amstel. In 1663 he obtained authority over all the settlements on the Delaware. The Swedish colonists submitted, and Stuyvesant relinquished his control. Upon the conquest of New Netherland by England, Hinoyossa returned (1674) to the continent where he fought in the Dutch army against the French invasion by Louis XIV.

Hin'ton, Richard Josiah, American author: b. London, England, 25 Nov. 1830; d. 20 Dec. 1901. He settled in the United States in 1851; studied topographical engineering at the Columbia School of Mines; and removing to Kansas in 1856 became a supporter of the cause of John Brown. He served in the National army in 1861–5; and was the first white man appointed to raise and lead colored troops. After the war he engaged in newspaper work in Washington, New York, and San Francisco. He was the author of 'Life of William H. Seward'; 'Life of Gen. P. H. Sheridan'; 'John Brown'; etc.

Hip, that part of the trunk comprised between the abdominal wall and the lower limb, particularly the region over the hip-bone (the crest of the ilium).

Hip Joint, the joint of the upper leg or thigh (femur where it joins the trunk. It is a ball and socket joint, formed by the sinking of the smooth globular cap into the deep hollow, called acetabulum (vinegar bowl), of the os innominatum. Its movements are controlled by five ligaments: the capsular; the ilio-femoral; the teres; the cotyloid; and the transverse. These movements are more wonderful than even those of the arm, being flexion, extension, abduction, adduction, and rotation inward and outward. It is the most powerful joint in the body and hardest to dislocate.

Hip Joint, Disease of, a disease of the ball and socket of the hip. It often results from scrofula; comes on in children or young persons, from very slight causes; is often traced to a long walk, a sprain in jumping, or a fall. In the early stage of the disease the whole of the structures of the joint are inflamed and after proper treatment may be sometimes subdued with no worse consequences than a more or less rigid joint. Usually, however, abscesses form around the joint, and often communicate with its interior; and the acetabulum and the head and neck of the thigh-bone become disintegrated, softened, and gritty. In a still more advanced stage, dislocation of the head of the thigh-bone commonly occurs, either from the capsular ligament becoming more or less destroyed, and the head of the bone being drawn out of its cavity by the action of the surrounding muscles, or from a fungous mass sprouting up from the bottom of the cavity, and pushing the head of the bone before it.

As the disease advances, abscesses occur around the joint. True shortening of the limb now takes place, which at the same time becomes adducted and inverted. From this stage, if the health is pretty good, and the lungs are sound, the patient may be so fortunate as to recover with an anchylosed (or immovable) hip-joint; but the probability is that exhaustion and hectic will come on, and that death will supervene, from the wasting influence of the purulent discharges occasioned by the diseased bone.

Hipparchus, hĭ-pär'kŭs, Greek astronomer: b. Nicæa in Bithynia. He lived about 160–125 B.C.; resided for some time at Rhodes, but afterward went to Alexandria, then the great school of science. A commentary on Aratus is the only work of his extant. He first ascertained the true length of the year, discovered the precession of the equinoxes, determined the revolutions and mean motions of the planets, prepared a catalogue of the fixed stars, etc.

Hipparion, hĭ-pā'rĭ-ŏn, a genus of fossil three-toed *Equidæ*. See HORSE, EVOLUTION OF.

Hippel'ates, a genus of midges to whose agency is ascribed the spread in many instances of the southern ophthalmic disease of cattle called pink-eye. See FLIES; PINK-EYE.

Hippocrates, hĭ-pŏk'ra-tēz, Greek physician, the father of medicine: b. in the island of Cos 460 B.C.; d. Larissa, Thessaly, 357 B.C. Besides practising and teaching his profession at home he traveled on the mainland of Greece. His writings, which were early celebrated, became the nucleus of a collection of medical treatises by a number of authors of different places and periods, which were long attributed to him, and still bear his name. The best edition is that of Littré (in 10 vols Paris, 1839–61). He has the great distinction of having been the first to put aside the traditions of early ignorance and superstition, and to base the practice of medicine on the study of nature. He maintained, against the universal religious view, that diseases must be treated as subject to natural laws; and his observations on the natural history of disease, as presented in the living subject, show him to have been a master of clinical research. His accounts of phenomena show great power of graphic description. In treating disease he gave chief attention to diet and regimen, expecting nature to do the larger part. His ideas of the very great influence of climate both on the body and the mind, were a profound anticipation of modern knowledge. He reflected in medicine the enlightenment of the great age in Greece of the philosophers and dramatists.

Hippodrome (from the Greek, *Hippos*, a horse, and *Dromos*, a race course), the name given by the Greeks to places where races were held. This included both chariot and single horse racing, but the hippodrome later took the form of a circus, other games, such as wrestling, boxing, running, etc., being added, and for a short time after the introduction of Roman customs and manners it became the scene of gladiatorial combats, but as sights of this nature did not find favor in the sight of the Greeks, these combats were eventually eliminated and the main feature of the games, as in the beginning, was the chariot race. To the brutal taste of the Roman populace flowing blood acted as an elixir, but to the more refined Eastern people the amphitheatre was abhorrent. Though numerous amphitheatres were scattered throughout western Europe very few were ever built within the limits of the Eastern empire and then only where the influence and manners of the Romans were most powerful.

The first mention of a hippodrome is made by Homer, but it is believed that the term then applied to any course over which a race of any kind was run and that it did not necessarily have a fixed location. As the chariot-racing became the national game, the proper courses for the holding of such events became necessary, as in these races, though much of the success depended upon the courage and skill of the driver, the loss of life was often great, through collision, the overthrow of the chariot in turning caused by rough ground, the breaking of an axle, or numerous other accidents. The hippodrome was built for the purpose of avoiding, as much as possible, the possibility of such mishaps, by providing a wide and smooth track, thus leaving plenty of space for the contestants. Of the ancient hippodromes (as distinguished from circus, amphitheatre, etc.), probably the most famous are those of Olympus and of Constantinople, and while the Circus Maximus of Rome may to a great extent have been more of a circus than race course, it was planned after the Greek race courses, was used by the Romans for this purpose, and thus may properly be classed with the other two.

The origin of the hippodrome at Olympus tradition gives to Hercules, but the only description of it obtainable is found in the passages of Pausanias (v. 15 ¶ 4; vi. 20 ¶ 7 foll.) though from the explorations of the German archæologists the ground plans of most of the structures described by Pausanias have been traced. Of its length and breadth there is no precise information, the overflow of the Alphus River having washed away the indications of its limits, though probably the distance from the starting place of the races to the goal, or from one goal to the other, was 770 metres or 4 Olympic stradia, and it was about one fourth as wide, or the same as each side of the starting place.

In general form the hippodrome was an oblong, one end of which was semicircular; on three sides having seats for the populace and on the fourth, where the races were started, seats for the royalty and nobles. The right side, formed by an artificial mound, was a little longer than the left side, which was built on the natural slope of a hill, the base of the fourth side being formed by the portico of Agnaptus, named after its builder. The form of the starting place was not unlike the prow of a ship, each side being 400 feet long, and containing stalls for the chariots and their horses. In the arena were two goals around which the chariots passed several times to complete the race; one of these goals having a bronze statue of Hippodameia upon it, the other an altar dedicated to "Taraxippus, the Terror of the Horses." The principal difference between the Greek hippodrome and the Roman circus was in the width of the arena, in the latter only four chariots being able to race at one time; there was also some slight difference in the arrangement of the carceres.

The erection of the hippodrome of Constantinople was due to two Roman emperors, Septimus Severus and Constantine the Great, who each in turn captured Byzantium by storm. About six years after its capture by him (197 A.D.) Severus commenced operations a little to the west of Byzantium, but in that year was called away by a rebellion in the West and never returned to the city For over a hundred years it remained untouched, until 323, when Constantine, having conquered the city, pushed the work to completion after changing the details in the original plans. On 11 May 330 it was inaugurated.

The external appearance of the hippodrome was imposing for its vastness, its height, and even for its beauty. The walls were of brick, laid in arches, and faced by a row of Corinthian columns 260 in number and standing 11 feet apart. There were four entrances from the city each flanked with towers, but of the stairways leading to these entrances no description has come down to us.

Some idea of the immensity of this prodigious structure may be given by the fact that its dimensions were 1,400 feet in length by 400 feet in width, covering an area of 535,866 square feet, or 12.3 acres. On the north was a structure containing the apparatus for the games, the servants' and attendants' apartments, the chariots and horses, the arsenal, etc., called by the Romans the *carceres* and by the Greeks *μάγγανα*. This apartment was separated from the arena by pillars with latticed gates, 12 in number. Next to these gates was the little church or oratory, where the rival contestants prayed before the games.

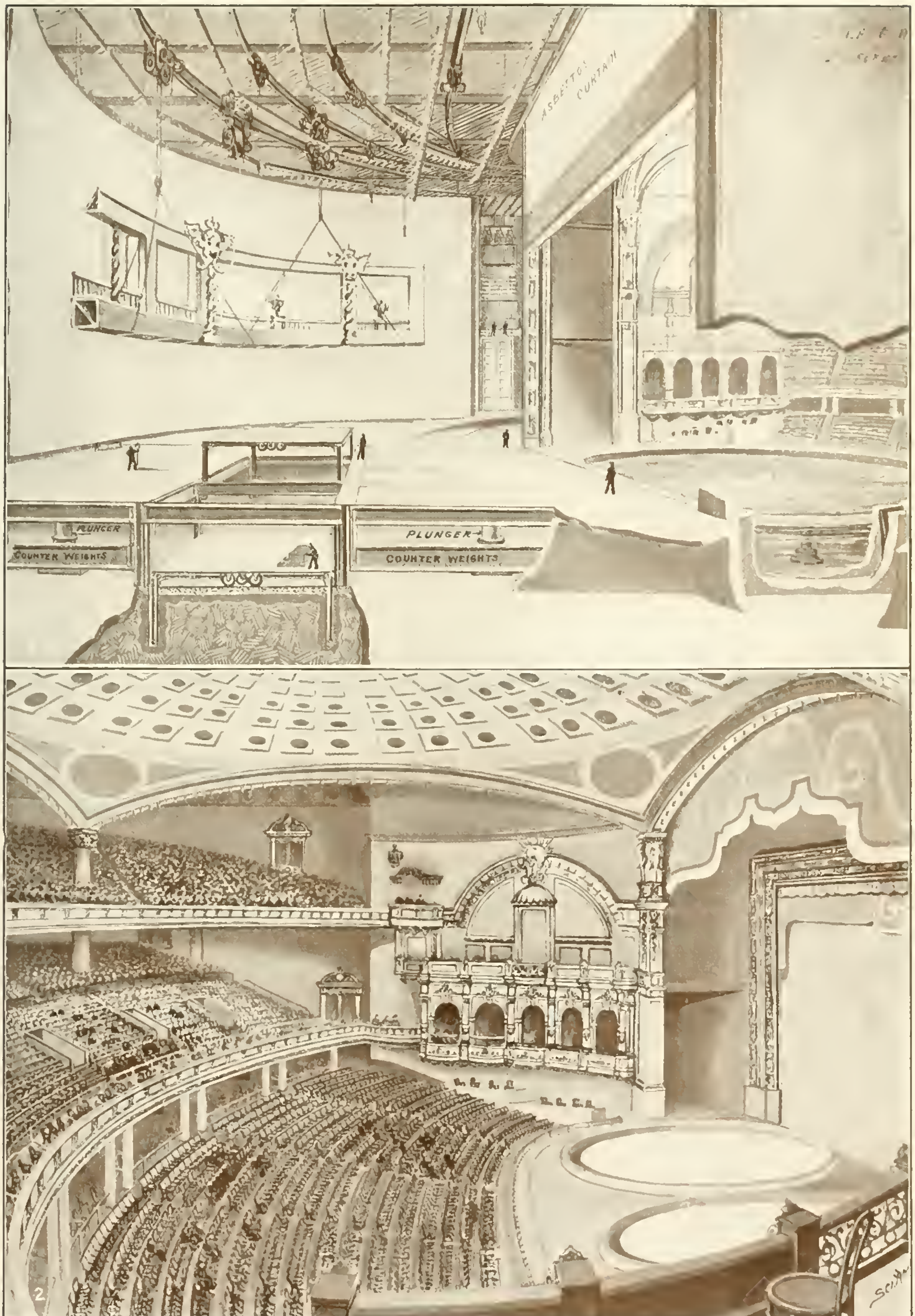
The ground story was 20 feet high. On it rested the palace of the Kathisma or Tribunal, in the centre of which, supported upon 24 marble pillars was the platform in Kathisma proper, on the front of which was the emperor's throne. On either side and a little below the emperor were the seats for courtiers, ambassadors, etc. Far down the western side of the hippodrome and nearly opposite the built column was the gorgeous chamber of the empress, this supported upon four porphyry pillars and hence called the tetrakion.

The eastern, western, and southern portions were occupied by parallel rows of seats, appropriated to the spectators according to their rank. Behind these rose tier upon tier of benches until nearly half way to the top where was a broad promenade bounding the entire extent of the hippodrome except on the northern side. This promenade was without roof or covering, and, standing nearly 40 feet above the ground, protected by a solid marble railing reaching to the breast, the spectator had a spacious avenue 2,766 feet long. It is estimated that the hippodrome would seat 60,000 persons and have comfortable standing room for 20,000 more, while with a little crowding 100,000 might be accommodated.

The arena was 211 feet wide by 1,190 feet long and was bounded by a narrow walk called the Euripus, paved in tesselated stone. The semicircular southern portion of the arena, that included in the curve of the Sphendone, was reserved for the criminals and there too was the place for executions. In the centre of the arena and lying parallel to it was the Spina: a stadium, 607 English feet in length, it marked and governed the beginning, duration, and end of each course of a race. At each end of the Spina was a high, narrow framework, surmounted by seven poles, on one group being placed seven fish, on the other seven eggs; one of each was taken down upon the completion of each circuit during the race until the race finished. Toward the southern end of the Spina was the Phiale, a broad basin of running water devoted to the victims of accidents. The space between the northern goal and the carceres was called the Stama, where wrestlers and acrobats performed.

Many additions to the works of art already gathered by Constantine were made during the 700 succeeding years, but in 1203 the hippodrome was sacked by the Franks and Venetians and all were either carried off or destroyed. The most famous of these was the 'Four Golden Steeds,' which was stolen by the Venetians and which in turn was brought to Paris by Napoleon, and is now standing guard over the main entrance of the cathedral of Saint Mark. Among the others are the statues of Hercules, the She-wolf and Hyæna, the Virgin Goddess Diana, the Brazen Ass, the Caledonian Boar, Helen of Troy, the God of Wealth, and eight Sphinxes, beside the statues of the early Roman emperors, martyrs, teachers, philosophers, etc In the early days of the city games were of frequent occurrence, but as time went by they became less and less frequent owing probably to the great cost (it is estimated that a single celebration cost 1,000,000 francs) and at last were celebrated only on 11 May and 25 December, the birthdays of the city and Christ respectively.

It is not known precisely when this hippodrome was entirely destroyed, but as there is no definite reference to any chariot race later than the reign of Isaac Angelus, who was dethroned



MECHANICAL FEATURES OF THE NEW YORK HIPPODROME

1. Stage, showing mechanism of movable portion and electric hoist for handling scenery. Tank beneath front stage or apron.

2. The auditorium, the front stage or apron, and the proscenium arch.

in 1195, and as the place was sacked in 1203-4 it is probable that it did not survive the beginning of the 13th century.

The Circus Maximus at Rome was for a long time the only structure of its kind in the world, taking its form from the Greek hippodrome and furnishing the model for all later *circi*. In the Vallis Murcia, between the Palatine and Avantine hills, wooden seats were first constructed by Tarquinius Priscus (Liv. I., 35); were frequently burned and rebuilt until the time of Julius Cæsar, when the steps were constructed of stone and greatly improved. At that time it probably accommodated about 100,000 people. After its destruction by fire in 31 B.C. Augustus completely restored it, making several magnificent additions. The upper tier of seats on the Aventine side was again destroyed by fire in 36 A.D., but Claudius not only restored these, but greatly enlarged the entire circus. These additions were supplemented by others made during the reigns of Trajan and Constantine until it was estimated that the circus held 385,000 spectators, while the 'Notitia' places the possible number at 485,000.

The general plan of the Circus Maximus compared favorably with the Greek hippodromes, the main difference being in the arena around which Cæsar had constructed a moat 10 feet wide and 10 feet deep to prevent beasts from injuring the spectators, and in the width of the arena as before stated. Before the reign of Augustus the circus was used for gladiatorial fights with wild beasts and other forms of butchery, but after the erection of the amphitheatre of Statilius Taurus the circus was no longer used for such purposes. The popularity of this as of the Greek hippodrome also declined and it gradually decayed, now only a few of the remains standing.

The term hippodrome has also been applied to race tracks in England and on the continent, the most famous of these so called hippodromes being those at Vincennes, Longchamps, Chantilly in France, Newmarket and Epsom in England, and Curragh in Ireland. The modern hippodrome, or indoor circus, had its beginning in Paris, where the first was constructed in 1845. It was built entirely of wood, the arena was 108 metres long and 104 wide, and it had a seating capacity of 15,000 persons. This was destroyed in 1870 by fire. The word hippodrome was first utilized in this country when Franconi conducted a circus where now stands the Fifth Avenue Hotel, at 23d Street and Fifth Avenue, New York.

The first hippodrome of the accepted type to be built in America was the New York Hippodrome, which occupies an entire block on Sixth Avenue, between 43d and 44th streets. This structure was begun on 1 July 1904 and finished in five months, the opening performance occurring 12 April 1905. The main façade has a length of 200 feet, and the building extends 240 feet east on 43d and 44th streets. It is built of brick, marble, and steel, and rises to a height of 72 feet on Sixth Avenue, and 110 feet in the rear, the total cost being $1,750,000. It is the largest playhouse in the world, having a seating capacity of 5,200.

In the interior decorations the general scheme of coloring is a Roman red as a background, with all the structural features done in ivory, gold, and silver. The carpetings are of the same color, and the wall hangings, draperies, and upholstery are executed in a Roman red velvet enriched with heavy gold and silver embroidery and tassels.

The auditorium is about 160 feet long and 160 feet wide in the first story, and the balcony and gallery occupy the building in front of the stage above the first story. At the rear of the balcony is the mezzanine floor, below the rear seats of the balcony being the wide segmental promenade with main entrances and flights of shallow stairs at each end leading to the street. Behind the promenade the space, 20 to 50 feet wide and 200 feet long, is occupied by smoking rooms, parlors, waiting rooms, and cloak rooms. The promenade and lobbies are finished in marble and cæn-stone, relieved by rich illuminations of the ornamented parts in gold and silver. A special feature of the auditorium is the arrangement and construction of cages for animals of the feline kind. Their dens are arranged in a segmental curve in the promenade floor, and have plate glass fronts with iron bars behind.

The chief point of interest in the hippodrome centres the stage and the entirely novel mechanical arrangements for operating the movable platforms, filling and emptying the tank, raising and lowering the stage, and handling the scenery. The depth of the stage from the extreme front to the back wall is 110 feet, or 50 feet from the back wall to the proscenium opening and 60 feet from the arch to the front of the stage. This latter part of the stage lying forward of the proscenium arch is known as the "apron." It is large enough to contain two regulation circus rings, each 42 feet in diameter. Beneath the "apron" is built a huge steel and concrete tank, over 14 feet in depth, and large enough for the whole "apron" to sink within it. When aquatic performances or naval pageants are given the tank is filled with water and the movable "apron" is submerged below the water to the bottom of the tank.

Bibliography.—As before stated, the only description of the Olympia as it originally stood is contained in 'Pausanias' (v. 15 Φ 4; v. 120 Φ 7 foll.). From results of excavations the best descriptions of the old hippodromes of the world may be had in the following: Curtius, 'Olympia' (Berlin 1852); Grosvenor, 'Hippodrome of Constantinople' (London 1889); Lehndorf, 'Hippodromos' (Berlin 1870); Pollack, 'Hippodromica' (Leipsic 1890). For descriptions of chariot races consult: Homer's 'Iliad,' and Livy, and "Lew" Wallace, 'Ben Hur' (New York 1880). Of the New York Hippodrome probably the best description is contained in the 'Scientific American' (Vol. XCII., No. 12: 25 March 1905). For a study of the architectural features of the structures of those times consult Sturgis, 'European Architecture' (New York 1896).

Hippopot'amus, the generic and popular name of a great amphibious ungulate, allied to the swine, of which two species are known. One (*H. amphibius*) is common throughout the greater part of Africa; the other (*H. liberiensis*) is not only smaller, but has other important differences, and is found only in the African west coast rivers, and those flowing into Lake Tchad. The former species has a thick and square head, a very large muzzle, small eyes and ears, thick and heavy body, short legs terminated by four toes, a short tail, two ventral teats, skin about two inches thick on the back and sides, and without hair, except at the extremity of the tail. A curious feature of the skin is the reddish exudation which pours from its pores when the animal is excited or in pain. It is called "bloody sweat," but the blood has no part in it. The incisors and canines of the lower jaw are of great strength and size, the canines or tusks being long and curved forward. These tusks sometimes reach the length of two feet and more, and weigh upward of six pounds. The animal is killed by the natives partly as food, but also on account of the teeth, their hardness being superior to that of ivory, and less liable to turn yellow. The hippopotamus has been found as much as 14 feet long, and nearly 5 feet high, but usually measures much less. It delights in water, living in lakes, rivers, and estuaries, and feeding on water-plants or on the herbage growing near the water, where it can walk as well as swim. It often leaves the water after nightfall, and goes, sometimes long distances, to grassy pastures to feed; regular paths are worn through the reeds, and here the Africans often arrange pits, deadfalls, or other traps for their capture. These animals are quick of sense, timid and anxious to escape danger; but when brought to bay or enraged prove formidable antagonists and often destroy canoes. They are excellent swimmers and divers, and can remain under water eight or ten minutes. The behemoth of Job is considered to be the hippopotamus. Several extinct species are found in Old World Tertiary formations, and modern species formerly inhabited not only Madagascar, but southern Europe and India, where they were contemporary with the men of the Stone Age.

Hippuric (hĭ-pū'rĭk) **Acid**, an organic acid, $C_9H_9NO_3$, existing in the urine of herbivorous animals, and, in small quantities, in that of human beings. It is increased by a vegetable diet, and by the disease called diabetes, and may be caused to appear in the human urine in considerable quantities by the administration of benzoic acid with the food. It is most conveniently prepared by boiling horse urine with milk of lime, filtering, neutralizing with hydrochloric acid, and evaporating to about one eighth of its volume. The concentrated urine is then acidified with hydrochloric acid and allowed to stand, when impure hippuric acid comes down as a yellowish-brown precipitate. To purify the crude product, it is heated to 212° F. with not quite enough water to entirely dissolve it, and chlorine gas is passed through the solution until the unpleasant smell has entirely disappeared. The solution is then filtered while hot, and the crystals which separate upon cooling are isolated and subjected again to the same treatment, the chlorine being passed through the solution, in this second treatment, until the solution is bright yellow. When thus prepared, hippuric acid crystallizes from water in the form of large prismatic plates, belonging to the trimetric system. Its crystals are colorless or white, free from odor, and have a slightly bitter taste. Hippuric acid has a specific gravity of about 1.308, and melts at 360° F.; it begins to boil at about 465° F., giving off benzoic acid and benzonitrile. It is insoluble in benzene, carbon disulphid, and cold chloroform, and is but slightly soluble in ether and in cold water. It is very soluble, however, in boiling water, and in hot alcohol. With bases, hippuric acid forms salts that are remarkable for the beauty of their crystalline forms. When boiled with dilute hydrochloric, sulphuric, nitric or oxalic acid, it yields benzoic acid and glycocoll.

Hiram College, a coeducational institution, founded in 1850, in Hiram, Ohio, under the auspices of the Christian Church. It was first called the Eclectic Institute, but was incorporated as a college in 1870. In 1903 there were in attendance about 400 pupils in the departments of oratory and music and in the preparatory department and college. There are about 6,200 volumes in the library.

Hiroshima, hē-rō-shē'mä, Japan, a town on the island of Hondo, about 100 miles from Kobe, and after Osaka the most important port on the inland sea. Pop. (1899) 122,306.

Hirsch, hĭrsh, **Emil Gustav**, American rabbi: b. Luxemburg, Germany, 22 May 1852. He studied at the University of Pennsylvania and at Berlin, was rabbi successively in Baltimore, Md. (1877) and Louisville, Ky. (1878–80), and in 1880 was chosen minister of the Sinai congregation of Chicago, Ill. In 1880–7 he was editor of the 'Zeitgeist' of Milwaukee, Wis., and later became editor of the 'Reform Advocate' of Chicago. He was appointed professor of rabbinical literature in Chicago University in 1892. He appeared as an orator on various patriotic and other occasions, and wrote several monographs on religious and Biblical topics. He was also prominent in Republican State politics, and in 1896 was presidential elector-at-large for Illinois.

Hirsch, Maurice, Baron de (Baron Maurice de Hirsch de Gereuth), Austrian Jewish capitalist and philanthropist: b. Munich 9 Dec. 1831; d. Ogyalla, Hungary, 21 April 1896. His fortune was computed to be $200,000,000, and his yearly income at about $20,000,000. His benefactions equaled nearly $100,000,000, the most of this sum being directed toward the improvement of the condition of the Jews in all parts of the world. The De Hirsch trust for the United States is a fund of $2,500,000 for the Americanizing and education of Rumanian and Russian Jews. Other large gifts were those of $5,000,000 for the endowment of schools in Galicia, and of $50,000,000 to the Jewish colonization association for the establishment of colonies in Argentina. In 1888 he offered to the Russian government $10,000,000 for schools, with the condition that in the distribution of the amount no discrimination as to race or religion be made. This offer was not accepted. Baron de Hirsch made extensive sums through the construction of railways in Turkey.

Hirth, hērt, **Friedrich**, German-American educator: b. Grafentonna, Saxe-Coburg, Germany, 1845. He studied at Leipsic, Berlin, and Greifswald, entered the Chinese customs service in 1870; retired in 1897, and in 1902 was called to the newly created professorship of Chinese in Columbia University. In the summer of 1902 he was in St. Petersburg, cataloguing a collection of manuscripts taken at Peking. He made a valuable collection of Chinese porcelains, now in the museum at Gotha, and one of printed

HIPPOPOTAMUS (*Hippopotamus Amphibius*).

books and MSS., now in the Berlin Royal library. Among his publications are: 'China and the Roman Orient' (1885); 'Ancient Porcelain' (1888); 'Chinesische Studien' (Vol. I., 1890); and 'Ueber fremde Einflüsse in der Chinesischen Kunst' (1896).

His'cock, Frank, American legislator: b. Pompey, Onondaga County, N. Y., 6 Sept. 1834. In 1855 he was admitted to the bar, in 1860-3 was district attorney of Onondaga County, and in 1867 a member of the State constitutional convention of New York. He was a Republican representative in Congress in 1879-87, and obtained recognition as a party leader and speaker. In 1887 he was United States senator from New York and then returned to professional practice.

Hispania, hĭs-pā'nĭ-a̤. See SPAIN.

Histol'ogy, the science of animal and vegetable tissues. It investigates by means of the microscope the various tissues of man, animals and plants in their anatomical relations and compositions. Topographical histology considers the more minute structures of the organs and systems of the body; normal histology deals with the healthy tissues; and pathological histology investigates the changes they undergo in disease. Marie François Xavier Bichat (1771-1802) is generally credited with the foundation of the science of histology. Unfortunately the imperfect condition of the microscope in his time prevented Bichat and his contemporaries from carrying their investigations to the point which Schleiden, Schwann, Johann Müller, Virchow, Von Recklinghausen, Cohnheim, etc., have reached. It has been found that all structures however complex are made up of cells, and that the parts of a body may be resolved into a small number of elementary tissues now grouped as: (1) epithelium, which lines almost all the cavities of the body and is directly or indirectly in communication with the atmosphere; (2) the nervous tissues, which as nerve cells originate and as nervous fibres transmit all nervous impulses; (3) muscle, which produces motion whether voluntary or involuntary; (4) glandular tissue which consists of cells standing in close relation with the blood-vessels which take from the blood certain substances and secrete them; (5) connective substances which support and hold together the more delicate and important structures, especially forming the cartilages and bones. See CELL; ANATOMY, COMPARATIVE; ANATOMY OF PLANTS.

Many tissues have the power of repairing injuries that happen to them. This power is called regeneration, and is found especially in the lower animals, in polyps, worms, and in many amphibious creatures and reptiles. In other cases the lesion is supplied by a new growth of connective substance. In diseases the tissues undergo many changes and many of these diseases in the organism are shown also by the changing of color. The science of such changes is generally called pathological histology. It is a comparatively young science and has been cultivated by Virchow, who was the founder of cellular pathology.

Vegetable histology is that department of botany which deals with microscopic phytotomy or the anatomy of plants, especially investigating the plant cells and plant tissues. It is properly subordinate to morphology and is a distinctively descriptive science. It deals with the question in what relation the cells or forms of tissue stand to the vital activity of plants, what functions they perform, and in what respect they are constituted for the fulfilling of those functions. (Compare CYTOLOGY.) Owing to the excessive minuteness of the cells which form the tissues of all plants the investigation relies almost entirely on the microscope, and naturally has made its advance in proportion as the microscope has been made more perfect. Microscopes that are now used magnify at least 1,000 diameters, and the materials used have to be carefully prepared and mounted. Many of them have to be colored with hæmatoxylin, fuchsin, saffranin, and other alcoholic or aqueous dyes. Consult Delafield and Prudden, 'Handbook of Pathological Anatomy and Histology' (1901).

Historical Societies in the United States. John Pintard, of New York, deserves the credit of being the first who endeavored to organize historical societies in the United States. He was born 18 May 1759, received his education at Princeton College, and became actively identified with several military expeditions in the War of the Revolution, being also deputy commissary for American prisoners. He was especially zealous in the study of American history, and appreciated the need of preserving the literature, muster-rolls, private and public documents, relics, and other material of the colonial period, at that time uncollected. In 1789 he visited the Rev. Jeremy Belknap, in Boston, who writes: "When Mr. Pintard was here he strongly urged forming a society of antiquarians." In August 1790 Mr. Belknap, following this suggestion of Mr. Pintard, drew up an outline for such a society, in which was the following clause, "Letters shall be written to gentlemen in each of the United States requesting them to form similar societies and a correspondence shall be kept up between them for the purpose of communicating discoveries and improvements to each other," and quaintly concludes, "When ye societie's funds can afford it salaries shall be granted to the secretaries and other officers." In February 1791 Mr. Belknap writes: "We have now formed our society and it is dubbed, not the Antiquarian, but the Historical Society. It consists at present of only 8, and is limited to 25. We intend to be an active, not a passive, literary body; not to be waiting like a bed of oysters for the tide (of communication) to flow in upon us, but to seek and find, to preserve and communicate literary intelligence, especially in the historical way." In 1794 the membership was increased to 60, and by act of legislature in 1857, the limit of resident members was placed at 100. Associated with Jeremy Belknap in the new society were Rev. John Eliot, Rev. James Freeman, James Sullivan (later governor of Massachusetts), Rev. Peter Thatcher, William Tudor, the noted lawyer, Thomas Wallcut, the antiquary, James Winthrop, for years librarian of Harvard, Dr. William Baylies, a physician of Dighton, and George R. Minot, the author. The position held to-day by the Massachusetts Historical Society is so well recognized at home and abroad that it would be futile to attempt to describe either its valuable contributions or its stimulating example to similar societies, during its unqualified success of over 100 years. Its officers in 1903, were: President, Charles Francis Adams; vice-presidents, Samuel Abbott Green, M.D., Thomas Jefferson Coolidge; recording secretary, Edward James Young; corresponding secretary, Henry Williamson Haynes; treasurer, Charles Card Smith; librarian, Samuel Abbott Green, M.D.; cabinet-keeper, Henry Fitch Jenks.

To John Pintard is due the credit for the first meeting, 20 Nov. 1804, of the New York Historical Society. Those present included John Pintard, Judge Egbert Benson, DeWitt Clinton, Rev. Wm. Linn, Rev. Samuel Miller, Dr. David Hosack, Rev. John M. Mason, Rev. John N. Abeel, Samuel Bayard, Peter G. Stuyvesant and Anthony Bleecker. These patriotic founders organized "for the purpose of discovering, procuring, and preserving whatever may relate to the natural, civil, literary, and ecclesiastical history of the United States in general, and of this State in particular." The valuable library of John Pintard was acquired in 1807, thus forming the nucleus of the 100,000 volumes owned by the society in 1903. The first gift from outside sources, recorded in the minutes of the Society, came in 1810, when 10 volumes of the publications of the Massachusetts Historical Society were presented. The society is now erecting a new home on Central Park West, 76th and 77th streets, where its thousand members may more adequately enjoy its collections; including the galleries of American portraits and old masters; the famous Egyptian collection of Dr. Henry Abbott, the Nineveh sculptures presented by James Lenox, the original Audubon water colors, together with countless original papers, engravings, prints, broadsides and relics of the Colonial and Revolutionary periods. Meetings are held the first Tuesday of each month, October to June inclusive, at which papers, dealing with American history, are read. The society established a fund for printing its proceedings and collections; 28 volumes have been issued since 1868, as follows:

Vol. I.— 'The Continuation of Chalmer's Political Annals of the American Colonies' (1685–96); 'The Colden Letters on Smith's History of New York' (1759–60); 'Documents Relating to the Administration of Jacob Leisler' (1689–1769).

Vol. II.— 'The Clarendon Papers, Relating to New York and New England' (1662–7); 'The Destruction of Schenectady' (1690); 'Montague's Arguments on Acts of New York Assembly' (1701); 'Colden's Letter on Smith's History of New York' (1759); 'Plowden's New Albion' (1632–50); 'Gardiner's History of East Hampton, New York' (1798); 'Collection of Evidence and Vindication of the Rights of New York to the New Hampshire Grants.'

Vol. III.— 'Territorial Rights of New York Against the Government of New Hampshire,' a brief by James Duane; 'Old New York and Trinity Church' (1730–90); sermon by the Rev. Francis Makemie (1707).

Vol. IV., Vol. V., Vol. VI., Vol. VII.— 'The Papers of Major-General Charles Lee' (1754–1811).

Vol. VIII.— 'Letters of General Pattison, Commandant of New York City' (1779–80); 'Letters to General Lewis Morris (1775–82).

Vol. IX., Vol. X.— 'Official Letter-Books of Lieutenant Governor Cadwalader Colden' (1760–75).

Vol. XI.— 'Papers of Charles Thomson, Secretary of the Continental Congress' (1765–1816); 'Letters of Colonel Armand' (1777–91); 'Letters to Robert Morris' (1775–82).

Vol. XII.— 'Trial of General Schuyler' (1778); 'Trial of General Robert Howe' (1781); 'Journal of Commissary Rainsford, Enlistment of Hessian Troops' (1776–78).

Vol. XIII.— 'Trial of General St. Clair' (1778); 'Journal of Occurrences at Quebec' (1775–76); 'Case of William Atwood, Chief Justice of New York' (1703); 'Vesey's Sermon in Trinity Church, at the Funeral of Lord Lovelace' (1709); 'Letter of Dominie Michaelius, First Minister in New Netherland' (1628); 'Records of the Court of Lieutenancy, New York Militia' (1686–96).

Vol. XIV.— 'Journals of the Engineer Officers, Colonel James and Captain John Montressor, of Services in America' (1757–78).

Vol. XV.— 'Journal of Lieutenant Von Krafft, of the Hessian Army' (1776–84); 'Letter-Book of Captain Alexander McDonald, of the Royal Highland Emigrants' (1775–79).

Vol. XVI., Vol. XVII.— 'Papers of Lieutenant-Colonel Stephen Kemble, Adjutant-General of the British Army in America, Journals and Correspondence' (1775–89); 'General Orders of the British Army in America' (1775–8); 'Journals, Documents, and Correspondence of the Expedition to Nicaragua' (1780–1).

Vol. XVIII.— 'The Burgher Right and Roll of Burghers of New Amsterdam' (1648–61); 'Roll of Freedom of New York City' (1675–1866); 'Register of Indentures of Apprentices of New York City' (1694–1708).

Vol. XIX. to XXIII.— 'The Deane Papers, Correspondence, Official and Private, of Silas Deane' (1774–89).

Vol. XXIV.— 'Muster Rolls of New York Provincial Troops' (1755–64).

Vol. XXV.— 'Abstracts of Wills on File in the Surrogate's Office, City of New York' (1665–1707).

Vol. XXVI.— Same (1708–29), with Appendix.

Vol. XXVII.— Same (1730–44).

Vol. XXVIII.— Same (1744–).

The officers of the New York Society for 1903 are: President, Samuel Verplanck Hoffman; first vice-president, Frederic Wendell Jackson; second vice-president, Francis Robert Schell; foreign corresponding secretary, Archer Milton Huntington; domestic corresponding secretary, George Richard Schieffelin; recording secretary, Sydney Howard Carney, Jr., M.D.; treasurer, Charles Augustus Sherman; librarian, Robert Hendre Kelby.

Following in the steps of these two oldest societies hundreds of a similar character exist to-day. Indeed, hardly a city or county in each State of the Union but has had its own local historical society. A casual glance at a few local societies in Massachusetts and New York will give an idea of the spirit which prevails for the preservation of the historic past:

The American Antiquarian Society, Worcester, Mass., was incorporated 24 October 1812; this inland city being selected as less exposed to possible invasion from the sea, with the consequent loss of historical collections.

The Essex Historical Society, Salem, Mass., was originally started by Dr. Edward A. Holyoke, of Salem, and incorporated in 1821. Some 15 years later the Essex County Natural History Society was incorporated, and in 1848 both of these societies united, forming the Essex Institute. Of other societies in Massachusetts a few will suffice. The New England Historic Genealogical Society, Boston; The Quoboag Historical Society, Brookfield; Historical Society, Nantucket; Old Residents' Association, Lowell; Old Colony Historical Society, Taunton; Pocumtuck Valley Memorial Association, Deerfield; The Pilgrim Society, Plymouth; The Rumford Historical Society, Woburn. Rehoboth, Watertown, Westborough, Weymouth, and Winchester have each local societies.

In New York State mention may be made of the Long Island Historical Society, Brooklyn; Suffolk County Historical Society, Sag Harbor; Oneida Historical Society, Utica; Onondaga Historical Association, Syracuse; Rochester Historical Society; Buffalo Historical Society; Westchester Historical Society, and Tarrytown Historical Society. In many States the various religious denominations have historical societies and there was organized recently the American Jewish Historical Society, New York.

The various organizations in the several States have assumed so much usefulness that there now exists an "American Historical Association," organized at Saratoga, N. Y., 10 Sept. 1884, incorporated by Act of Congress, approved 4 Jan. 1889, and reports annually to Congress through the Smithsonian Institution. The more recent patriotic societies, such as the Sons of the Revolution, Society of Colonial Wars, Mayflower Society, Daughters of the Revolution, Colonial Dames, and Huguenot Society, are largely indebted to the historical societies for their existence. Indeed, the Sons of the Revolution was formed in the hall of the New York Historical Society.

The following list of historical societies existing in 1903, is arranged in alphabetical order of States, with the information furnished, in so far as replies have been received, from the secretaries of States, or officers of historical societies:

Alabama.— The Alabama Historical Society, organized 8 July 1850 at Tuscaloosa, Chancellor Alexander Bowie being first president. Incorporated by Act of the General Assembly 5 Feb. 1852. During Civil War all work was suspended, many documents being lost. 1874 revived by Dr. Joshua H. Foster, its first secretary. 10 Dec. 1898; The Alabama History Commission was created at Montgomery, Hon. Thomas M. Owen being secretary and treasurer.

Alaska.— Society of Alaska, Natural History and Ethnology, incorporated 11 April 1888 at Sitka. Alaska Historical Library and Museum incorporated 6 June 1900, at Sitka.

Arizona.— The Arizona Pioneer Historical Society, located at Tucson, was established some years ago.

Arkansas.— There are two historical societies in the State, both styled "Arkansas Historical Society," one at Little Rock, Fay Hempstead, secretary; the other at the University of Arkansas, Fayetteville, J. H. Reynolds, secretary.

California.— The California Historical Society, organized in 1886, San Francisco.

Colorado.— The State Historical and Natural History Society, Denver; incorporated 11 July 1879. Charles R. Dudley, secretary.

Connecticut.— The Connecticut Historical Society, Hartford, organized 1825; revived by the general assembly 1839; Albert C. Bates, secretary; New Haven Colony Historical Society, New Haven, 1862; New London County Historical Society, New London, 1870; Fairfield County Historical Society, Bridgeport, 1881; and the Middlesex County Historical Society, Middletown, 1902.

Delaware.— The Historical Society of Delaware, Wilmington, incorporated 1868; Hon. Chas. B. Lore, president; Wm. Hall Porter, recording secretary.

District of Columbia.— The Columbia Historical Society, organized 9 March 1894; Mrs. Mary Stevens Beall, recording secretary; and also the American Historical Society.

Georgia.— The Georgia Historical Society, Savannah; Hon. William Harden, secretary.

Idaho.— The Historical Society of the State of Idaho, Boise City; Hon. Wm. A. Goulden, secretary.

Illinois.— The Illinois State Historical Society, organized 30 June 1890. Local organizations in the State cooperate with the Society. The last legislature made the society a part of the Illinois State Historical Library, which library has heretofore issued publications of the society. Mrs. Jessie Palmer Webb, librarian of State Historical Library, and secretary and treasurer State Historical Society.

Indiana.— The Indiana Historical Society, organized 1830.

Iowa.— The State Historical Society of Iowa, Iowa City; organized 1857; present articles of incorporation date April 1892; F. E. Horack, secretary. The historical department of the State Library, Des Moines, should not be confused with this society.

Kansas.— The Kansas State Historical Society, Topeka; organized 14 Dec. 1875; Geo. W. Martin, secretary; "this library contains 24,424 books; 72,789 pamphlets; 25,926 volumes of newspapers; 25,977 manuscripts; 6,696 relics; 5,751 pictures; and 5,129 atlases and maps.

Kentucky.— The Kentucky Historical Society; organized 1839–40. The legislature donated rooms to the society 1879–80. In August 1902 it became a department of the State. Gov. J. C. W. Beckham, president; General Fayette Hewitt, first vice-president; W. W. Langmoor, second vice-president; Mrs. Jennie C. Morton, secretary and treasurer.

Louisiana.— The Louisiana Historical Society; organized 15 Jan. 1836; Judge Henry A. Bullard, president; reorganized 1846 with Judge F. X. Martin, president; incorporated 1847 and a new charter given 30 April 1877, transferring it from Baton Rouge to New Orleans. From 1860 to 1888 Judge Charles Gayarré, president, being succeeded by Judge W. W. Howe. Since 1894 Prof. Alcée Fortier has been president.

Maine.— The Maine Historical Society, Portland; organized 1822; H. W. Bryant, recording secretary; The Bangor Historical Society, Bangor; The Kennebec Antiquarian Society, Augusta; York Institute, Saco; The Sagadaboc Historical Society, Bath; The Lincoln County Historical Society, Wiscasset; The Skowhegan Historical Society, Skowhegan; The Waterville Historical Society, Waterville; and The Eliot Historical Society, Eliot.

Maryland.— The Maryland Historical Society, Baltimore; Geo. W. McCreary, librarian; The Frederick County Historical Society, Frederick; The Harford County Historical Society, Belair, Dr. Archer, president.

Massachusetts.—See data previously given.

Michigan.— The Michigan Pioneer and Historical Society, Lansing; organized 22 April 1874; issues each year a volume of historical collections; Henry R. Pattengill, secretary.

Minnesota.— The Minnesota Historical Society, St. Paul, is the only society in that State.

Mississippi.— The Mississippi Historical Society; organized 1898; Dr. F. L. Riley, secretary; Dunbar Rowland is director of the department of archives and history of the State of Mississippi, Jackson. This department was created 26 Feb. 1902 and is under the auspices of the historical society.

Missouri.—The Missouri Historical Society, St. Louis; chartered in 1875; The State Historical Society, Columbia, in 1899.

Montana.— The Montana Historical Society, Helena; organized December 1864; incorporated February 1865 and is a part of the State Library; Miss Laura E. Hovey, secretary and librarian.

Nebraska.— The Nebraska State Historical Society, Lincoln.

New Hampshire.— The New Hampshire Historical Society, Concord.

New Jersey.— The New Jersey Historical Society, Newark; organized 1845; William Nelson, corresponding secretary; Bergen County Historical Society, Hackensack, 1902; New Brunswick Historical Club, New Brunswick, Hunterdon County Historical Society, Flemington; Salem County Historical Society, Salem; Princeton Historical Association, Princeton; Woodstown and Pilesgrove Historical Society, Woodstown.

New Mexico.— The Historical Society of New Mexico; incorporated 5 Feb. 1881; home office, Santa Fe.

New York.— See previous references.

North Carolina.—The Historical Society of North Carolina was chartered in 1833; rechartered 22 March 1875; Dr. K. P. Battle, department of history University of North Carolina, Chapel Hill, secretary; The North Carolina Literary and Historical Society, Raleigh; W. J. Peele, secretary; and The Trinity Historical Society, Durham; Dr. J. S. Bassett, secretary.

North Dakota.— The North Dakota Historical Society; incorporated 8 March 1895; Col. C. A. Lounsberry, secretary, Fargo.

Ohio.— The Ohio State Archæological and Historical Society, Columbus; incorporated 13 March 1885, E. O. Randall, secretary. There are many local societies in Ohio: The Western Reserve Historical Society, Cleveland; The Fireland Historical Society, Norwalk; The Ohio Philosophical and Historical Society, Cincinnati; and others.

Oklahoma Territory.— The Oklahoma Historical Society, founded by the Oklahoma Press Association at Kingfisher, May 1893. By act of territorial legislature 21 Feb. 1895 it became trustee of the Territory "for the care, collection and preservation of all kinds of historical matter, and for the expending of any appropriation made by the Territory for such historical purposes, and located the society at the University building at Norman." In June 1901 the society accepted the offer of the entire upper floor of the Carnegie Library, Oklahoma City, pending the erection of a capitol building. Lincoln McKinlay, president; Sidney Clark, custodian.

Oregon.— The Oregon Historical Society, organized 17 December 1899; F. G. Young, secretary, University of Oregon.

Pennsylvania.— The Historical Society of Pennsylvania, Philadelphia; organized 1824; John W. Jordan, librarian; Bucks County Historical Society, Doylestown; Montgomery County Historical Society, Norristown; York County Historical Society, York; Lancaster County Historical Society, Lancaster; Wyoming Historical and Geological Society, Wilkes-Barre; Washington County Historical Society, Washington; Lebanon County Historical Society, Heilman Dale; Chester County Historical Society, West Chester; Delaware County Historical Society, Chester; Berks County Historical Society, Reading; Tioga Point Historical Society

Athens; and the Presbyterian, Baptist, and Methodist Historical Societies, Philadelphia.

Rhode Island.— The Rhode Island Historical Society, Providence; founded in 1822; The Newport Historical Society, Newport, R. I.

South Carolina.— The South Carolina Historical Society, Charleston; organized 1855; Gen. Edward McCrady, president; A. S. Salley, Jr., secretary.

South Dakota.— The Department of History in the State of South Dakota; administered by the State Historical Society; was organized by act of legislature 21 Jan. 1903; located at Pierre; Doane Robinson, secretary.

Tennessee.— Tennessee Historical Society, Nashville; Robert T. Quarles, corresponding secretary.

Texas.— The Texas State Historical Society; organized 2 March 1897; Hon. John H. Reagan, Palestine, president.

Utah.— The State Historical Society of Utah; organized 31 Dec. 1897; Salt Lake City.

Vermont.— The Vermont Historical Society; organized 1838; Montpelier; Joseph A. Deboer, recording secretary.

Virginia.— The Virginia Historical Society, Richmond; organized 1831; William G. Stanard, corresponding secretary and librarian.

Washington.— The Washington State Historical Society, Tacoma; Hon. Ezra Meeker, president; E. N. Fuller, secretary.

West Virginia.— State Historical Society, Charlestown.

Wisconsin.— The State Historical Society of Wisconsin, Madison; organized 1849; re-organized 1853, this latter date being considered the real date of organization.

Wyoming.— The Wyoming Historical Society; organized 1895; Robert Morris, secretary, Cheyenne.

Sydney H. Carney, Jr., M.D.

History is a record of events which have occurred among mankind; embracing an account of the rise and fall of nations, and other great mutations which have affected the political and social condition of the human race. In a more limited sense, history is a record of the progress of mankind in civilization; and, therefore, deals especially with those nations which have performed great achievements and exerted a commanding influence upon the fortunes of the human race.

History is generally divided into three great epochs — Ancient History, Mediæval History, and Modern History. Ancient History begins with the first appearance of historic records, and ends with the fall of the Western Roman Empire 476 A.D. Mediæval History, or the History of the Middle Ages, extends from the fall of Rome 476 A.D., to the discovery of America 1492 A.D. Modern History embraces the period from the discovery of America to the present time. Sometimes, however, the world's history is divided into only two great periods — Ancient and Modern; Ancient History embracing the whole period before the fall of Rome, 476 A.D., and Modern History comprising the entire period since that event.

The three sources of history are written records, architectural monuments and fragmentary remains. Several races of men have disappeared from the globe, leaving no records inscribed upon stone or parchment. The existence and character of these people can only be inferred from fragments of their weapons, ornaments and household utensils, found in their tombs or among the ruins of their habitations. Among these races were the Lake-dwellers of Switzerland; the prehistoric inhabitants of the Age of Stone and the Age of Bronze of the British Isles; the builders of the shell-mounds of Denmark and India; and the Mound-builders of the Mississippi Valley.

The discovery of monuments of great antiquity has aided vastly in ascertaining the date of ancient events. The Parian Marble, brought to England from Smyrna by the Earl of Arundel, contains a chronological arrangement of important events in Grecian history from the earliest period to 355 B.C. The Assyrian Canon, discovered by Sir Henry Rawlinson, the great English antiquarian, consists of a number of clay tablets, constructed during the reign of Sardanapâlus, and containing a complete plan of Assyrian chronology, verified by the record of a solar eclipse which must have occurred 15 June 763 B.C. The Fasti Capitolini, discovered at Rome, partly in 1547 and partly in 1817 and 1818, contains in fragmentary records a list of Roman magistrates and triumphs from the beginning of the Roman Republic to the close of the reign of Augustus. The Rosetta Stone, discovered by a French military engineer during Bonaparte's expedition to Egypt in 1798, contains inscriptions in the Greek and Egyptian languages, the deciphering of which has led to the discovery of a key to the meaning of the hieroglyphic inscriptions on the Egyptian monuments. The fragmentary writings of Sanchoniathon give us some light on Phœnician history; those of Berosus on Babylonia and Assyria; Manetho's lists of the 30 dynasties of Egyptian kings afford us valuable information; and the works of Herodotus, the «Father of History,» have given us a graphic account of the ancient nations — their annals, manners, and customs, as well as a geographical description of the countries which they inhabited.

Herodotus was the first of Grecian historians. Other Greek writers of history were Thucydides, the great philosophic historian; Xenophon, the writer of charming historical romances; Ctesias; Diodorus Siculus; Polybius; and Plutarch, the charming biographer of antiquity. Ancient Rome produced Livy, Tacitus, Sallust, and Cornelius Nepos, who have given us the facts of Roman history. For the history of the ancient Hebrews we are indebted to the books of the Old Testament and the works of Josephus, the celebrated Jewish historian, who wrote a complete history of his countrymen in Greek. Among early Christian Church historians were the Roman Eusebius and the Anglo-Saxon, the Venerable Bede. The Frenchmen Comines and Froissart were celebrated chroniclers of the Middle Ages. The Italian Macchiavelli achieved fame by his historical writings. Among modern historians have been many who have acquired celebrity by their works. Such were the great trio of British historians — Hume, Gibbon, and Robertson, whose works have always been regarded as standards. England has produced many famous writers of history; such as Macaulay, Carlyle, Grote, Thirlwall, Froude, Lingard, Arnold, Allison, Freeman, Rawlinson, Green, Knight, Merivale, Milman, Hallam, and others. France produced Rollin, Voltaire, Thiers, Guizot, Sismondi, Mignet, Michelet, and the brothers Thierry. Germany has given the world a great ecclesiastical historian in the person of Mosheim; and a number of German historians have given the world the benefit of their scholarly researches, among whom we may mention Niebühr, Neander, Rotteck, Heeren, Schlosser, Mommsen, Curtius, and Leopold von Ranke. Among American historians the most renowned have been Hildreth, Prescott, Bancroft, Motley, Lossing, and Parkman.

The origin of nations has been involved in obscurity, which has only quite recently been removed by the diligent study and the patient research of modern European scholars. Investigation into the affinities of the various languages has given us some new knowledge upon this interesting and important subject. Comparing the languages of most of the modern European nations with those spoken by the ancient Romans, Greeks, Medes, and Persians, and Hindus, we observe that all these languages had a common origin, entirely different from those spoken by the ancient Chaldees, Assyrians, Phœnicians, Hebrews, Arabs, and Egyptians; these latter being related to each other, but not to those of the nations previously named. The former of these languages are called *Aryan*, the latter *Semitic* and *Hamitic;* while the Central Asian Tartar nomads have a language called *Turanian.*

The Aryan branch is called Japhetic, because it has been supposed to be descended from Japheth; while the Semitic branch is regarded as the posterity of Shem, and the Hamitic branch as the children of Ham. The name Aryan means "tiller of the soil"; wherein this race has differed from the Turanian, or nomadic races of Central Asia.

In the course of time nations became divided into civilized and uncivilized, as their intellectual development was furthered by talents and commerce, or retarded or cramped by dullness and by isolation from the rest of mankind. Uncivilized nations are either wild hordes under an absolute and despotic chief who wields unlimited power over his followers, or wandering nomadic tribes, guided by a leader, who, as father of the family, exercises the functions of lawgiver, governor, judge and high priest. Neither the wild hordes under their despotic chiefs, occupying the unknown regions of Africa (negroes), the steppes and lofty mountain ranges of Asia, the primeval forests of America (Indians), and the numerous islands of Oceanica (Malays), nor the nomadic races with their patriarchal government, find any place in history.

The oldest civilizations were those found in the Tigris-Euphrates and Nile valleys, in the Hindu peninsula, and in the remote empire of China. The exact origin of the ancient nations and civilizations is lost in the dimness of their remote antiquity. These regions were richly endowed by nature with the resources necessary for sustaining a dense population; and the oldest historic empires accordingly took their rise in the rich alluvial lands watered by the Tigris and the Euphrates in southwestern Asia and by the Nile in northeastern Africa.

Historical Asia is southwestern Asia; where the great Hamitic and Semitic empires of Chaldæa, Assyria, and Babylonia successively flourished, in the Tigris-Euphrates valleys; where the Hebrews and the Phœnicans played their respective parts in the world's historic drama; and where the Aryan race finally came upon the scene in the appearance of the great Median and Medo-Persian empires and the Græco-Macedonian empire of Alexander the Great and his successors, followed by the Parthian, Eastern Roman, and new Persian empires; after which the Semitic race again prevailed in the sudden rise of Mohammed's religion and the great empire founded by his successors; followed by the conquests of the Seljuk Turks from Tartary, the two centuries of warfare between Christendom and Islam for the possession of the Holy Land as represented in the Crusades, the terrible scourges of the conquering Mongol and Tartar hordes of Genghis Khan and Tamerlane; and, lastly, the rise of the now-decaying Mohammedan empires of the Ottoman Turks and the modern Persians.

Southern Europe was the seat of the greatest two nations of antiquity—the Greeks and the Romans—the former by their literature and philosophy and their political freedom, and the latter by their laws and political institutions influencing all future European nations. The other nations of ancient Europe were barbarians, many of whom were conquered and civilized by the Romans. The overflow of the Roman dominion in the 5th century after Christ entirely changed the current of European history by a redistribution of its population through the migrations and conquests of its vast hordes of northern barbarians, who 14 centuries ago laid the foundations of the great nations of modern Europe. America and Oceanica were wholly unknown to the ancient inhabitants of the Old World, and have only occupied the field of history since their discovery and settlement by Europeans within the last four centuries.

The cradle of civilization — if not the cradle of the human race — was the fertile alluvial Tigris-Euphrates and Nile valleys, where, with the dawn of civilization, flourished the old Chaldæan and Egyptian empires—the most remote of historical states of antiquity. History begins with Egypt, the oldest of historical nations.

Asia is the birth-place of the great religions and the home of absolute despotism. The two great pantheistic religions — Brahmanism and Buddhism; also the great monotheistic religions — Judaism, Christianity, and Mohammedanism — arose in Asia; while Asiatic governments today are what they have been from time immemorial — absolute monarchies, or despotisms; no republic or constitutional monarchy ever having flourished on Asiatic soil.

Europe, on the contrary, inhabited by the progressive Aryan race, has carried political institutions to the highest state of development; civil, political, and religious liberty having had a steady growth. Asiatic civilization has been stationary, while European civilization has been progressive. The Asiatics are passive, submissive, given to contemplative ease and disinclined to active exertion. The Europeans are active, energetic, vigilant and aggressive. Europe has also colonized other portions of the globe; the greater part of the present populations of North and South America being the descendants of Europeans who settled in the New World, and drove away, or assimilated with, the aborigines; while Europeans have also settled in portions of Africa, Asia, and Oceanica. The Asiatics, on the other hand, do not colonize.

History, Ancient. Objectively history is a succession of past events connected with one another as cause and effect; subjectively it is a record of such events as determined by the processes of investigation included in historical method. The history of mankind treats not so much of individuals as of the progress and decline of communities and states with especial reference to morality, religion, intelligence, social organization, economic condition, refinement and taste, government, and the peaceful and military relations of governments to one another (cf. Andrews, 'Institutes of General History,' p. 3). Strictly there are no periods; the life of mankind flows continuously, never wholly changing the direction of its current at any definite time. But for the convenience of study history is more or less arbitrarily divided into periods, during each of which the resultant of changes in the life of mankind, or of a particular part of it, is supposed to be a determinable movement of progress or decline which the historian takes as characteristic of the period.

The familiar division of general history into ancient, mediæval, and modern may be accepted as the most practical, though it is exceedingly difficult to define these long and complex ages. Most obvious is the geographical characteristic. Leaving out of account India and the farther East, which have contributed little to the progress of the rest of the world, ancient history has to do (1) with the fertile river-valleys adjoining the east end of the Mediterranean; (2) with the Mediterranean basin itself; for the few outlying countries which had a share in ancient history depended upon this area for their civilization. Or taking race and religion as the basis of division, we may define ancient history as the development of pagan, non-Germanic civilization; for with the thorough establishment of Christianity and the coming of the Germans the Middle Age begins. Although ancient history includes many nations and numberless movements of growth and decay, it shows nevertheless remarkable unity. From simple though diverse beginnings the various peoples of the area above defined developed into the one complex political and social organization known as the Roman empire; and when with the wreck of this system the ancient world passed away, there began under new conditions that fresh life of mankind which in its earlier stage we call mediæval and in its more mature growth modern.

History does not concern itself with ultimate origins; it begins with man in the lowest condition in which it actually finds him, and with the help of anthropology, archæology, and kindred sciences it traces his improvement from that point upward through the earlier known stages of his existence. The prehistoric age, which precedes contemporary written records, is taken into account in so far as, by furnishing relative beginnings, it affords an explanation of later developments. Even when the historian reaches the period of contemporary documents and literature, he continues to use all available auxiliary sciences, principally epigraphy, archæology, numismatics, philology, and geography. In testing the genuineness and the historical value of sources he makes use of critical principles which are becoming more and more definite and effective with the growth of historical method into a science.

Nowhere has source material accumulated so rapidly in recent years as in the Orient. As a result of continued explorations there our knowledge of Oriental life has been vastly increased, and the beginnings of Oriental history have been pushed much farther back into the past. We are now able to study the Egyptians of the paleolithic age (cf. Petrie, 'History of Egypt' (4th ed. i. p. 5 ff), although no date can yet be assigned to that primitive culture, nor have yet been discovered all the links which connect it with the historic age. Beginning with the earliest appearance of written records in the Orient, we may divide ancient history into the following periods:

I. *The Dawn of Civilization; the old Egyptian Kingdom and the Chaldean and Syrian City-States, 5000–3000 B. C.*—Whether mankind first emerged from the Stone Age in the valley of the Nile or in that of the Tigris and Euphrates rivers is disputed, and the date of this event has not been even approximately determined. There can be no doubt, however, that early in the fifth millennium B.C. civilization in both these regions had reached a comparatively high development. People irrigated their fields, built cities, in which they lived under kings, and were acquainted with the elements of practical science as well as with the art of writing. The Egyptian alphabet of this period was hieroglyphic, the Chaldean cuneiform. Egypt achieved political unification under a monarch near the beginning of the period; Chaldea and Syria remained divided among rival city-states.

Through the most brilliant part of the period the Egyptian capital was Memphis, whose Pharaohs of the fourth dynasty (about 4000–3725 B.C.) constructed the great pyramids at Gizeh. This epoch is unique in the world's history for the bold attempt to surpass nature in the grandeur and strength of its buildings, which at the same time indicate the high centralization in the hands of the monarch. The people of Egypt, devoted to agriculture and the industrial arts, were peace-loving, submissive to authority, and intensely religious. Prominent among the Chaldean cities were Ur, Nippur, Agade (Accad), and Babylon, under independent kings who strove with one another for the mastery. In spite of their military occupation the people, like the Egyptians, engaged their best thought and energy in creating the elements of civilization. Among their early achievements were the science of astronomy, the calendar, and a system of weights and measures, which with some modifications afterward passed to Europe. Early in the fourth millennium Chaldean civilization began to affect Syria.

II. *The Middle Kingdom of Egypt; the Political Unification of Chaldea; the Neolithic and Æneolithic Ages in Greece, about 3000–2000 B. C.*—In the beginning of the period Thebes supplanted Memphis as the political centre of Egypt. The most brilliant dynasty was the twelfth (about 2775–2550 B.C.). The Pharaohs of this family with a firm hand controlled the feudal lords who since the sixth dynasty had been growing strong over all Egypt, and to whom most of the famous rock-graves of the period belong. The same dynasty conquered Ethiopia (Nubia), carried on a lively trade with Syria, and had commerce with countries as far west as Crete. They built splendid temples, and regulated the waters of the lower Nile by means of a great reservoir in the Fayûm. Their utilitarian works contrast strikingly with the grand though selfish idealism of the pyramid-builders. Meanwhile in Chaldea the strife among the cities continued till the whole country was unified under Babylon (2250 B.C.).

In the industries both nations reached a high stage of technical skill. The Egyptians excelled in inlaid work, the Babylonians in the engraving of gems. The architecture was massive, the Chaldean in brick, the Egyptian in stone. The sculpture, too, though lacking grace, showed great strength. The literature was looked upon by after ages as classic. In government we find a centralized monarchy with a bureaucratic administration regulated by written law (cf. the Code of Hammurabi (q.v.), about 2250 B.C.). The family was monogamic, and society was definitely organized in classes. The prime motive power in life was religion, which, manipulated by the priests, was already reducing the activities of man to a system of conventions and thus putting an end to originality.

In the region about the Ægean Sea the period is represented by the first settlement at Troy, of neolithic culture (3000–2500 B.C.), and by the second or "burnt" city, which was æneolithic (2500–2000 B.C.). Crete, in communication with Egypt, seems to have taken the lead in the civilization of this region.

III. *The Earliest Empires and Their Struggles; the Beginnings of Assyria, Phœnicia, and the Hebrews; the Bronze Age in Greece, 2000–1000 B. C.*—After the twelfth dynasty Egypt weakened; from the beginning of the second millennium the Hyksos (q.v.) a barbarous people from Asia, controlled the lower Nile valley for several, possibly five, centuries. After their expulsion the Egyptians became a conquering people. The eighteenth dynasty (about 1600–1325 B.C) extended their dominion on the south to the centre of Ethiopia and on the northeast to the Euphrates River. Cyprus and the "isles of the Great Sea" sent as tribute and gifts vases of Mycenæan manufacture.

Chaldea, ruled by Cossæan — Kassite — kings (1717–1140 B.C.), was not only unable to prevent these conquests, but even lost her hold upon Assyria, which now began a long winning struggle with Babylon for supremacy. Both countries courted the favor of the powerful Pharaohs. For the first time in history we have great states in relations of war and peace with one another — the beginning of diplomacy and "world-politics." Assyria (1125 B.C.) suddenly created an empire which extended northward to the sources of the two rivers and westward to the Mediterranean. She advanced beyond Egypt in the organization and administration of conquered countries, but her empire soon fell to pieces, partly from internal exhaustion and partly because of invasions from Arabia.

Before the rise of the Assyrian empire the Hittites had conquered eastern Asia Minor and had wrested northern Syria from Egypt; but their power was as speedily overthrown by swarms of invaders of unknown race from Asia Minor, who then made a fierce assault upon Egypt.

Before the end of the millennium the Phœnicians had planted many trading-stations on the islands and coasts of the Mediterranean and had created a "world-commerce." Sidon was at first the leading city, and afterward Tyre. Their civilization, with that of all Syria, was fundamentally Chaldean, affected to some extent by Egyptian commerce and conquest. About 1000 B.C. the Greeks adopted their phonetic alphabet.

Among the immigrants from Arabia into the civilized districts of Hither Asia were the Aramæans, who established themselves in northern Syria with their capital at Damascus, and the Hebrews, who conquered the country in southern Syria now known as Palestine (1150 B.C.). At first their government was a theocracy represented by prophets and "judges," but soon (about 1050 B.C.) they established a kingship.

In this period the creative energy of the Egyptians had exhausted itself. Life became artificial; wealth, flowing in from conquests, substituted magnificence for taste, and in the end enfeebled the national spirit. On account of the wars the military class came into great prominence; the king, more than before, became the proprietor of the state, and the priests gained control of the material as well as of the spiritual activities of the nation. In Hither Asia, also, artistic and industrial civilization suffered through the decline of Chaldea; for the Assyrian genius was chiefly political and military rather than artistic or intellectual. The Hebrews, however, were moving in the direction of monotheism, and Phœnicia was spreading Oriental civilization abroad over the Mediterranean lands.

Of enormous importance for history was the development of civilization in the Ægean region. The beginnings of the Bronze Age — proto-Mycenæan — are represented by the third, fourth, and fifth cities at Troy (2000–1500 B.C.), followed by the fully developed Mycenæan civilization, represented by the sixth city at Troy, by Tiryns, Mycenæ, and many other cities on the Greek peninsula, in Crete and the Ægean islands. Characteristic of the civilization are massive fortifications, large palaces, immense tombs, wonderfully skilful work in gold, in vase-making, gem-cutting, and inlaying with precious metals, also excessive ornamentation of apparel and effeminate luxury. Toward the close of the millennium this culture began rapidly to decline.

Parallel to this development in the Ægean, yet little affected by it, the Etruscans of central and northern Italy were creating a peculiar civilization,— less artistic and less grand than the Mycenæan,— which did not reach its height till the following millennium.

IV. *The Growth and Decline of the Syrian Kingdoms; the Rise of the Assyrian Empire; the Epic Age in Greece, 1000–700 B. C.*— Tyre, taking the place of Sidon, became the centre of the world's commerce. Under king David the Hebrews developed a great political power; but after the death of Solomon they split into two kingdoms, Judah and Israel. Damascus, which had belonged to the realm of David, again became the capital of an independent Aramæan kingdom. Near the end of the period, however, all Syria excepting Tyre fell under the Assyrian yoke. The people of Damascus (about 730 B.C.) and Israel (722 B.C.) were carried into captivity, and Judah became tributary. Babylon, too, was definitely conquered (728 B.C.). Egypt, again declining, divided into many small principalities, while Ethiopia rose to a power of the first importance. Her king conquered the Nile valley to its mouth in 728 B.C. But the greatest political event of the period was the rise of the Assyrian empire. Through persistent warfare carried on by a line of able kings for crushing frequent rebellion as well as for new conquests, the empire reached the height of glory, though not yet its widest extent, under Sargon (722–705 B.C.).

Great progress was made in civilization. The Hebrews, afflicted by Assyria, were purging themselves of polytheism, and under the lead of inspired prophets were learning to look upon Jehovah as the only God, almighty, pure, and jealous, who demanded of his worshippers not only ceremonial exactness but clean hearts and spiritual devotion. With the Assyrians, notwithstanding their strong religious nature, political motives were dominant. For strengthening their empire they adopted the plan (1) of recruiting their armies partly from conquered peoples, (2) of transplanting populations from one part of the empire to another, to break up local attachments and weaken the power of resistance, (3) of organizing some of the conquered countries into provinces ruled by Assyrian officials, though many were still left under their native rulers. In government and administration, accordingly, Assyria was at this time the most progressive of nations.

The centre of interest in the growth of civilization, however, shifted to the Ægean region, where in this age the Ionic Greeks produced the first European literature — the 'Iliad' (q.v.) and the 'Odyssey' (q.v.) Colonists in a strange country, the Ionians were not in a condition to cultivate the Mycenæan arts, but drew their subsistence from grazing, agriculture, and war. With a high degree of refinement, mixed with barbarity, they possessed remarkably virile, elastic minds. In contrast with the slavish Orientals, the Greeks, represented by the Ionians, were in spirit free. To them neither nature nor religion was terrible: their gods were intensely human, generally the helpers, never the implacable enemies of man. Combined with this intellectual liberty and boldness was a rare sense of fitness and proportion, manifested in the Homeric poems referred to above. In Greek manhood, virility, freedom, intelligence, and taste combined to produce a civilization which was already rapidly advancing beyond that of the Orient.

V. *The Fall of Assyria and the Rise of the Persian Empire; in Greece Colonial Expansion and the Awakening of a National Consciousness; the Struggle Between Asia and Europe, in which Greece Becomes the Centre of Interest in the World's Politics; in the Central Mediterranean Region the Political Growth of Carthage and Etruria; at Rome the Primitive Kingship and the Beginning of the Republic, 700–479 B. C.*— Early in the period Lydia became a conquering state, and reached the height of its imperial power under Crœsus (560–546 B.C.), who ruled nearly all Asia Minor west of the Halys River. Egypt fell under the Assyrian power (664 B.C.); but soon throwing off the yoke, it enjoyed a long period of independence (645–525 B.C.). Before the loss of Egypt the Assyrian empire reached from Thebes on the Nile nearly to the Caspian Sea, and from the Persian Gulf nearly to the Black Sea — the greatest extent of country yet united under one ruler. In Nineveh, their new capital, the kings built magnificent palaces of brick, adorned with representations of their wars in sculptured reliefs. They established libraries, too, of Babylonian learning. But they had already ceased to make political progress, and they failed to give their empire an organic unity, and to inspire the conquered nations with loyalty to the central government. Suddenly the empire was overthrown by a combination of the Babylonians and the Medes, who destroyed Nineveh in 606 B.C. With this event Assyria disappeared from history.

Two empires — the Median and the Babylonian — divided between them the Assyrian domain. The former lay in the north of Hither Asia, the latter in the south. Under Nebuchadnezzar (606–562 B.C.), Babylon became the largest and wealthiest city in the world, a brilliant seat of industry and commerce. He destroyed Jerusalem, carried Judah into captivity (586 B.C.), and conquered Tyre. Of the other empire the ruling people were the Medes, who inhabited the plateau between the Tigris Valley and the Caspian Sea. Their sway extended westward, on the north of Babylonia, to the Halys River, and southward over their Persian kinsmen. Both empires, however, were short-lived: in 550 B.C. Cyrus, an Elamitic prince, at the head of a Persian revolt, established himself master of the Median realm. This event made the empire Persian. After conquering Lydia (546 B.C.) and Babylon (538 B.C.), Cyrus proceeded to subdue the countries to the east and northeast of Persia: so that at his death (529 B.C.) his empire extended from the Ægean Sea to the Indus River, and from the Persian Gulf to the Jaxartes River — an area perhaps five or six times as great as that of the Assyrian empire. His son and successor Cambyses added Egypt (525 B.C.), and Darius, the following king (522–485 B.C.), completing an organization begun by Cyrus, divided the empire into twenty satrapies (provinces), each under a governor termed satrap. This magistrate, appointed by the king, exercised full military and civil authority over his province, subject to royal regulations and commands. Though checked by the continual presence of a royal secretary and by the occasional visits of the king's «eye» (inspector), the satrap enjoyed the splendor and nearly all the power of a sovereign. Darius also built roads throughout the empire, distributed the taxes equitably, and established a system of gold and silver coins. He annexed Thrace to his empire, and made an unsuccessful attempt to conquer Greece.

In the beginning of this period the Greeks were extending the sphere of their influence through colonization. About 750 B.C. they had begun to settle in southern Italy and Sicily: and for two centuries the movement of expansion continued, till their settlements extended from Naucratis, Egypt, to the Pillars of Hercules, and from the northern coast of the Black Sea to Libya. With colonial enterprise the industries and commerce kept full pace. They manufactured armor, artistic bronze-ware, and tastefully painted vases. From Lydia they learned the art of weaving and dyeing fine woolens as well as of coining money; from Egypt they derived the elements of astronomy, of surveying, and of the other practical sciences. Great intellectual progress took place; lyric poetry flourished in all parts of Greece — a kind of poetry which shows that the Greeks were actively thinking on all subjects suggested by their expanding environment. They made a beginning of geography, history, and philosophy. Thinking led to religious and moral progress; the Greeks began to exercise self-restraint and moderation in life. Their sympathies widened with their intelligence; they discovered that they were all of one blood, one speech, and one religion, and began to call themselves by the common name of Hellenes. They became aware, too, of the differences between themselves and foreigners, whom they termed "barbarians," and of their own superiority to all other races. Conflicts with foreigners made the Greeks feel that they ought to combine for mutual defense. In the preceding age (1000–700 B.C.) their whole country was divided among a multitude of small city-states, each under an independent king. While in the more progressive parts of the nation in the period now before us the government was rapidly developing from kingship through aristocracy, oligarchy or timocracy, and tyranny in the direction of democracy, a corresponding movement was going on toward political unity. The city of Sparta, after uniting by conquest Laconia, Messenia, and Cynuria in the strong military state of Lacedæmon, built up the Peloponnesian league with herself as leader. The basis of her superior military organization was the phalanx. Under the fear of Persian invasion this power expanded into an Hellenic league of all the loyal Greek states on the peninsula and on the neighboring islands. In Sicily a similar league grew up under Syracuse for defense against two formidable powers, Etruria and Carthage. The Etruscan dominion extended from the Alps to the vicinity of the present Naples, and probably included the then insignificant city of Rome, which after having been ruled from the earliest times by kings set up a republic in 509 B.C. The Etruscans, now at the height of their development, were equally powerful by land and sea. Even more formidable to the Greeks was Carthage, the greatest Phœnician colony, which united under its leadership all the other Phœnician settlements in the western Mediterranean region. By means of enormous wealth, accumulated through commerce, this city recruited a vast army of mercenaries, with which she hoped to overwhelm the western Greeks.

Checked by the growth of foreign powers, Greek colonial expansion came to an end about 550 B.C. Then the boundary of free Hellas on the east was pushed back by the Lydian and Persian conquests in Asia Minor. A revolt of the Ionians against Darius,— in which the insurgents were aided by the mother country,— precipitated between Asia and Europe a conflict destined to affect the whole future history of the world. An army sent into Greece by Darius, was beaten back by the Athenians at Marathon in 490 B.C. Ten years afterward, Xerxes, son and successor of Darius, led a vast host into Greece, hoping to overwhelm the free little country by the sheer force of numbers. But his fleet was shattered in the battle of Salamis (480 B.C.) and his army destroyed at Platæa by the forces of the Hellenic league (479 B.C.). Meantime at Himera, Sicily, the despot of Syracuse destroyed the invading mercenary army of Carthage (480 B.C.). The Greeks met with brilliant success both in the East and in the West: those of their race in Asia Minor were liberated; all were relieved from fear of foreigners; Greek civilization was free to develop without the restraint of alien rule; Greece came out of the struggle strong, proud, self-conscious, ready for great achievements in peace and in war.

VI. *The Culmination and Decline of Greek Political Power and of Greek Civilization; the Hellenization of the Orient; the Unification of Italy Under Rome, 479–264 B. C.*—The splendid naval force which Athens furnished for the war, together with superior statesmanship, placed her at the head of a new league of maritime Greek states, known as the Delian Confederacy (organized 477 B.C.). Rivalry for the headship of Greece between democratic Athens and oligarchic Sparta led to the Peloponnesian war, which involved a great part of the Greek world (431–404 B.C.), and which ended in the establishment of Spartan supremacy (404–471) over eastern Greece, while nearly all western Greece was united under Syracuse. Oppression on the one hand, and on the other the love of the Greeks for city-autonomy, caused the downfall of both political powers. For a short time under Epaminondas (371–362 B.C.) Thebes attempted to take the place of Sparta, but in vain; the Greek state-system,— consisting of leagues and hegemonies of cities,— was rapidly crumbling. Meanwhile Macedon, a territorial state under King Philip, taking advantage of the political disunion and mutual jealousies of the city republics, began to encroach on free Hellas. After defeating the combined forces of Athens and Thebes at Chæronea (338 B.C.) he imposed his protectorate upon the Hellenic state-system. His son Alexander the Great in a series of brilliant campaigns (334–331 B.C.) conquered the Persian empire, and afterward extended its boundaries to the northeast and the east. His empire was the largest the world had known. Among his improvements was the specialization of administrative functions, financial, judicial, and military. When he died, the empire after a long struggle among his generals ultimately divided into three great states,— Egypt, Asia (the Seleucid empire), and Macedon, including Greece. To regain and preserve their liberty many of the cities of eastern Greece entered into two federal unions, the Ætolian and the Achæan. These institutions, though long known to the Greeks, came into favor too late to save them from the domination — not of Macedon but of Rome. The western Greeks, however, were first to meet their fate.

After adopting a Republican constitution Rome engaged with her neighbors in a long, desperate struggle for existence (509–431 B.C.). Then by securing the headship of Latium (431–406 B.C.) and by the conquest of Veii she became one of the strongest powers in Italy. A series of wars with the Latins, Samnites, and Italiot Greeks (343–290 B.C.) gave her control of all Italy south of the Rubicon River. The success of the Romans was due to their improvement on the Greek phalanx, their strict discipline and obedience to authority, their laborious patience in fortifying acquired territory, and their liberality in the treatment of conquered peoples. The political system which in this period they gradually built up on the basis of Italian nationality recognized various gradations of rights and obligations among the communities of the system from the tributary subjection of the Gauls to the full Roman citizenship. Though partly federal, the system left to Rome absolute control of foreign and military affairs. At the close of the period (264 B.C.) Rome and Carthage were the great powers of the western Mediterranean; those of the East were Macedon, Egypt, and the Seleucid empire.

The century and a half (479–322 B.C.) following the Græco-Persian war was in some respects the most brilliant in the history of civilization. The tremendous energy roused in Greece by the war displayed itself under the guidance of taste and reason in every field of activity. A wave of independence, overthrowing tyrannies and oligarchies, established popular governments in many cities, and intensified the democracies already existing. In Periclean Athens, which depended economically upon the labor of slaves and tributes from dependent allies, the citizens enjoyed a more liberal education and a wider range of political and social privileges than have ever fallen to any other community known to history. In close relation with this political and social development architecture, sculpture, and literature reached ideal perfection. The fifth century produced the Attic drama (Æschylus, Sophocles, Euripides, and Aristophanes), the noblest historical writing (Herodotus and Thucydides), and the inimitable Parthenon and Erechtheum. But the Peloponnesian war exhausted the energy and resources of eastern Greece. The growing refinement and love of peace which characterized the following century is indicated by the fact that the inhabitants of the city-states shirked military service, so that war came largely into the hands of mercenaries drawn from the less cultured territorial states. Thought prevailed over action; and in art strength was to some extent sacrificed to beauty and finish. While poetry declined, oratory and philosophy reached the height of their development in Demosthenes, Plato, and Aristotle, who brought classic Greek literature to a close.

Following the conquests of Alexander, commerce, colonization, and administrative policy spread Hellenic civilization over the Orient. In the post-classic period (after 322 B.C.) Pergamum and Alexandria became the most famous seats of Hellenistic culture, which was distinguished for painstaking scholarship rather than for creative power. The West, too, was falling under Hellenic influence. Rome adopted from the Greeks not only the phalanx, but also various deities and religious ideas, the alphabet,— either directly or through the Etruscans, — and other rudiments of civilization. From the Etruscans chiefly came the impetus to the building of public works,— temples, sewers, roads, bridges, fortifications,— in which the Romans showed creative genius. But to the end of the period they paid little attention to learning; they were without literature and had few if any schools. A realistic, practical people, they were narrow and unamiable in private and business relations, but excellent warriors and citizens. Duty and Discipine were the great commandments to which the family and society, citizens and soldiers, yielded religious obedience. These heroic virtues were not the least important factor in the creation of their empire.

VII. *The Expansion of the Roman Power over the Mediterranean World; the Growth of Plutocracy and the Decline of the Republic, 264–27 B. C.*—The extension of the power of Rome over the peninsula brought her into collision with Carthage, which had occupied nearly the whole of Sicily and was now threatening southern Italy. Not only did Rome feel bound to protect Italy, but her growing commercial class desired by conquest to extend its opportunities for trade and speculation. The First Punic War (264–241 B.C.) may be compared in character and importance with the recent war between the United States and Spain, which resulted in the occupation of the Philippine Islands by the former power. To meet the Carthaginians on their own element, Rome built a navy, and thus equipped herself for transmarine conquests. As a result of the war, Carthage surrendered Sicily to Rome in addition to paying a heavy indemnity. This island became the first Roman province (227 B.C.). Sardinia and Corsica, acquired soon after the war, were organized into a second province. Then by conquering the Gauls in the north of Italy (225–222 B.C.) the Romans extended their sway to the Alps. In the Second Punic War (218–201 B.C.) the Carthaginian Hannibal, one of the most eminent generals of all time, invaded Italy, defeated one Roman army after another, desolated the country, and came near wrecking the power of Rome. Her preservation was due to the wisdom of the senate, to the solidity of Roman character, and to the tie of common interests and of kindred blood which bound the Italians together against the alien intruder. This war of defense shows Rome at her best. Peace brought her two provinces in Spain and the destruction of her rival's navy. So greatly superior was now her strength that the conquest of the civilized world had become merely a question of a few years. In another series of successful wars (200–146 B.C.) she acquired Macedon, Greece, Asia Minor, and the country about Carthage. Corinth and Carthage were destroyed, and most of the acquired territory was organized into provinces. At this date (146 B.C.) Rome was the only great power in the entire Mediterranean basin. The further growth of her empire consisted mainly in the conversion of protected and dependent countries into provinces and an occasional conquest. To Pompey belongs the subjugation of Syria (65–62 B.C.), which alone remained of the Seleucid empire, and to Julius Cæsar the more important conquest of Gaul (58–50 B.C.). Egypt, long dependent, became a province in 30 B.C. The Roman empire, consisting of provinces and dependent allies, now included the whole circuit of the Mediterranean.

Some advantages came to the world from Roman rule: while in the East Græco-Oriental culture continued undisturbed, Latin civilization, which was falling more and more under Hellenic influence, gradually permeated the provinces of the West; throughout the empire the cities retained their own laws and self-administration under the government of their wealthy class; all parts but the frontiers enjoyed lasting peace. The evil effects of the system, however, soon began to outweigh its advantages. To secure a monopoly of commerce for themselves, the Romans restricted or even prohibited trade among the subject communities. Over all the empire they acquired vast estates, which they worked by slave labor, thus destroying everywhere the free peasantry. Their policy of farming the taxes was also unjust and oppressive.

The governors, too, with rare exceptions made office a means of amassing fortunes. In these ways the administrative and capitalist classes recklessly exploited the provinces for their own profit. At the same time commercial restrictions and the competition of slave labor were ruining the farmers and business men of Italy, and a worthless, dangerous mob was growing up in the capital.

The early government of Rome by magistrates, senate, and assemblies, although admirably adapted to a small community, proved unequal to its new and complex functions. The assemblies, now becoming corrupt, were in the hands of magistrates, ministers of the senate, which as a whole was controlled by a small knot of members, the curule ex-magistrates. This inner circle formed in the beginning a nobility of merit; it saved the state from Hannibal and conquered the Mediterranean world. But it soon transformed itself into an hereditary caste, which, monopolizing the domestic and imperial offices, used them as a means of absorbing the wealth of the world. In brief the nobility degenerated into a corrupt, self-seeking plutocracy. As to the general condition of the world at this time it should be noted that the want of competition, such as exists among nations of approximately equal power, by reducing the vitality of mankind, stopped progress, and decay was already setting in. Thorough reform was needed even to postpone the collapse of ancient civilization.

The Gracchi sacrificed their lives in a vain attempt to regenerate the peasantry and to restore Italy to its old condition of economic health; at the same time they showed the enormous power of the plebeian tribunate for purposes of reform or revolution. Far preferable to government by the corrupt aristocracy or by the mob, which Gaius Gacchus organized, would be the strong rule of one man; and the task of creating in the army a solid foundation for a government of the kind was accomplished by Gaius Marius. After him the governor (proconsul) of a military province employed his position as a means of acquiring an army for political use; and the proconsuls became rivals for the mastery of Rome. Finally Gaius Julius Cæsar, an aristocrat by birth but a champion of the people, allying himself with the tribunes, overthrew the republic and created a virtual monarchy. By radical reform of the entire administration this great creative statesman arrested the decay of civilization and gave the institutions of the ancient world a new lease of life. The assassination of the monarch, far from restoring the republic, was followed by a war of succession, in which his grand-nephew Octavius — after 27 B.C. Augustus — won the imperial prize (31 B.C.).

VIII. *The Empire at Its Height, 27 B. C.–180 A. D.*— Instead of recurring to the autocracy of Cæsar, Augustus hit upon a compromise between republic and monarchy (27 B.C.). The senate through its magistrates and promagistrates was still to govern Rome, Italy, and the peaceful provinces, while Augustus as holder of the military authority (*imperator*, hence emperor) was to rule directly the exposed and unquiet provinces and to exercise supervision even over those administered by the senate; the republic was to continue for Italy, the monarchy was established for the subject countries. In Rome Augustus held the tribunician power, and was sometimes elected to republican offices; but his chief influence over the home government was exercised not through office but in the capacity of political "boss,"— a position which the Romans dignified with the name of *princeps* (foremost citizen). The prince and the senate had not only their separate fields of administration but also separate treasuries and separate sets of officials. Augustus concealed the independent position of the prince; Tiberius brought the dyarchic antithesis into bold relief; the Claudian and Flavian princes, by gradual encroachment on the senatorial prerogatives, aimed to convert the dyarchy into a monarchy. As the senate declined, the officials of the prince, originally his friends and household servants, developed into an imperial bureaucracy. After the tyranny of Domitian the "Good Emperors" (96–180 A.D.), in reconciling the nobility to the principate, laid more firmly the constitutional basis of their power. The government may now be termed a monarchy, although some elements of the dyarchy remained, and though the senate, with its republican traditions, continued to be a material check upon the powers of the prince.

The emperors made few permanent conquests,— chiefly Britain and the Danubian provinces. Their fundamental task was to extend Latin civilization to the un-Hellenized parts of their dominion. In Africa west of Egypt, notwithstanding the survival of the Phœnician language in private life, Latin civilization took deep root. Spain and southern Gaul became perhaps even more thoroughly Latinized. Northern Gaul was less affected, and Britain still less, by the Romans, while the northern provinces east of Gaul varied greatly in their receptivity of Latin culture. The principal factor in the work of civilization was the city; in most of their European domains the Romans superseded the old tribal organization by the Italian municipal system, which gave the nations the refining and disciplining influence of comfortable homes, useful and artistic public works, schools, courts of justice, and local self-government. Each city was a centre from which Latin modes of life and Latin ideas radiated. Imperial rule cured most of the ills of republican administration. Abolishing the farming of direct taxes, it placed their collection in the hands of imperial officials, and distributed them on the basis of a careful census. The governors, now drawing their salaries from Rome, and deprived of their former unlimited opportunity for extortion, were held responsible to the emperor. The armies, placed under strict discipline and controlled by one will, no longer wasted the empire by civil wars. For the vast extent of the frontier the soldiers were few, and the burden of their support was light. The republic had looked upon the provinces as its estates; in the 2d century A.D. the emperor came to regard himself as the parent of the subject peoples, whom he was in duty bound to treat with love as well as with justice. Though oppression was not wholly eradicated, the imperial government was in a high degree efficient, just, and humane. The progress of civilization was followed by the extension of the Roman citizenship. The liberal policy of Claudius in bestowing it was continued by his successors, till shortly after the period under discussion all freemen of the empire became Romans by the edict of Caracalla (212 A.D.).

In this period was tried the experiment of maintaining profound and lasting peace over the large area comprising the interior provinces. Prominent among the results was a material prosperity far greater than has ever blessed those countries in any other age. Another result was the development of the "feminine virtues." Men "became chaste, tender-hearted, loyal, religious, capable of infinite endurance in a good cause" (Seeley, 'Roman Imperialism'). They began to regard women as their equals, to treat children and slaves humanely, to show kindness even to animals, and in spite of gladiatorial contests, to abhor bloodshed. Morals, at their lowest ebb in the Rome of Nero, were rapidly purified by the coming in of the best families from the provinces, so that under the Good Emperors morality in the capital reached a high level. The spirit of the age expressed itself not only in the private and social virtues, but also in the Civil Law, which rested upon the principles of justice, kindliness, and equality among men.

The unimaginative Romans failed to produce a literature of the highest rank. In the late republic lived Lucretius, a poet of real genius, and Cicero, the versatile author of orations, philosophic works, and private correspondence. The Augustan age created the epic and rural poetry of Virgil, the 'Odes' and 'Satires' of Horace on social and moral topics, and Livy's stately history of the republic. The most splendid Latin writers of the age of the Good Emperors were the satirist Juvenal and Tacitus, the historian of the early empire. Among the most famous writers in the Greek language at this time were Pausanias, author of a 'Tour of Greece,' Appian, the historian, and Plutarch, the biographer of eminent men. Hellenism continued to be the chief liberalizing and refining force in the empire. Its highest intellectual product from Roman soil was Stoicism, which found its best expression in the writings and character of Marcus Aurelius.

IX. *From Limited Monarchy to Despotism; the Reorganization of Diocletian and Constantine; the Barbarian Invasions and the Decline of the Empire, 180–500 A. D.*— Writers generally agree in making the decline begin with the reign of Commodus (180–192 A.D.), though disintegrating forces had long been in operation and though for generations afterward the empire at times, as under Septimius Severus and Diocletian, showed great recuperative power. The century which intervened between the death of Marcus Aurelius and the accession of Diocletian (180–284 A.D.) we may regard as a period of revolution. The happiness of the Roman world under the Good Emperors had been chiefly due to the wisdom of a succession of rulers who were able to secure the good will of the senate and of the populace of Rome, the subordination of the pretorians and of the army, and the respect of surrounding nations. The weak, brutish Commodus allowed these nicely adjusted forces to conflict, and the result was civil war and anarchy. The revolution, sweeping away the influence of pretorians, populace, and senate, almost of Rome itself, brought new principles of government into play. The emperor was to be a despot of the Oriental type,— a God on earth,— who surrounded himself with stately splendor, and governed through a complex bureaucracy. He appointed a colleague, and two Cæsars were named as heirs of the emperors, all four dignitaries being men of eminent military ability. The empire was reorganized in prefectures, dioceses, and provinces under appropriate magistrates. These arrangements, chiefly the work of Diocletian (284–305 A.D.) and Constantine (sole emperor 324–337 A.D.), were in the main permanent. In making better use of the resources of the empire for the purposes of defense the new organization brought fresh strength, but rivalry between the emperors again caused civil wars with all their evil consequences. Under Constantine, who removed the capital to Byzantium, thereafter called Constantinople, the two imperial offices were again vested in one person, and were not definitely separated till the accession of Arcadius and Honorius, sons of Theodosius (395 A.D.). Even then the theory of a single empire ruled by two colleagues continued; and when in 476 A.D. Romulus "Augustulus" was deposed at Rome and the imperial trappings were sent to Constantinople, people understood merely that the collegial government had once more given way to monarchy.

Meanwhile from the heart outward through every limb the empire was falling to decay. The underlying cause, already referred to, was declining vitality, fundamentally due to lack of interest in the welfare of the state, of the community, of future generations. As the civilized part of the human race lost love of life and hope for the future, it began to die out. A related cause was slavery, which long before Marcus Aurelius had been destroying the free population; in his time the plague, and after him foreign and civil wars, continued to waste life, while the burden of taxation, always increasing, made life every day more wretched. The wealth of the empire flowed to the East in exchange for useless luxuries; and for want of gold and silver the coinage was debased; at the same time the cost of living became excessive. Then, too, the growing splendor of the imperial courts added to the burden. With their scant means many found it impossible to support families, and even the slaves grew fewer. In these conditions most of the lower population, free and slave, became hereditary serfs — *coloni* — bound to the soil and to the payment of fixed dues to their lords. But it was not only the poor who suffered. The municipalities had once enjoyed freedom in local affairs, each governed by a senate, whose members — *decuriones* — were the wealthier men of the community. Gradually the emperors encroached upon the liberty of these cities, till they had converted even the privileges of the senators into intolerable burdens. For as these officials were responsible for the taxes due from their districts, many of them, unable to wring the required amount from the poorer classes, were themselves reduced to poverty. Nevertheless they could in no way shirk their duty, but were held for life by an iron hand to the unenviable task of collecting and of paying oppressive taxes. Artisans and traders, too, were bound strictly to their hereditary vocations, in order that the government might be sure of the dues to which they were subject. In brief, society was forced into a rigid caste-like system, which crushed freedom and made the life of rich and poor, bond and free, almost equally wretched. As under these circumstances the population grew unwarlike, the government found it more and more necessary to make up the armies of Germans, who consequently settled in the empire in ever increasing numbers. Although they readily adopted Roman civilization, their independent spirit, out of harmony with the conditions above described, acted as a new disintegrating force. Another power, which while aiming to make the world over on its own model tended to destroy ancient ideas and institutions,— including the empire itself,— was Christianity. Rome, essentially polytheistic, always tolerated the religions of the nations which she conquered; in the adoption of their gods into her pantheon she found a means of political centralization. Judaism, however, she regarded with disfavor, and attempted to suppress Christianity. These exceptions to her policy of toleration were due to the irreconcilable conflict between monotheism and polytheism and to the leveling tendency of the Christian religion. The apostles of Christ taught that the gods of Rome were demons, that the worship of the emperor was sinful, that all men from the emperor to the slave were equal before God, that the heaping up of wealth was an abomination; in brief their religion seemed to the Romans subversive of all the principles on which the empire rested. But although Christianity and Germanism were disintegrating the empire, they were destined in combination to make the old world new. The estimate of their value as creative agencies belongs to the mediæval period.

In appearance more formidable than internal decay were the hostile nations outside the empire. In the 3d century the Germans, who had long been threatening, began to break through the northern frontier. The Franks flung themselves upon Gaul; the Goths occupied Dacia and crossed the Danube, to defeat and kill an emperor. In the East, too, a new danger appeared; on the ruins of the old Seleucid power had arisen the Parthian empire, which in the 3d century was supplanted by a new, vigorous Persian empire. The warlike Persian monarchs nearly made good their threat to drive the Romans from Asia.

Early in the 5th century the Germans began to establish their states within the empire,— the Visigothic kingdom in Gaul and Spain (415 A.D.), that of the Vandals in Africa, and of the Burgundians in the Rhone valley. About the middle of the century the Angles and Saxons began to overrun Britain; a little later the Franks, who long before had crossed the Rhine, began the conquest of Gaul (486 A.D.); and in 493 A.D. the Ostrogoths conquered Italy. Before the end of the century the western branch of the empire had fallen into the hands of Germanic chiefs, who while vaguely recognizing the emperor at Constantinople as their lord were in reality sovereign kings of the countries they ruled. Here ancient history ends; the interaction between Roman and German life under Christian influence is the subject of mediæval history.

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History, Mediæval. *Definition.*— Mediæval history may be most easily defined as the middle period between ancient and modern history. Some scholars have wished to do away with the term entirely, and to use only two divisions, ancient and modern. In fact, in Oriental history there is no mediæval period. But most students prefer to keep to the threefold division for European history. This is due largely to the fact that the mediæval period can be presented with greater unity than either ancient or modern.

Mediæval history began with the disintegration of the Roman Empire in the 5th century, the ruin of paganism, and the migrations. Without arguing the merits of the various dates which may be assigned for the end of the Middle Ages (q.v.), we shall here discuss the history to about 1500 A.D. During this period of one thousand years, the most marked characteristic is the dominant influence of the Church. The most important peoples are the Germanic races, who emerged slowly from barbarism, and gradually assimilated some of the features of the Roman civilization. Based upon the ruins of the older rose a new civilization, which caused a radical transformation in political, social, and religious ideals.

Contrast Between Romans and Germans.— The Romans had a highly developed and very complex civilization. From their Greek subjects, they had acquired the knowledge of art, literature, science, and philosophy. Under the Roman peace, an active commerce had grown up throughout the empire, supplying to each province the products of all of the others. In law and administration the Romans had reached such excellence that we still imitate them. Moreover, Christianity had become the state religion.

The Germans were barbarians, having the virtues and vices of their savage state, and resembling, in many respects, the North American Indians. But they were a vigorous race, with a great capacity for learning. Some of them had been converted to Christianity before they entered the Roman Empire, but most of them were still pagans.

Migrations.— The Roman Empire had for centuries held the barbarians in check, by the prestige of its name, by the payment of tribute, or by the policy of exciting dissension among its enemies. This last is well summed up in the Roman proverb, *Divide et impera*, which may be paraphrased, "Cause divisions and strife among those whom you fear and thus rule over them." In the latter part of the 4th century, however, the terrors inspired by the advance of the Huns (q.v.) into Europe, the knowledge of the weakness of the Roman Empire, and their own desire for more fertile lands, caused the Visigoths (q.v.) to enter upon their great migration. Their example was followed by other German tribes, and the movement continued throughout the 5th and 6th centuries. By the year 600, all the European portion of the Western Empire, except a few positions in Italy, was held by the Germans.

During the period of the migrations, there was a great destruction of life and property. But the conquered inhabitants were neither exterminated nor driven out. The German invaders were relatively few in number, and, in many sections, they found unoccupied lands sufficient for their needs. The conquerors and the conquered lived in constant contact with one another, and the resultant civilization was partly Roman and partly German. See MIGRATIONS.

Fusion of the Two Civilizations.— The 7th and 8th centuries were the period of fusion. By the year 800, the terms *Roman* and *Barbarian* were no longer used. The inhabitants formed a single people, with a civilization much lower than the Roman but much higher than that of the Germans when the latter had entered the Empire. In this new composite civilization, the Roman influence was greater in language, mechanical arts, business arrangements, and municipal, intellectual, and ecclesiastical affairs. The German influence was greater in military matters and judicial procedure

The fusion was practically completed by the time of Charles the Great. He realized clearly the task of the Middle Ages, and did all in his power, on the one hand to retain all that was best of the older German customs, and, on the other hand, to introduce from Italy such Roman customs as his subjects were able to adopt. He did much to foster education, which followed Roman models. By his wars, he brought under his sword all of the German peoples.

The New Empire.— In 800, Charles's services received fitting recognition in his election as emperor of the Roman Empire. The idea of a Roman empire which embraced all Christians had never been lost. After 476, when Romulus Augustulus was deposed by Odoacer, the people in the West, Germans and Romans alike, had regarded the emperor at Constantinople as the head of the Christian world. Even barbarians like Clovis (q.v.) had been proud to secure recognition and obtain a title from the emperor. The popes had looked to the emperors for support. In the last years of the 8th century, the East was ruled over by Irene (q.v.), who was both despised because she was a woman and for her crimes and heresy, so that it seemed to many that the imperial office was vacant. Consequently, Charles was crowned emperor and was considered the successor of Augustus, Trajan, and Constantine (qq.v.). Under his strong rule, the Western world was governed firmly, and the western nations were held together.

Disintegration of the Empire.— After Charles's death, his son was unequal to the task of ruling the empire. Under the combined effects of civil strife and constant invasions by the Northmen, the Mohammedans, and the Slavs (qq.v.), the central power was weakened, and the last Carolingian rulers were unable to protect their subjects. The whole frontier was exposed to attacks and the raids of the enemy even extended far into the interior. In each district the strongest man came to be regarded as the natural leader and protector. Sometimes it was a royal official, holding a fortification; sometimes it was an abbot or a bishop; at other times, a bold adventurer, who usurped authority. In the absence of a strong central government, each leader had to police his land and administer justice. Naturally, he demanded to be paid for his services, and exacted tribute from all under his control.

Because of the lack of money, the Carolingians (see CARLOVINGIANS) had always furnished to their counts and other official estates from which they obtained their living. Under the weak kings, the temporary grants of both land and office became hereditary, with or without the rulers' consent. The rulers, however, soon recognized the necessity of allowing this, and sought merely the recognition of their own overlordship and ultimate ownership of the lands. Consequently, they granted the benefices to the heirs and conferred, in addition, the immunity, or right of independent jurisdiction. Thus almost all land and power came to be held feudally. See FEUDALISM.

Feudal Anarchy.— There was constant warfare as each strong lord sought to obtain greater power or a more independent position. On the other hand, each king or suzerain tried to increase his own feudal holdings by conquest or marriage. Every vassal was anxious to avoid all the feudal services that he could, and, at the same time, to exact as much as possible from the people subject to him. Commerce was burdened with excessive tolls in each fief and exposed to the depredations of the robber barons. Little attention was paid to maintaining roads and bridges, consequently travel was difficult as well as dangerous. As a whole, the feudal régime tended to isolate each fief and to reduce the peasantry to misery. It is significant that the term "Dark Ages," formerly applied to the whole of the Middle Ages, is often used now for the 9th and 10th centuries.

The Church.— The great cohesive and educating force was the Church. Soon after they entered the Roman Empire, each tribe of Germans had been converted to Christianity. In every barbarian kingdom the bishops were important officials. They often obtained great wealth, and ruled over vast estates. On their possessions, the serfs were treated somewhat better than on the lay fiefs. Monasteries had been founded throughout Western Europe, and often these served both as schools and as model farms. Boniface did much to bring the tribes of Germany into direct connection with Rome, and he held frequent church councils at which the clergy and nobles of a whole district came together. These councils were very important for their effect in unifying the Church and making its work more effective.

From this time the Church gained steadily in power and influence. Charles the Great did much to increase its wealth by enforcing the payment of tithes. He insisted that the clergy should be better educated themselves and should do more for the education of the people. In the 9th century the growing power of the papacy and the weakness of the kings enabled the popes to bring the bishops more directly under their own control. Thus the clergy of Western Christendom were brought into intimate association with Rome. Latin was the common language of all churchmen. Their feeling of membership in the Church was frequently stronger than any local attachment. Consequently the more able men were equally at home in every country and the Church had a greater unity than any lay power. This all-pervasive Church was the great unifying element amid the divisions of the feudal period.

Investiture Struggle.— After periods of weakness in the first half of the 10th and again in the first half of the 11th century, the Church at Rome was purified and strengthened by the support of the German emperors. About the middle of the 11th century, the strong personalities of Pope Leo IX. (q.v.) and of Hildebrand (later Gregory VII.) (q.v.) led to a great reform movement, and also to an effort to make the pope's power more effective. One feature of this movement was an attempt to secure entire control of appointment to church offices. This brought the papacy into conflict with the kings who considered that they had a right to nominate the bishops in their own kingdoms. The struggle was most acute between the German emperors and the popes, and resulted in the long investiture conflict, which was ended in 1122 by a compromise. See INVESTITURE.

Roman Empire of the German Nation.— But the investiture struggle was only a single phase in the relations between the empire and the papacy (q.v.). In order to understand this it is necessary to study the fortunes of the empire after Charles the Great. Under his successors, the emperors had gradually lost their power, so that by the end of the 9th century, the title of *emperor* had become almost a meaningless designation, either conferred by a pope on anyone of whom he wished to make use, or else usurped by any ruler who chanced to be temporarily the strongest personality in Italian affairs. This continued to be the fate of the imperial title until Otto the Great (q.v.) was summoned to Italy, because of the discord reigning among the various Italian nobles. In 963 he was crowned emperor, and became the ruler of both Germany and Italy. Under his son and grandson, Otto II. and Otto III., "the Roman Empire of the German nation" was a very effective power in controlling both the imperial lands and the papal policy. After the death of Otto III. in 1002, the German rulers paid little attention to Italian affairs until 1046, when Henry III. was summoned to Rome because of the contest which was being waged between three rivals for the papal office. For 10 years he wielded a power similar to that of the Ottos. But at his death, as the heir was a young child, the reformed and strengthened papacy was able to assert its independence. When Henry reached manhood and desired to regain his father's power, the contest began and took the shape of the already mentioned investiture struggle. After the Concordat of Worms (q.v.) there was a truce which was broken by the accession of Frederick Barbarossa (q.v.), who was determined to be emperor in fact as well as in name.

Empire and Papacy.— On the other hand, the papacy was strong and was determined to assert its paramount authority. There ensued a struggle of one hundred years between the Hohenstaufen emperors and the popes. In spite of the ability of the rulers and the brilliancy of their reigns, the popes triumphed, largely by means of the assistance of the Lombard cities, which had grown rich and powerful and claimed to be independent of the imperial control. The death of Frederick II. in 1250 really marks the end of the mediæval empire, as a strong international power, although it continued, under a changed form, to be a factor in European politics for centuries longer, and came to a close only in the 19th century.

The Crusades.— The increasing power of the popes was also marked by their desire to extend their authority over the Eastern Church as well as the Western. This was in part the cause of the crusades, which were the most important manifestation of the strength and influence of the Church. The spirit of asceticism (q.v.) had long been inculcated as the most distinguishing mark of Christianity. The consciousness of their own sins and the teachings of the Church led many to do penance. One of the favorite forms, especially for heinous crimes, was a pilgrimage to some hallowed spot. The most difficult pilgrimage and the one to which greatest sanctity attached was the journey to Jerusalem. In the 11th century, one hundred and sixteen separate pilgrimages to Jerusalem are recorded, and, in some of these expeditions, hundreds and even thousands took part. Thus attention was directed to the Holy

Land. Moreover, in spite of the disorders of the feudal régime, the population was increasing, especially in France. The people were hard-pressed to get food, and were anxious for a change of any kind. Consequently, when the Emperor Alexius appealed for aid and Pope Urban II. preached the crusade at Clermont thousands took the cross. The movement spread rapidly and affected every country in Europe. Although Jerusalem was in the possession of the Christians for little more than a century, the crusades to the Holy Land, which continued for 200 years, produced great results. In order to understand these, it is necessary now to take up the Byzantine and Muslim civilizations. See CRUSADES.

Byzantine Civilization. — Until a half-century ago, the Byzantine history was misunderstood. It was looked upon as the long death struggle of a society in which all progress had ceased, and despotism, tempered by assassination, crushed out all vitality. Gibbon styled the history «a tedious and uniform tale of weakness and misery.» It is known now that this was unjust. The most striking fact about the Byzantine Empire is its «constant vitality and power of recuperation.» It was threatened by invaders, but it repelled them all. At times it lost some of its most fertile provinces, but at other periods it would rise triumphantly and recover its lost possessions. Throughout the period between 700 and 1100, Constantinople was the bulwark of Europe, against which the waves of invasions rolled in vain. In addition to being a bulwark, Constantinople was, throughout the Middle Ages, the great storehouse of the Greek and Roman civilizations, where it was preserved until the European nations were sufficiently advanced to profit by it. Constantinople (q.v.) was also the most important commercial centre of the Middle Ages. The city was marvelously wealthy and excited the admiration of every traveler. Most of the crusaders passed through Constantinople and the Greek lands on their way to Jerusalem; by them the influence of its civilization was widely spread throughout the West. See BYZANTINE EMPIRE.

Muslim Civilization. — No less important was the influence of the Mohammedans. After the death of the prophet in 632, his followers had conquered with wonderful rapidity the greater part of the civilized world. From Persia and India they held all Asia to the Hellespont. Egypt and the whole north coast of Africa, Spain, and about one third of Gaul, were under their sway within a century. Their advance in civilization was equally rapid. The Arabs had wonderful acquisitive ability and were taking almost the first step in their education. In each country they learned the arts and sciences known by the inhabitants, and they carried this knowledge wherever they ruled. The Greek philosophy, which they acquired from the peoples in the lands formerly under Greek sway, the mathematical knowledge of India, the irrigation practised in Egypt, are illustrations of their acquisitions, which enabled them in the 10th and 11th centuries, to develop a civilization far in advance of any other, with the exception of the Byzantine. From Bagdad to Spain this culture was spread throughout the Mussulman world. In Syria, the crusaders were in contact with this civilization for two centuries. By their agency and by the association of Christians and Mussulmans in Spain, Sicily, and other points, much of the Muslim learning was conveyed to the Christians of Western Europe.

Changes in the 12th and 13th Centuries. Enrichment of Europe. — In addition to this fructifying intercourse with other civilizations, many elements in their own contributed to cause a rapid advance in the 12th and 13th centuries. Among these may be noted the increase in population, the cultivation of waste lands, the revival of commerce, the general progress along educational lines, and the rise of strong kingdoms. But as it is impossible to isolate each factor and to determine the part which it played, the results will be considered as a whole and the changes which took place in Western Europe after 1100 will be described.

The hundreds of thousands of crusaders had to procure large sums of money for their equipment and journey. Consequently the precious metals which had been hoarded came into circulation as money. Instruments of credit were devised and the money circulated rapidly. Contact with other civilizations gave birth to new tastes and these were gratified by means of a greatly increased commerce which extended to all parts of Europe and even to the extreme East. The merchants became numerous and prospered. Cities increased rapidly in population and new ones were founded. The Italian cities, because of their position, prospered the most of all. The merchants became an important class because of their wealth, and by the end of the 13th century became a political factor which was recognized by their inclusion in the new parliamentary bodies.

Intellectual Advance.—The investiture struggle had caused scholars to study history in order to find precedents in support of the imperial or the papal claims. The contact with other peoples broadened the intellectual horizon of the Western people. The new points of view with which they became acquainted led them to question the traditions which had ruled their lives. The new books, especially the works of Aristotle (q.v.), which fell into their hands, were studied eagerly. The new wealth gave leisure. Students flocked to the centres where teachers were to be found, and gradually universities arose. Roman law was fostered by the emperors; canon law, by the Church. Scientific knowledge, especially in medicine, was acquired from the Greek and the Arabic works. Gothic cathedrals of exquisite beauty were built in western Europe. The deeds of the crusaders furnished new material to literature. The old tales were re-worked and given a literary form.

Growth of Monastic Orders. Temporal Power of the Popes.—No less marked were the changes in the Church. At the close of the 11th century a great wave of asceticism spread over western Europe. The idea of sacrifice caused thousands to enter monasteries, and many new orders of monks were founded. These orders vied with one another in austerity and asceticism. Their reputation for sanctity and their services to the community brought to them great donations from the pious. Their knowledge enabled them to increase their wealth. But this wealth led many to enter the monasteries from unworthy motives, and thus caused a gradual decline in their lofty morals. The wealth of the Church, as a whole, caused many, both monks and laymen, to attack it as having departed from its Christian ideals. Heretics became numerous and had to be repressed by persecutions and the inquisition. In the 13th century the mendicant orders became prominent, partly as a protest against the wealth of the Church, and partly as an agency to combat heresy. The ideal of service to others for which they stood became dominant in monasticism, and later orders were founded, almost universally, for some special service. See MONACHISM; ORDERS, RELIGIOUS.

The papacy, engaged in a struggle with the monarchs, felt the need of temporal power and strove for it. Innocent III. had monarchs as his vassals, and wielded a temporal authority greater than that of any previous pope. After the popes had triumphed over the Hohenstaufens they seemed to have achieved success. Their struggle with the French king, at the beginning of the 14th century, however, led to defeat and to the "Babylonian captivity" at Avignon. Then ensued the schism and the conciliar period when many felt that the general councils and not the popes should be supreme. Finally the papacy emerged triumphant, but with a changed ideal, laying less stress upon temporal power (q.v.) than upon control over the conscience of the individual.

Chivalry. Decadence of the Knights.—In the 12th century, the clergy and the knights formed the aristocracy. The latter, too, had their period of great splendor. The ideals of chivalry, which became prominent in the 12th century, were inculcated by the Church, and the knights were often likened to the clergy as a class specially set apart by their religious vows. These ideals were also inculcated by the new literature, which glorified not only bravery and loyalty, but also generosity and luxury. The latter led to the ruin of many of the knights. Their income, arising from feudal dues, was relatively fixed. As their tastes expanded and they expended more upon luxuries, they fell into debt. The rate of interest was ruinous and they were unable to pay. Consequently many were compelled to alienate their fiefs, the monarchs and other lords of large fiefs absorbed the lesser fiefs, and there was a tendency for the knights to become retainers of the more wealthy. Their consequence as a class declined in comparison with the growing importance of the merchants. The development of strong infantry forces finally deprived them of their pre-eminence in military matters. See CHIVALRY.

Rise of the Nations.—The contact with other peoples led to the rise of a national consciousness. In the earlier days, when each feudal castle or village was practically isolated and often at strife with its neighbors, there had been little feeling of common interests. Association with foreigners brought a sense of national feeling in opposition to the foreigners. This is very marked in the armies of the second and third crusades. This movement was coincident with, and one cause of, the growth of the strong monarchies. The merchant class was also an important element in the development of the king's powers. Commerce was heavily burdened with feudal tolls and exposed to depredations by the knights. The merchants sought privileges and protection from the kings. In return they furnished them money, which aided them in extending their power at the expense of that of their nobles. The kings came to depend largely upon the cities for support in all struggles with the nobles. By their wealth the citizens were able to rival the nobles in luxury and ostentation. The sons of the merchants frequented the universities and developed into officials of the kings. More and more the kings came to depend upon the third estate and to withdraw power from the nobles.

The French Monarchy.—The development of the monarchical power took different forms in the several countries, but took place about the same time in the leading nations. In France, the Capetian kings (see CAPET) had at first little power. They had only a small territory directly under their control, and consequently only a small income. But by fortunate marriages and by confiscations they enlarged their feudal domains. Several of the kings had long reigns and the evils of a minority or a change of dynasty were avoided. Gradually all the fiefs were brought under the control of the king, and feudal usages were made the basis for the assertion of a really monarchical power. Under Saint Louis (1226–1270) and his successors France was centralized and the kings became supreme. The prosperity of France was checked for a time by the Hundred Years' war (1328–1461). This was due in part to a failure of male heirs in the direct line, which enabled the English kings to make a claim to the throne on the ground that they were the most direct heirs. But France finally emerged triumphant and England lost all her territory in France. The kings, supported by the third estate, became practically absolute.

The English Monarchy.—In England the Norman Conquest (q.v.) made William supreme lord. Following the Norman feudal usages, he insisted upon an oath from each one of his subjects, and did not allow the intervention of the feudal nobles. In spite of the civil wars of the 12th century, Henry II. was able to retain the supreme control. The tyranny and incompetence of John led to a revolt on the part of the barons and the extortion from him of the Great Charter. (See ENGLAND — *Civil History.*) The efforts of the kings to evade the provisions of the charter caused the union of the nobles and third estate, the distinctive feature of the English constitution as contrasted with that of France or of Germany. The loss of its continental possessions really strengthened England and enabled it to develop a strong government in its own island.

The German Monarchy.—Germany was a kingdom made up of great duchies. The king was strong only when he had all these duchies under his immediate control. The imperial title which he held was usually a source of weakness, because of the necessity of maintaining his authority outside of Germany. Those kings who neglected the imperial interests in Italy and Burgundy were strongest at home. Frederick Barbarossa, Henry VI., and Frederick II. (qq.v.), who attempted to build up strong empires, were compelled, as the price of support from their German subjects, to make constant concessions. Thus they bartered away most of their German lands and royal rights. The towns and cities, in particular, acquired privileges and practical independence in payment for their support in men and money. On the extinction of the Hohenstaufen house, Germany was divided up into many separate entities, varying in size from a duchy to a village or to a knight's fee, all claiming independence of all control except the imperial. The weak emperors of the 14th and 15th centuries were unable to maintain any effective control or order. Each emperor was intent only upon retaining his position and securing such property for his family as he could. Consequently Germany became a prey to internal dissension and division.

The Other Monarchies.—The other countries were more backward. In Spain, the Christian kings were engaged in conquering Muslim territory or else in warring with one another. These movements were going on for several centuries, and culminated just at the close of the Middle Ages. In 1492, the Moors were conquered in Granada, their last stronghold. The two most powerful kingdoms, Castile and Leon, had already been united, and 20 years later the Spanish portion of Navarre was added. In Scandinavia powerful monarchies were growing up. In the eastern portions of Europe new Christian kingdoms had arisen, especially Russia and Hungary, which were destined to play an important role in the later centuries.

The Period of the Renaissance: Discoveries.—The last period of the Middle Ages is often spoken of as the Age of the Renaissance (q.v.). The name is to a certain extent a misnomer. But it is sanctioned by general usage, and there are certain factors that may be brought together, which serve to mark the transition from the mediæval to the modern world.

The travel and commerce of the 12th and 13th centuries caused an interest in foreign lands which never abated. In particular, the taste for spices, which had become common, led to attempts to secure these more easily and more cheaply. After the loss of the Christian possessions in Syria, the importation of spices into Europe was burdened with heavy tolls by the Muslim rulers through whose territories they had to be carried. To the men of the 15th century there seemed to be two possible routes by sea to the spice islands, one by sailing around Africa, the other by sailing directly west to India. Attempting the latter led to the discovery of America; attempting the former, to the doubling of the Cape of Good Hope. The result of these discoveries was to make the nations on the ocean the leaders in commerce. The Mediterranean ceased to be the centre of the world's commerce and the Italian cities lost their pre-eminence as commercial centres.

Inventions: Compass, Printing-press, Gunpowder.—This exploration was possible only by the use of the compass (q.v.). This had been known in the West by the 12th century; in the East, centuries earlier. But it was perfected as a real aid to navigation only in the 14th century. About the middle of the 15th century came an even more important invention, that of printing (q.v.). This resulted at once in increasing enormously the number of books in existence and in cheapening their cost to one fifth or less, so that books were readily accessible to a much larger number than before. At about the same time the manufacture of gunpowder was being perfected. Compositions similar to gunpowder (q.v.) had long been known in the East, and the knowledge of the composition of "Greek fire" had been brought to the West. But it came into general use only in the 15th century, and the guns long after that were held by many to be inferior to the cross-bow. But gunpowder, before 1500, was revolutionizing the art of war and rendering the mediæval knight obsolete.

Classical Literature and Pagan Spirit.—Contemporary with these discoveries and inventions was the awakening of an interest in classical literature. In the 12th century there has been at some centres an eager study of the Latin classics, but, in the 13th, this had been superseded to a great extent by the branches considered more practical, especially law, mathematics, and science. In the 14th and 15th centuries men turned again to the classics, and Greek, which had long been neglected, became a favorite study. Along with the study of the pagan authors developed a new feeling for art, which resulted in the wonderfully natural works of the Renaissance artists. Other sides of this new activity were manifested in the more scholarly spirit of criticism and in scientific study. In fact, with the period of the Renaissance modern history had dawned.

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History, Modern.—*General Characteristics.*—When History is divided merely into Ancient and Modern, the term Modern applies to history subsequent to the 4th century A.D. The *Americana,* however, keeps to the more usual triple division into Ancient, Mediæval, and Modern; and with this classification Modern History begins about the year 1500.

At that date, as for several centuries preceding it, the scene of human progress was confined to Western Europe, and the actors were the Latin and Teutonic peoples. Nations, in the proper sense, were not made; and the political map bore faint resemblance to that of to-day. There was one Latin Christendom, binding in feeble union the several geographic units. But most of the units themselves were broken into fragments under local rulers; and these fragments, sometimes of widely separated lands, were recombined, with kaleidoscopic confusion, in loose, shifting aggregates which possessed not even permanent names. Out of this feudal chaos, strong monarchies were just emerging, to organize states, in France, England, and Spain; but there was hardly a prophecy of a Germany or an Italy. Except for Poland with its Latin church and borrowed German culture, Eastern Europe was outside the pale of civilization. The barbarous northern Slavs seemed doomed to Tartar domination, and the somewhat less barbarous southern Slavs with the neighboring Magyars were enslaved by the Turk. From the devouring victorious march of the Turk even Central Europe was in imminent peril.

This dismal political picture had its counterpart in social and economic conditions. Society was hopelessly aristocratic and predominantly militant, and it was crystallized in strata. The skilled industry of the towns was managed upon the guild system; and agricultural labor, except in England and some other small districts, was carried on by serfs.

But Europe had been astir with dim impulses to change for four hundred years,— ever since the Crusades broke the torpor of the Dark Ages and prepared the way for the rise of towns and the Renaissance. Near the close of the 15th century the tendency to progress became more pronounced, and the lines of activity more varied. Louis XI. in France, the Tudors in England, Ferdinand and Isabella in Spain, prepared the way for new consolidated political societies, and for new principles of government; the invention of printing made possible the preservation and utilization of the recently rediscovered Greek learning and the rapid dissemination of new ideas; the discoveries of Columbus and Vasco da Gama set free undreamed-of energies among the lands of the Atlantic seaboard, and summoned commercial Europe to a right-about from east to west; the adoption of gunpowder in the wars between Francis I. and Charles V. marked the passing of the military superiority of the knight in armor, and undermined the citadel of aristocracy in politics; the opening of the Protestant Reformation (1520) shattered the old unity of Christendom, and, together with the Catholic Counter-Reformation called out new energies in the fields of morals and intellect. Within two generations, the one just before and the one just after the year 1500, there stood revealed not merely a new physical hemisphere and new continents in the old one, but also a new universe of thought and feeling. Europe had passed into a new age.

The four centuries of Modern History have been a period of constant, marvelous, increasingly rapid transformation,— intellectual, political, industrial. The stage itself has widened from a corner of the smallest continent into wellnigh the whole surface of the globe. The actors have multiplied, until they promise in the near future to include all branches of the human race. The drama has become infinitely complex, with the interaction of countless streams of influence. As compared with Ancient or Mediæval History, Modern History deals with a brief time, but with vast spaces, complex relations, and accelerated progress. The separate movements that make up the bewildering maze are discussed severally in some detail, under appropriate headings, in the *Americana.* This article attempts only to marshal them in such order as to bring out the essential relations between them.

It is convenient to divide the four centuries of Modern History into the *age of monarchic states* and the *age of nation-states.* The American and French Revolutions make the transition from one to the other, and the most satisfactory dividing date is 1789.

From the Reformation to the French Revolution.—*Monarchic States.*—The constant warfare of the 16th, 17th, and 18th centuries is the simplest thread by which to connect the other movements of the age. Speaking broadly, the contests of the first half of the period, to 1648, are "religious wars," Catholic against Protestant, while after 1648 the struggles grow out of dynastic and commercial rivalries.

The declaration of the war which split Christendom into opposing camps for over a century came in 1520, when Luther burned the Pope's bull. The Diet of Worms at once pronounced against the rash monk the ban of the Empire; and the decree would have been enforced, and Protestantism stifled at its birth, if the young Emperor, Charles V., had had a free hand. But Charles had just become involved in strife with Francis I., over the claims of Spain and France in Italy, and he was kept busy with war against France and the Turks until 1544. For a generation, therefore, the new faith was left to spread itself unchecked over Germany and Scandinavia, while during the same period the English church cut itself off from Rome, and Presbyterian heresy made headway in France and Switzerland. For a time, indeed, Protestantism threatened to conquer even the south of Europe; but the Catholic Counter-Reformation, with equal zeal and superior skill, finally saved the Romance lands to the old faith.

Religious Wars, 1546–1648.—Meanwhile, entangled in his strife for European sovereignty, Charles could not strike at Protestants in Germany until 1546. It was then too late. In 1555, after brief struggles, the princes of the Schmalkald League forced upon him the Peace of Augsburg; and, though troubled with incessant bickerings, Germany had no further civil war for sixty years. Just that period, however, was filled with terrible religious contests in the Netherlands and France; and then the age of religious wars closed with another civil war in Germany,— the most destructive in European history. The century of strife from the opening of the Schmalkald War to the close of the Thirty Years' War (1546–1648) did not materially alter religious frontiers. Catholicism, to be sure, made some conquests with the sword, — Bohemia, South Germany, and the southern Netherlands,— but in most of these districts, as in the Latin countries of Southern Europe, the Counter-Reformation was making rapid gains before war began.

The close of the period of religious war is marked by the decay of Spain, the continued disruption of the Holy Roman Empire, and the rise of France and of the Dutch Republic. To explain these changes it is needful to dwell somewhat further upon the wars.

In 1556–7, after his failure in Germany, Charles V. resigned his crowns,— the Austrian possessions passing to his brother, and the Spanish to his son, Philip II. Despite the division, Philip was far the most powerful monarch in the world. Each year the "gold fleet" filled his coffers from the exhaustless wealth of the Americas, and in 1580 Portugal with her East India empire fell into his hands. This was the power,— supreme in Europe and sole mistress of the New Worlds east and west,— against which the petty, disunited Netherland provinces dared to rebel. Beginning as a political revolt in 1568, the struggle soon became a religious war; and it was waged for more than forty years with a relentless fury which made it a byword for ferocity even in that brutal age. The ten southern provinces finally returned to Spanish allegiance; but the northern provinces,— Dutch in blood and Protestant in religion,— fought on with desperate courage until they won independence. At the same time they preserved political and religious liberty for the world. Midway in the struggle, Elizabeth of England sent some tardy aid. Philip then turned upon England; but the destruction of his "Invincible Armada" in the splendid sea-fight in the Channel not only saved England at home but also paved the way for the English colonization of North America. The war closed in 1609. Spain had sunk into a second-rate power, never again to play an important part in European politics; but the United Provinces, through the stage of the desolating war, had grown prosperous. They drew wealth, not from the wasted land, but from the sea, plundering the new possessions of Spain in the East Indies and building there a colonial empire for themselves. For most of the century, in intellectual, commercial, and industrial activities, the Dutch held the first place in Europe.

In France the Edict of Nantes (1598) closed the wars of religion by guaranteeing toleration and handing over certain garrisoned towns to the Huguenots as security. During the next half century, under the wise administration of Henry IV. and then of Richelieu, the industry of the people restored prosperity with marvelous rapidity. Richelieu crushed the feudal nobles and recaptured from the Huguenots their garrisoned towns. In other respects, however, he kept toward the Protestants the pledges of the Edict of Nantes; and as he warred upon the Protestants within France in order to strengthen the royal power, so he aided the Protestants of Germany in the Thirty Years' War in order to make France supreme in Europe. France had long been in real peril from the Hapsburg powers of Spain and Austria, which ringed her about in hostile embrace; but the failure of Spain against Holland and Richelieu's policy of weakening Austria in the German war removed the peril, and, as Spain declined from the first place in Europe, France stepped into it.

Meantime the Thirty Years' War (1618–48) was desolating Central Europe. The princes of North Germany proved timid and incapable; and the cause of Protestantism was saved only by foreign intervention, by Denmark, by Sweden, and finally by Catholic France. At the close of the struggle, the first European Congress reorganized Europe. By the Peace of Westphalia, France received most of Alsace and some other Rhine districts. The independence of Switzerland and of the United Provinces was formally recognized. Sweden, already reaching down both west and east shores of the Baltic, secured much of the south shore also, with command of the mouths of the German Oder, Elbe, and Weser. On the other hand, the Empire lost more than territory. The political rearrangements within that state reduced the imperial Diet to the level of a useless debating society and put an end to whatever had persisted of national unity. From this time until it vanished, a century and a half later, the Holy Roman Empire was a meaningless survival, cumbering the earth, and the Hapsburg "Emperors" derived their only real importance from their position as hereditary archdukes of Austria. To most of Germany the war had brought blasting ruin. Half the population and two thirds the movable property were swept away. Land tilled for centuries became waste, and men became savages. Not till the middle of the nineteenth century did large districts again contain as many homesteads and cattle as in 1618; while the low position of the German peasantry, until 1850, was due in great measure to this war.

American Colonization.—Before the religious wars closed, the continent of Europe had ceased to be the sole scene of important historical development. American colonization was well advanced, and political liberty had received a remarkable development both in England and in English colonies. These topics demand attention before the student enters upon the consideration of the next period of European wars.

Spain made her first settlement upon the American continent at the Pearl Coast in 1513. Then sweeping to north and south, she took swift possession of all South America except Brazil, all Central America, and of the Floridas and Californias, far up both coasts of North America, while plans were afoot to plant her flag over the rest of that continent. But the ruin of the Armada, together with Spain's decay at home, came in time to leave room for other colonization. France seized upon the mouths of the Mississippi and the St. Lawrence, the apparent gateways to the continent; and English colonies stretched themselves in patches along the fringe of the North Atlantic coast. The Dutch spent their colonizing energies mainly in the Orient; and, despite some ambitious beginnings, Sweden soon grew too weak to be a serious factor in North America. Thus that continent was left in dispute between Spain, France, and England. The contest was to be interwoven with the European wars of the last half of the seventeenth century and of the eighteenth century, and the outcome was big with consequence to the world. All European countries except England governed their colonies on despotic plans. The English colonists took to the New World institutions and principles of freedom, and soon gave them a wider development there than had been possible even in the old home. Besides the rights of free speech and jury trial and *habeas corpus*, each English colony had from the first, or very quickly inaugurated, a representative legislature with full parliamentary privileges and with control over taxation. In several colonies, local government also was conducted on extreme democratic principles. Not until two hundred years later did any of these free principles appear in the colonies of any other people,— and then only because of the success of the English colonies.

England in the Seventeenth Century.— In England itself the seventeenth century saw an important development in free government. Through the Stuart period, from 1603 to 1688, England was engaged in a critical struggle between the royal claims of "Divine Right" government and the rising spirit of popular government. Except for brief intervals the conflict was parliamentary, not military, but it was constant and stubborn. Much of the time it was confused with ecclesiastical questions, which, to the men of the time, often seemed the chief issue; and it was fortunate, indeed, that the stern heroism of Puritanism became engaged on the side of political liberty. During this century, too, England was the last remaining battle ground in Europe for free government. In the other large states,— in Spain, France, Austria, in the Scandinavian lands, even in the petty principalities of Italy and Germany, — despotism was triumphant. In England, popular principles not merely maintained themselves against the Stuart attack; they came out of the conflict with increased vitality. The great experiment of a Puritan Commonwealth failed; but after the Stuart Restoration it became apparent that the body of the monarchists themselves were now thoroughly devoted to parliamentary government, and the attempt of the later Stuarts to set up a personal absolutism called forth the "Glorious Revolution" of 1688, which established the supremacy of Parliament over the king.

Dynastic and Commercial Struggles, 1648–1783.— We now return to the general development of Europe after 1648. On the continent the period from the Peace of Westphalia to the French Revolution (1648–1789) is marked (1) by absolutism within the several states and (2) by dynastic interests in their foreign relations,— with incessant selfish war, as the result. The famous phrase ascribed to Louis XIV. of France, —"I am the State,"— might have been used appropriately by any monarch of the time outside of England. A few great rulers dominate the period. Indeed the stage is largely filled by three monarchs,— Louis XIV. (1643–1715), Peter the Great (1689–1725), and Frederick the Great (1740–86). The influence of Peter was restricted for the most part to Russia; but the other two belong to all Europe, and the period divides itself naturally into the Age of Louis XIV. and the Age of Frederick II. The chief aim of statesmen was to prevent any one country from becoming too strong for the safety of its neighbors. The Peace of Westphalia had transferred political predominance from the Hapsburgs to the Bourbons. Thus, during the first half of the period France threatened the "balance of power," and league after league of other powers was organized against her. International morality, however, was low; and commonly rulers were willing to let a strong power rob a weaker one if they could find "compensation" by robbing some other state themselves. In the last wars of Louis XIV., just before and after 1700 (known in American history as King William's War and Queen Anne's War), the dynastic interests of European ruling families became merged in a titanic, century-long struggle between France and England for world dominion,— though neither country was yet fully conscious of the import of the strife.

In Europe, France was no longer in peril, as she had been in the period preceding Richelieu; and Louis the Fourteenth's half-century of war was merely a struggle to enlarge his dominions. For a generation the victories of Turenne dazzled Europe; and France annexed some important strips of territory on the east, at the expense of Spain and of the decaying Empire. But in the closing period, when the Allies also had found great generals, in the English Marlborough and the Austrian Prince Eugene, even success in the field deserted Louis; and to a comprehensive view his failure was profound. Exhausted France was crushed by taxation to pay the interest of the war debt; while, in attacks upon petty provinces in Europe, she had wasted energies and opportunities that might have made her supreme in Asia and America. Within, the economic reforms of the great Colbert were abandoned; and the revocation of the Edict of Nantes (1685) drove into exile more than two hundred thousand of the best citizens of France. The effect corresponded in a measure to the effect upon Spain of the expulsion of the Moriscoes somewhat earlier. The Huguenots had comprised the skilled artisans and the enterprising merchant classes; and their flight added to the terrible economic demoralization and deprived France of all chance at industrial leadership.

To men of the time, however, the failure was partially disguised by the glamor that surrounded the court of the *Grand Monarque*. French literature, brilliant and sparkling, was in its first splendid period; and French intellectual leadership survived for more than a century. Until after 1800, the court of Louis XIV. remained the model for every court in Europe; and French thought, French fashions, and the French language were the common property of all polite society.

The Treaty of Utrecht (1713), while it left France still one of the three greatest powers, marks her recession from predominance. Spain resigned her territories and claims in Italy and on the Rhine, and, except for her decaying colonies, withdrew finally within her own peninsula. England gained Newfoundland and Nova Scotia from France, and in Europe she secured command of the Mediterranean by the conquest of Gibraltar and Minorca. By the same treaty and by the rearrangements that immediately followed, the old Spanish Netherlands, the Duchy of Milan, and the Kingdom of Naples and Sicily fell to Austria. The Duke of Savoy (one of the faithful allies against France) acquired Sardinia, with the title of a kingdom for his enlarged state. A little before, in 1701, the Elector of Brandenburg had secured the title of King of Prussia. Thus, out of the wars of Louis, at the beginning of the eighteenth century, arose the two kingdoms, Prussia and Sardinia, which in the latter part of the nineteenth century were to make modern Germany and modern Italy against the will of modern France.

About 1700, other important changes took place in the map of Europe. For three centuries, Austria had been one of the chief bulwarks of Christendom against Mohammedanism. In 1683 Vienna had been besieged by the Turks, and had been saved only by the arrival of the gallant Sobieski with his Polish chivalry. But thereafter Austria took the offensive. She won back Hungary, and then, step by step, extended her dominions down the Danube valley and the Illyrian coast. In the latter part of the reign of Louis XIV., the Austrian Hapsburgs, turning away from the Rhine, definitely adopted a Danubian policy and sought to aggrandize themselves by seizing Slav territory from Turkey.

This new policy of Austria gave Louis XIV. a freer hand on the Rhine than he otherwise would have had, and so helped on the decline of Holland. In 1640, Dutch vessels carried the commerce of the world,— even the greater part of that between England and her colonies. Soon after that date, however, England attacked the Dutch commercial supremacy by navigation laws, and at last by war. Fearful of French conquest, and deserted or timidly defended by Austria, Holland had no choice but to ally herself to her commercial rival. After 1689 in particular (when William of Orange became King of England), Holland followed the lead of England in politics, while that country drew to herself the Dutch carrying trade.

In the north of Europe the former great powers, Sweden and Poland, were declining before the rise of Russia and Prussia. Peter the Great (1689–1725) consolidated the government in Russia, introduced a veneer of Western civilization, and started his country on its deliberate march toward distant seas, west, south, and east. Peter himself secured the western "window" by seizing from Sweden the southeastern Baltic provinces. In the middle of the century, the Empress Elizabeth (1741–62) robbed Sweden of the rest of the Baltic coast up through southern Finland. The northern half of Finland remained Sweden's until Alexander I. seized it in the Napoleonic wars; but toward the close of the eighteenth century, under Catherine II., Russia began her advance along the Black Sea at the expense of Turkey. Under the same ruler occurred the Russian gains in the partitions of Poland,— a story which can be understood only in connection with the rise of Prussia

For three centuries the Hohenzollern Margraves of Brandenburg had been patiently adding scrap by scrap to their realms. Soon after 1600 these dominions lay mainly in three widely separated groups,— Cleves on the Rhine, Brandenburg on the Elbe, and East Prussia beyond the Vistula. The object of Hohenzollern politics was to consolidate these provinces by acquiring intermediate territory. Toward the close of the Thirty Years' War, Frederick William, the Great Elector, made important headway in this respect and accomplished still more for his country after the close of that struggle by persistently maintaining peace and fostering industry. It was his son who in 1701 secured the title of King. The second king of Prussia built up a magnificent army and reared a son who was to use it magnificently. Frederick II. ascended the throne in 1740 and began his long reign by an unjust but profitable war. The Hapsburg realms had just fallen to a woman, and, disregarding solemn treaties, Frederick took unscrupulous advantage of the supposed weakness of the Archduchess, Maria Theresa, to seize from Austria the rich province of Silesia. The heterogeneous Hapsburg realms seemed about to fall to pieces; and Spain, France, Savoy, and Bavaria hurried to join Prussia in dismembering the carcass. But England and Holland threw themselves into the struggle on the Austrian side, and the Treaty of Aix la Chapelle (1748) closed the War of the Austrian Succession without further territorial changes. Frederick kept Silesia, reaching far down into the heart of Germany, and Prussia stood forth as one of the great powers.

The significance of the contest, however, lay in its wide extension into India and America. Indeed, colonial war between England and Spain had already begun before Frederick appeared on the stage, and France must soon have joined Spain in any event. In the New Worlds, too, the Peace restored the former boundaries; but the war marks a clear consciousness in England and France that the two were rivals for vast realms outside Europe. The family interests of monarchs as a cause for war were giving place to the commercial interests of English and Dutch merchants as opposed to those of French and Spanish merchants, while back of these selfish motives lay the mighty question, big with consequence to the world, whether French or English political ideas should hold the New World.

In 1756, Austria fortified herself by alliance with Russia, Sweden, and even her old enemy France, and prepared to destroy Prussia. Frederick's supreme military genius saved his country for the moment, and the next year England came to his aid. During the brief interval between the European wars, England and France had practically remained at war in America; and now that France had joined Austria, England was constrained to support Prussia. In all the period from 1689 to 1815, no matter what the origin of the wars, England and France soon became the chief factors; and though they were at one time or another on every side of every question, they were never on the same side at the same time.

This Seven Years' War (1756–1763), or Great French War, as it is commonly known in

America, was literally a world-wide struggle. Red men fought by the Great Lakes of North America, and black men fought in Senegal, while Englishmen and Frenchmen grappled in India as well as in Germany, and their fleets engaged on every sea. The showy battles took place in Germany, and on the whole the European conflict determined the wider results. Pitt, with vision fixed upon a coming British empire, declared that in Germany he would conquer America from France. This he did. England furnished the funds, and her navy swept the seas. Frederick, supported by British subsidies, furnished the generalship and most of the troops for the German battlefields. The striking figures in the struggle are (1) Pitt, the English imperialist and the directing genius of the war; (2) Frederick, the military genius, who won Pitt's victories in Europe; (3) Wolfe, who won French America from the great Montcalm; and (4) Clive, the East India Company's clerk, who laid the basis for England's supremacy in India.

Changes in the World-Map; the American Revolution.— The Treaty of Paris (1763) left Europe without change; but in India France lost all except a few unfortified trading posts, while in America England received Florida from Spain, and Canada and the eastern half of the Mississippi valley from France. France ceded to Spain the western half of the Mississippi valley, in compensation for the losses Spain had incurred as her ally; and, except for her West India islands, she ceased to be an American power. Spain still held South America and half North America; but her huge bulk was decaying day by day. Holland, too, with widespread empire, was plainly in decline. England, having dispossessed France in both Asia and America, stood forth as the leading world-power.

The American Revolution, a few years later, did not lessen this pre-eminence; but it had other results of supreme significance. The war came because the American colonies had really become a nation, and because the English government unwisely insisted upon managing American affairs after the Americans were quite able to take care of themselves. English interference in economic matters had long been irksome, and the danger of interference in ecclesiastical matters was feared. England had just relieved the colonies from fear of French conquest. External bonds were gone, and internal ties were dissolving. Then George III. and his ministers supplied the necessary jar to effect separation by trying to raise revenue in America by Acts of Parliament. Astute patriots rallied the majority of the Americans by an old English shibboleth; and after a bitter eight-years conflict (1775–83), the thirteen English colonies became the first free American nation.

The Revolution «split the English race and doubled its influence.» It paved the way for a more enlightened economic science, since, contrary to all expectations, the trade of free America from the first proved more valuable to England than that of colonial America had been. It reacted upon England, so that, when the great wars were over, both that country and its remaining colonies made new advances in political liberty. It set up the standard of independence for the states of Spanish America in both continents. But its supreme importance lay in the birth into the family of nations of the United States itself, though the full significance of the new nation hardly began to impress Europe for more than two generations.

England's European enemies had seized the opportunity to attack her in a war of revenge. England came out of the contest with glory little tarnished. She had been fighting, not America alone, but France, Spain, and Holland, as well; and though she had lost the best part of her old American empire she was not without compensating gains. She seized Dutch colonies at will; she strengthened her grasp upon India; she won back the undisputed sovereignty of the ocean by shattering the navy of France; she rebuffed all assailants from the rock of Gibraltar, the key to the Mediterranean; and in some measure she made good even her American loss by the acquisition of Australia just afterward.

The Partitions of Poland.— To return to continental Europe in the closing half of the Age of Frederick the Great:— one more territorial change calls for attention. Poland had fallen into anarchy under its elective, figurehead king and its oligarchic nobles. This anarchy gave the neighboring powers excuse for plunder. Catherine II. determined to seize a large part of the country. Frederick II. persuaded his old enemy, Austria, to join him in compelling Russia to share her booty. The First Partition of Poland (1772) pared off a deep rind. The Second and Third Partitions, which «assassinated the kingdom,» had not even the pretext of misgovernment in Poland, for the Poles had earnestly taken up the work of reform. These final divisions took place in 1793 and 1795, after the death of Frederick, amid the wars of the French Revolution. Prussia gained large extent of territory, with valuable sea coast; and, most important of all, the additions brought the principal Prussian provinces,— formerly scattered,— into a compact body. But Russia gained far the greatest part of the territory, and she now bordered Germany on the east, as France had come to do earlier on the west, after the destruction of the Burgundy of Charles the Bold. The wise policy of the Germans, early and late, would have been to support the buffer states against the greed of Russia and France. Failure to do so has left Germany exposed ever since to direct attack by powerful enemies, and has compelled her to build up artificial frontiers of fortresses and bayonets, and to accept an undue militant character for all her civilization.

The Beneficent Despots of the Eighteenth Century.— In foreign relations, the Age of Frederick the Great saw little improvement over that of Louis. In the government within the several states, however, there was a beneficent and significant change. Frederick of Prussia, Catherine of Russia, Charles III. of Spain, Leopold of Tuscany, Ferdinand of Naples, Joseph II. of Austria, all belonged to a new class of «crowned philosophers» and «benevolent despots» who sat upon the thrones of Europe in the latter half of the eighteenth century. In Sweden and Portugal, also, great ministers sought to impose a liberal policy upon the monarchs, as

Turgot succeeded in doing for a while, even in France. A remarkable school of French writers,— Diderot, Voltaire, Rousseau,— had created a new, enlightened sentiment in the ruling classes, and a new sense of responsibility. Government was no more *by* the people than before, but despots did try to govern *for* the people, not for themselves. Sovereigns spoke of themselves no longer as privileged proprietors, but, in Frederick's phrase, as "the first servants of their states." All these rulers planned far reaching reforms,— the amelioration or abolition of serfdom, the correction of abuses in the church, the building up of popular education. In Prussia, for a time, much was accomplished. The condition of the peasantry was improved: the administration was rendered economical and efficient: and wealth and comfort began to increase by bounds. But these happy results were secured only by the tireless energy of one of the world's greatest geniuses. On the whole the liberal monarchs made lamentable failures. One man could not lift the weight of a nation. It remained to see what the people could do for themselves. The age of enlightened despots was the prelude to the French Revolution.

THE AGE OF NATION STATES.— *The French Revolution, 1789–99.*—In the latter part of the Middle Ages, Italy had given the world an intellectual revolution; Germany began Modern History with a religious revolution; and France now introduced the last great division of the Modern period by a political and social revolution. Pre-eminently among political revolutions, the French Revolution deserves the name. The English Revolution of 1688 swept away temporary interference with ancient principles of English politics; the American Revolution made the Americans politically independent, but did not directly change the character of their society; the French Revolution cut loose from the past, and started France, with all the world, upon new lines of growth.

But if it destroyed the old, it also built the new. The work of destruction was needlessly horrible and bloody; but as a whole the Revolution was a vast and fruitful reform. The really significant thing is not the temporary mob-rule and bloodshed; the significant thing is the great national awakening which swept away an absurd society, founded on ancient violence and warped by time, to replace it with a simpler social system, based more nearly on equal rights.

The chief institutions of France were: (1) a monarchy, centralized, despotic, and irresponsible; but in weak hands, incumbered by complex survivals of ancient local institutions, and hampered by its respect for the good opinion of the privileged classes; (2) an aristocracy, wealthy, privileged, corrupt, skeptical; and (3) an established church, wealthy and often corrupt. Below these spread the masses, a necessary but ugly substructure. Over the continent, similar conditions held sway. In France the nobles had fewer duties, the peasantry had more completely risen out of serfdom, and more of a middle class had grown up, than in the other large countries of the continent. Feudal society was more decayed, and industrial society more advanced. The great European revolution broke through at the weakest spot.

The fundamental cause of the Revolution was the unjust privileges of the favored classes and the crushing burdens of the masses. The evil was no greater than for centuries, but the consciousness of it was greater. The masses began to demand reform; and the privileged classes had begun to distrust their rights.

The Revolution is usually dated from the meeting of the States-General in 1789. The king had summoned that body, hoping to induce the privileged orders to give up their exemptions from taxation, and so relieve the bankrupt treasury. The Third Estate, representing the middle class, and the liberal nobles and clergy had assembled with the determination to secure far-reaching reforms and to establish a "constitution." A sharp contest, with a brief period of anarchy, left power in the hands of these liberal elements, where, despite some attempts at counter-revolution and some danger of mob predominance, it remained for two years. The Constitution fashioned during this period provided for a weak kingship and abolished nobility and all special privileges before the law; but it carefully entrenched middle-class supremacy against democracy by graded property qualifications and a complex system of indirect elections.

Further changes were inevitable; but, if France had been left to herself, they might have come about as quietly as these first ones. Instead, foreign war gave the movement a new character. War was inevitable. Emigrant nobles gathered their forces on the Rhine under the protection of German princes. The Emperor, Leopold, brother-in-law of Louis of France, called upon the sovereigns of Europe to recognize the cause of Louis as "the cause of kings," and demanded from France such changes in her government as should protect Europe against the spread of revolution. This presumptuous dictation in their internal affairs roused a tempest of righteous wrath in the French nation; and in 1792 war began between "the cause of kings" and "the cause of peoples." For twenty-three years Europe was engaged in strife, upon a greater scale than ever before in history.

France was girdled with foes. The Empire, Prussia, and Sardinia, were at once in arms. Naples and Spain joined the coalition. Sweden and Russia both offered to do so, if needed. Ere long England and Holland were added to the enemies who expected to partition France. Vast armies invaded France; and the French forces were demoralized by treachery of officers and by fear of royalist plots. If France was to be saved, it could not be done by half-measures, nor with a king in secret alliance with the enemy. Control fell to extremists; and, while the mighty Danton roused and organized the national energies, the frenzied mob, unhindered, answered the victories and boastings of the invaders by the attack on the Tuileries and the Massacres. In September, the Convention established the French Republic with extreme democratic features and with manhood suffrage. Then revolution within revolution transferred power to more and more radical factions. The defeated Girondists raised the provinces against the capital; and for a time Paris and a score of central departments faced the remaining three fourths of France and united Europe. Out of this crisis, in 1793, grew the great Committee of Public Safety, which ruled France for a year with despotic power. The Revolution now became constructive, and never has the French genius for organization shown itself more triumphantly. The Committee deliberately adopted a policy of "Terror" to crush plots and dissension and to secure united action. Revolt was stamped out. A million soldiers were sent to the front. The invaders were rolled back in rout, and the ragged but devoted French armies swarmed victoriously across all the frontiers, to sow civil liberty over Europe with fire and sword. France was not again in serious danger from foreign foes until the fall of Napoleon, twenty years later.

Meantime, while the grim, crime-stained men of the Committee in war and tumult were organizing order within and victory abroad, the Convention was laying anew the foundations of French society and advancing the progress of the human race. It adopted the projects of Cambarcérès for the codification of French law, and the plans of Condorcet for a system of national education; it accepted Argobast's metric system of weights and measures; it abolished slavery in the French colonies, created provision for the public debt, instituted the first Normal School, the Polytechnic School, the Conservatory, the Institute of France, the National Library, and began the improvement of prisons and hospitals, and the reform of youthful criminals. Meantime the peasants had become free landholders, and the whole laboring class was rising rapidly in standard of living.

In 1794 the Jacobins split into factions, and these turned the "Terror" upon one another. The following year a conservative reaction gave the Republic a new constitution, which restored property qualifications and indirect voting. But the new plural executive (the Directory) proved incompetent and corrupt, and kept itself in power only by a series of *coups d'état*. It was assailed by conspiracy, radical and royalist; and France breathed more easily, when, in 1799, Bonaparte overthrew it with his troops and set up a firm military despotism, veiled by plebiscites.

Napoleonic Period, 1800–15.—For fifteen years, as First Consul (1800), Consul for Life (1802), and Emperor of the French (1804–14), Napoleon was sole master of France. He preserved the principle of civil equality and all the economic gains of the Revolution, but political liberty for a time was lost. True, his rule was a denial of the old doctrine of Divine Right: each new usurpation received the sanction of a popular vote, and he boasted that he was chief by will of the people. But every form of constitutional opposition was crushed or muzzled. The legislative chambers existed only to speak when and as he chose; free speech, free press, and all security for personal liberty were suppressed by a system of spies and secret police and by arbitrary imprisonment of suspects; local administration was centralized more highly than even under the old monarchy, "nor did there exist anywhere independent of him authority to light or repair the streets of the meanest village in France."

This all-pervading absolutism was directed by the penetrating intelligence and indomitable energy of the world's most "terrible worker"; and it conferred upon France great and rapid benefits. Order, precision, symmetry were introduced into every branch of the administration. The interrupted work of the Convention was resumed. Education was organized; law was simplified and codified; the church was again brought into alliance with the state; industry was fostered, and magnificent public works were carried out. But in all this, Napoleon was merely the last and greatest of the beneficent despots. And in the outcome, his rule fixed more firmly than before in the mind of the nation the dangerous willingness to depend upon an all-directing central power; so that in our own day, after many revolutions, the supremely difficult task of the Third Republic has been to create the spirit of local self-government.

No doubt, in 1800, when Napoleon came into power, he sincerely desired peace, in order to reconstruct France. By the brilliant victories of Marengo and Hohenlinden he dissolved the hostile coalition, and a series of treaties, closing with the Treaty of Amiens (1802), gave Europe a breathing spell. But soon Napoleon again desired war. His victories in Italy, as a general of the Directory, had first brought him to the world's notice, and only military glory could keep France from murmuring at his rule. Moreover, he aspired frankly to European empire. On the other hand, the nations felt that there could be no lasting peace with him except by complete submission to his will. In 1803, England and France renewed their strife, and between these powers there was to be no more truce until Napoleon's fall, eleven years later. In that time Napoleon fought also three wars with Austria, two with Prussia, two with Russia, a long war with Spain, and various minor conflicts. From 1792 to 1802, the unceasing European wars belong to the Revolutionary movement. From 1803 to 1815, they are properly Napoleonic wars, due primarily to the ambition of a great military genius. In the first series, Austria was the chief opponent of the Revolution; in the second series, England was the relentless foe of Napoleon.

Napoleon's insight readily divined his true enemy; but Nelson's great sea fight put an end to all possibility of directly invading England. On the continent, however, victory followed victory. After Austerlitz (1805), Austria gave up her remaining Italian and Illyrian territory, and many of her possessions in Germany. After Jena (1807), humiliated Prussia was reduced half in size, thrust beyond the Elbe, and bound to France by a shameful treaty. Less decisive conflict with Russia was followed by the diplomatic victory of Tilsit (1807). Emperor and Tsar entered into friendly alliance. France was to have a free hand in Western Europe; Russia was to be permitted to aggrandize herself at the expense of Sweden, Turkey, and Asia; and the two were to join in ruining England by enforcing Napoleon's "continental system."

The refusal of Portugal to obey Napoleon's command for the confiscation of English commerce led to the seizure of that state. Then followed a like seizure of Spain, out of which grew the long Peninsular War, which, as Napoleon confessed afterward at St. Helena, was really the canker that destroyed him. At the time, however, it seemed trivial, and for five years after Tilsit Napoleon was master of the continent. At its greatest extent the huge bulk of France filled the space from the ocean to the Rhine, including not only France as we know it, but also Belgium, half of Switzerland, and large strips of Germany, while from this central body two outward-curving arms reached toward the east, one along the North Sea to the Danish peninsula, and the other down the coast of Italy past Rome. The rest of Italy and half the rest of Germany were under Napoleon's protection, ruled as vassal states by his brothers and generals. Denmark and Switzerland were his willing allies, and Prussia and Austria were unwilling ones. Sweden and Russia, though nominally his equals, were allowed that dignity only because they upheld his policy. Only the extremities of the continent,— the islands of Sicily, Sardinia, and England, and the mountainous Spanish peninsula,— kept their independence, at the cost of wasting war.

The period was filled with important rearrangements for Europe, territorial, political, and social. Many of these were designed in selfishness: but nearly all were to bear good fruit. In particular, the Germany and Italy of to-day were made possible by Napoleon's fearless clearing away of old institutions, and by the vigorous impulse he gave to the new forces of political unity and social reform.

In Germany, even the territorial rearrangements paved the way for later national unity. Not only the twelve hundred anarchic territories of the "knights," but also the three hundred petty, scattered, despotic principalities, ecclesiastical states, and oligarchic city-republics (with a few exceptions) were absorbed in larger neighbors: so that the multitudinous, ill-governed states of the vanished "Empire" were consolidated into less than forty. Most of these reorganized states, outside Austria and Prussia, were further combined in the Confederation of the Rhine: and in this Confederation, as well as in the German and Italian territory annexed to France, and in the various vassal states over Europe, serfdom and feudalism were abolished and civil equality and the Code Napoleon were introduced. The administration of justice was made cheap and simple, and the old clumsy and corrupt methods of government gave way to order and efficiency.

Most important of all, similar reforms were adopted in Prussia, not from French pressure, but by the influence of the Prussian minister, Stein, who sought to make his country strong enough to throw off the French yoke and to regenerate Germany. Napoleon's insolence had at last forced part of Germany into a new national patriotism: and that patriotism began to arm itself by borrowing weapons from the arsenal of the Revolution.

Napoleon's "continental system," if embarrassing to England, was ruinous to Europe. Moreover, Tsar Alexander began to suspect Napoleon of intriguing against him in Finland and Turkey: and in 1811 he refused longer to follow Napoleon's commercial policy. Napoleon declared war. The destruction of his Grand Army amid Russian snows was the signal for the rising of the peoples of Central Europe in the Wars of Liberation. Napoleon, like a desperate gamester, refused all terms, and finally was crushed and deposed. The Bourbon dynasty was restored to the throne of France, and the powers met in the Congress of Vienna (1814–15) to reconstruct the map of Europe.

The Congress of Vienna.— In its desires, that Congress stood for reaction. Says Fyffe, "It complacently set to work to turn back the hands of time to the historic hour at which they stood when the Bastille fell." It ignored peoples, and considered only princes. Its work, therefore, had to be slowly undone through the next half-century.

Still, its power for restoration was less than its wish; and even its most selfish work contained seeds of progress. Nobody thought of restoring the old ecclesiastical princes, nor of undoing the consolidation of Germany. That country was left in thirty-eight states, and Italy in twelve. Austria, which had lost territory in Central Europe, received its compensation in Italy, so that its despotic energies were more than ever drawn away into Italian and Danubian questions. Renovated Prussia, in return for Slav lands, which it ceded for the Tsar's new Kingdom of Poland, received German territory,— half of Saxony, the Pomeranian sea coast, and German provinces on the Rhine taken from France. Thus, reaching down into the heart of Germany, and with distant isolated districts to defend on the Rhine and on the Niemen, Prussia stood forth the natural champion of Germany against Slav and Gaul. In like manner, Sardinia's gain of Genoa was one more step in the consolidation of Italy. In return for the vast national debt incurred in supporting coalitions against Napoleon, England added still further to her colonial supremacy by holding South Africa, Cyprus, Malta, and other important stations. Despite its brief welcome to Napoleon at his return from Elba, France was wisely left with the boundaries she had when the Revolutionary wars began. The most serious disappointment to the liberals was the failure to secure a national union in Germany. Reactionary Austria secured instead the Germanic Confederacy — a loose league under Austrian presidency, with a Diet which was merely a meeting of ambassadors,— "a polite and ceremonious means of doing nothing."

It was worth much to Europe merely to recognize that it had common interests which could be arranged by a peaceful congress. Even this gathering of despots was an advance from eighteenth century politics toward a better international organization. Some of its work, moreover, was distinctly progressive, such as the declaration against the African Slave Trade, the opening to commerce of the rivers flowing between or through different countries, and especially the neutralization of Switzerland under the protection of the powers.

From 1815 to the Revolutions of 1830.— For more than thirty years after the Congress of Vienna, reaction held sway. The restored princes, who "had learned nothing and forgotten nothing," strove to ignore the progress from 1789 to 1815. In Sardinia, serfdom was restored; in Spain and the Papal States, the Inquisition and other mediæval institutions; in some places, even street lamps were abolished along with other hateful French reforms. Five states,— Russia, Austria, Prussia, England, and

France,— determined the policy of Europe. The first three were divine-right despotisms; and though the Tsar and the King of Prussia played for a time at liberalism, the first disorders enabled Austria to draw them over to her own frankly reactionary program. At first, France and England were not much better than these Eastern powers. Louis XVIII. had found it necessary to give France a charter; but in that document itself the theory of divine right was preserved, until the revolutionary changes of 1830. That theory could have no place in England; but even there the government was for many years in the hands of an extreme Tory party. The evil genius of the whole period was the subtle Austrian statesman, Metternich, with his motto, "Government is no more a matter for debate than religion is." The one good thing to be said for Metternich's long supremacy is that he permitted no great war; and this was because he felt it necessary to hold the powers in friendly alliance, so as better to arrest progress within the lines drawn at the Congress of Vienna.

However, beneath the tide of reaction, the principles of the Revolution survived. The two positive forces in politics for the 19th century were to be democracy and nationality. The league of princes compelled them to work underground; but before the middle of the century they emerged in three series of revolutions — in 1820, 1830, and 1848.

The revolutions of 1820 started in Spain, to re-establish the Constitution of 1812, which had been adopted first during the war for Independence. Completely successful there for the time, the movement spread swiftly over the southern peninsulas — to Portugal and to the states of North and South Italy, while it stimulated the Greek rising against the Turks. Metternich found a weapon of repression ready. After Waterloo the four great allies, Russia, Prussia, Austria, and England, had agreed to preserve their union against revolutionary France by holding occasional congresses. Metternich now summoned these powers to the Congress of Troppau. Here the despotic masters of Russia, Austria, and Prussia signed an agreement to unite in putting down revolution against any established government. England protested and withdrew from the alliance; but her place was taken by France, and the united despots, popularly known as the "Holy Alliance," proceeded to carry out the Troppau programme. With overwhelming armies they crushed constitutionalism in Naples and Piedmont, and a little later, in Spain. England's fleet preserved the little sea-coast country of Portugal from attack; and the Tsar's sympathy for his Greek coreligionists held Metternich from aiding Turkey. Portugal and Greece were the only European lands to reap good from the widespread risings of this period.

American Progress.— Greater gain there was, however, outside Europe. The "Holy Alliance," successful in Spain, wished to restore monarchic control over revolted Spanish America. Here they failed. When Napoleon seized Spain (1808), the Spanish colonies, nominally loyal to the old Spanish dynasty, began to taste the sweets of economic and political freedom. They were powerfully influenced, too, by the success of the United States; and soon they began, one after another, to avow independence not only of Napoleon, but also of the mother country. The United States had recognized their independence. England had not done this; but now she interposed her sea-power to shield them against the proposed attack by the "Holy Alliance." England, indeed, urged the United States to join in a formal alliance to protect Spanish America. The United States chose to act separately, but it did act along the same line: in 1823 President Monroe's message announced that this country would oppose any attempt of the despotic powers to extend their political system to America. Thus was born a group of new nations. For more than fifty years, it is true, the best of the new states manifested anarchic tendencies; but before the close of the nineteenth century some of them began to make steady and promising progress in government and society. Their constitutions have been modeled generally upon that of the United States.

Before returning to Europe, brief attention should be given to the progress of the United States itself in the generation following the French Revolution. The Constitution of 1787 saved the thirteen States of that time from falling apart into jangling, insignificant units, and gave the world an advanced type of federal government. The Louisiana Purchase (1803) doubled the territory of the country and confirmed its destiny as the home of a mighty continental nation. During the closing Napoleonic struggles, the contemptuous disregard of England for the rights of neutrals, together with the treacheries of Napoleon, involved America in war with England; but, beyond this, except for the enunciation of the Monroe Doctrine, the United States, busied with its marvelous growth at home, had kept free from foreign complications. At the moment of the European revolutions of 1820, the great American Republic was entering on the forty years of anti-slavery debate which preceded the Civil War.

Revolutions of 1830.—The year 1830 is one of the notable dates in the 19th century. In America the victory of Jackson had just marked a fresh advance in popular government. In England the First Reform Bill began its two-year struggle in Parliament. On the continent of Europe, revolution struck a new blow at the system of Metternich. This time the movement started in France, where the July Revolution replaced the divine-right Bourbon monarchy with the constitutional, bourgeois monarchy of the Orleanists. Explosions followed over Europe. The Belgians rose against their Dutch masters; the Poles against Russia; Italian risings seemed for a moment to have some chance in the papal states and the duchies; and, while Russia and Austria were busied in Poland and Italy, liberal gains were secured in several German states. But soon Metternich, his hands free once more, set himself patiently to restore the old order in Germany. France, it is true, was lost to the "Holy Alliance," and joined England in defending liberal Belgium against despotic intervention. But in the final result, France and Belgium were the only gainers from this period. It was to take the third great "year of revolutions," to sweep away Metternich's shattered system.

To appreciate in any measure the wonderful progress of the remaining two thirds of the 19th century, it is needful to grasp the conditions of the world of 1830, or, we may say, of 1837, when the Victorian era began. It was still a small, despotic world, far more remote from the great, progressive world of 1900 than from the world of 1600. Civilization held only two patches on the globe,— western Europe and eastern North America. In the latter, the real frontier of the United States reached less than one third the way across the continent, and politics and society were dominated by the slave power. Europe knew "Germany" only as a pious aspiration of revolutionaries, and "Italy" as a "geographical expression." Metternich stood guard over central Europe. On the east hung Russia, an inert mass, in the chains of her millions of serfs. Under the contemptible Orleans monarchy, France was taking breath between spasmodic revolutions. England herself had only begun to stir under the long oligarchic rule of her landlord class. The rest of the globe hardly counted; a fringe of Australia held a convict camp; eastern Canada was a group of jealous, petty provinces, learning to agitate in disorderly fashion for self-government; Spanish America, prostrate in anarchy, gave as yet little hope of the coming renaissance; Japan was to sleep a generation longer; while the two largest continents were undisturbed in their native barbarism, except for England's grasp upon the hem of India and South Africa.

England in the 19th Century.—In Europe, England was to lead the van of progress; and in England, almost alone in Europe, reform was to come without revolution. But the England of 1830 was still mediæval. During the great French wars from 1690 to 1815, except for the one development of ministerial government, England had retrograded politically and socially. Her society was marked by extreme inequalities between rich and poor, intensified by cruel class legislation; her government, superficially representative, had really fallen into the hands of a selfish landlord class; her boasted local self-government was intensely aristocratic; her established church was aristocratic and unspiritual. In the last half-century had come an industrial revolution — the growth of the factory system — with marvelous increase of population and growth of city life, calling imperatively for new adjustments; but the great Tory party met all calls for reform with sullen denunciation and repressive legislation which made free speech a crime.

Under the system of rotten and pocket boroughs, more than half the House of Commons were the appointees of less than 200 landlords, while most of the rest represented small fantastic constituencies. Thus, reform necessarily began with Parliament itself. This parliamentary reform was accomplished by three great measures: that of 1832 placed power in the hands of an intelligent middle class, the landed and mercantile interests; 35 years later, the Second Reform Bill (1867) gave power to the artisan class of the towns; and the bill of 1884 once more doubled the electorate and left England a democracy.

The Reform Bill of 1832 was followed at once by social reform, in response to the swelling tide of humanitarianism in literature and society. Legislation swept away negro slavery in the colonies, and the hideous white slavery of women and children in English factories and mines; reformed the barbarous and fantastic criminal code; abolished the worst abuses of the pauperizing poor-law; began the protection of workmen in factories against carelessness or wilful neglect of capitalists; gave women legal rights; adjusted taxation more equibly; swept away the corn laws and introduced the free-trade era; removed the press gang, and brought in the penny post; enlarged the self-government of the colonies; and established a wonderfully efficient system of democratic self-government in cities at home. Subsequent political reform, despite the Irish difficulties after 1870, added to the rate of social reform. In particular should be noticed the complex industrial legislation, and, for dependencies where the nature of the population forbids self-government, the adoption of efficient, unselfish colonial administration, in which England has set an example for all world powers. Even India and Egypt, with their tremendous difficulties, have been touched with new life; while the great provinces of the English-speaking colonies, Canada and Australia, have organized themselves into two mighty federal states (1867 and 1901). In the rural units of England, too, the local government bills of 1888 and 1894 established true democracy.

Revolutions of '48.—Meantime, on the Continent, the next great progress after 1830 came with the revolutions of '48. A general explosion had been preparing; but again the signal was given by France. The Orleans monarchy had become reactionary; and the socialistic February revolution set up the Second Republic. March saw Metternich himself a fugitive, escaping from Vienna in a laundry cart, while thrones were tottering everywhere between Russia and Turkey on one side and England on the other. Even England trembled with a Chartist movement and the threat of an Irish rebellion. The kings of Holland, Spain, Denmark, and Sweden made constitutional concessions. In Germany and Italy there were complex movements, working (1) for constitutional liberty and social reform within the several states; (2) for the union of the fragments of the German race into a nation; and (3) for the independence of Italians, Slavs, and Hungarians, held in subjection by Austria.

The third movement resulted in wars, out of which Austria finally emerged triumphant; and her victorious army was a ready tool to restore absolutism at home. In Germany the undisciplined Liberals had wasted opportunity, Austria dispersed the Frankfort National Assembly, and, after humiliating unready Prussia at Olmütz, restored the old confederation (1850). A year later (1851) the *coup d'état* of Louis Napoleon closed the revolution in France and prepared the way for the Second Empire of the next year.

But there had been great gains. Feudalism and serfdom were gone forever, even from Austria. Sardinia, Prussia, and the minor German states kept their new constitutions. Switzerland had become a true federal republic upon the American type. Sardinia, by her sacrifices, and Prussia, in spite of the past mistakes of her timid government, were clearly marked out as the champions of Italy and Germany against Austria. Victor Emanuel of Sardinia recognized his mission to unite and free Italy; and Prussia, so recently shamed, had statesmen who would see that next time she should be ready.

Europe from 1850 to 1880.—The next 25 years (1850–75) saw not only the advance toward democracy in England, the victory of nationality and the abolition of slavery in the United States, the formation of the federal Canadian Dominion, on the American model, and the awakening of Japan under American constraint, but also a new federal German Empire, a united, constitutional Italy, a stable French republic, a constitutional Spain, and a constitutional, federal Austria-Hungary. The period was one of "blood and iron." Napoleon III., who had drawn England into the Crimean war (1854) to humiliate Russia, was himself drawn by the statesmanship of Cavour into the Austrian war of 1859 to help free Italy. Within a year after the resulting campaigns in Italy had closed, the American Civil War began; and before it ended, Bismarck had entered upon his trilogy of wars. In 1864 he robbed Denmark of the Schleswig-Holstein duchies, with the great harbor of Kiel for Prussia's projected navy, and so made trial of the new army he was at once to use (1866) in driving Austria out of Germany by the Six Weeks' War. The North German Confederation, then formed, was expanded into the German Empire by the Franco-Prussian war (1870–1), into which Bismarck next tricked French vanity and the despairing ambition of the decaying French government. These struggles completed also the unity of Italy. In 1866 Italy recovered Venetia from Austria, and in 1870, when France could no longer interfere, it at last marched its troops into its ancient capital, Rome. Even for conquered countries, during this period, did reform grow out of war. The Crimean catastrophe struck the chains from Russia's serfs; the shock of defeat in '59 and '66 woke Austria to constitutional progress; only when Germany shivered the sham of the Second Empire did France enter upon true republican life; and it was in the ashes of her old social system that our own South found regeneration.

Out of the Russian-Turkish war of 1877–8 a new group of Balkan nations was born, mainly Slav in blood, with at least the forms of constitutional government. But since 1871 political progress for the most part has been peaceful. The various monarchies of Europe, except Russia and Turkey, had already all adopted constitutions modeled upon the English government, though in none of them were the ministries so truly dependent upon popular will as in England. Indeed, in some states the formal constitutional monarchy really merges into a practical despotism. Progress in politics since 1871 has been of two kinds: (1) a growth in ministerial responsibility, and (2) rapid extension of the franchise toward a manhood basis. Actual administration, in most European countries, is still highly aristocratic; but in the matter of ultimate control democracy is generally triumphant, and it is training itself everywhere, by compulsory school systems, for the closer management of affairs.

International Relations Since 1880. Europe in Africa and Asia.—International relations since 1880 require brief statement. France longing to recover her lost provinces from Germany in a war of revenge, drew close to Russia. Bismarck offended Russia by supporting Austria in the Balkans. Italy was angered by the French seizure of Tunis in 1880. Thus new combinations of the powers appeared. In 1881, Germany, Austria, and Italy (all old enemies) leagued in the Triple Alliance; while a little later, France and Russia formally adopted a dual alliance. The Continent was thrown into two hostile camps, and has rested ever since under an armed peace. France became "the tail to the Russian kite." England, unwilling to join the Triple Alliance, as Bismarck wished, has been left in a position her statesmen have chosen to characterize as one of splendid isolation.

In the '90s, all these arrangements were threatened by the active appearance, in the field of international politics, of two non-European powers. The Chinese war of 1894 revealed Japan as a modern and powerful state; and the Spanish-American War (1898) made it apparent that the United States had abandoned its exclusively American policy. Moreover, since about 1880, European politics had been merging more completely than ever before in world politics. The questions at issue ceased to be Rhenish or Danubian, and became African and Asiatic. The 19th century, indeed, had been one of expansion of civilized powers, but that expansion had hardly been conscious of its own importance. The United States had quietly filled its borders from ocean to ocean with a homogeneous population. Russia had spread across northern Asia to the Pacific, and was reaching down in the Trans-Caspian region toward the Persian Gulf. And England had continued annexation of the keys to empire in waste spaces of the earth. These three were the world-powers. Far behind came France, with some important possessions in North Africa and some ancient claims in southeast Asia. Until 1884 Germany had no thought of colonial empire.

About 1880 a new, conscious greed for colonial territory seized Europe. Africa, some Pacific islands, and the helpless Asiatic empires of Persia, Turkey, Siam, and China were the only unappropriated lands. There followed a swift, peaceful division of Africa. In 1880, only patches here and there on the coast were European; in 1891, except for the native states of Abyssinia, Liberia, and Morocco, the continent was mapped out between European claimants. The three important African powers are England, France, and Germany, though Belgium, Spain, Portugal, and Italy are also represented. England is far in the lead. Her ambition has been to unite her two main possessions, in the Nile Valley and in South Africa, by acquiring intermediate territory; but the Congo Free State and German East Africa were thrust between too soon. France comes second in extent of territory; but, except for Algeria and Madagascar, her districts are less valuable than those of England or Germany. France would have liked to join her holdings on the east and west of the continent; but she found English territory thrust in between. German ambition was frustrated in similar manner. The three powers seem to have mutually stale-mated one another's attempts to dominate Africa.

The occupation of Asia by European states has proceeded more slowly, but has moved with increasing rapidity in recent years. England, Russia, Japan, and France are the chief powers concerned though Germany has shown an active disposition to take a hand in any partition, and though the commercial interests of the United States make it certain that that country will be an important factor in any further changes.

In 1894, Japan and China engaged in war over the control of Korea. With amazing rapidity, Japan overcame her bulky antagonist: but Russia, backed by France and Germany, stepped in to rob her of the fruits of her victory. Japan, owning not even one modern ship of war, was forced to yield — to spend all energies for the next 10 years in preparing for further conflict. Russia secured from China the right to extend her Siberian railroad through Manchuria, and in 1898 she also obtained the powerful fortress of Port Arthur. Germany and England then compelled China to grant them important districts, which, like the Russian acquisitions, seemed to command the heart of China and to doom that power to partition. In 1900 the Chinese resentment against "western barbarians" culminated in the Boxer massacres. The powers sent armies to rescue their beleaguered embassies at Peking; but, largely through the policy of the United States, no territorial indemnities were demanded. During the campaign, however, Russia occupied Manchuria, and, despite repeated solemn promises, it soon became plain that she meant to keep it. The powers apparently acquiesced; but when Russia in 1903 encroached also upon Korea, Japan foresaw danger to her own independence, and, in 1904, she began war. The struggle has been tremendous, almost beyond parallel; but Japanese victory has been swift and overwhelming, and has changed the whole face of world politics. Russian aggression in the East has been checked for a long period. See MANCHURIA; PORTSMOUTH, TREATY OF.

Summary.—The three mighty agents in the 19th century transformation have been democracy in politics and industry, humane sentiment in morals, and scientific progress. The first of these has been the main theme of the latter part of this article. The gentler spirit of recent society, likewise touched upon, has abolished slavery, ameliorated law, and brought about organized, zealous, and intelligent effort to lessen misery and crime. But perhaps the most marvelous phase of the "Wonderful Century" is the scientific advance. Since the primitive inventions of making fire, of the bow, of domesticating animals, of smelting iron, and of the alphabet, all the inventions of man up to the year 1800 probably count for less than those since that year. In civilized lands, life has been lengthened over a fourth, and the population of the civilized world has trebled. This larger amount of life has been lifted to a higher level. Wealth is more abundant; and the laboring masses, though still getting too little of it, get far more than formerly. The area of civilized life has been wonderfully expanded, but steam and electricity bind the most scattered portions together more closely than adjacent villages were joined in the near past. And this new solidarity is not merely in material interests: it has its intellectual and moral side. There is a growing unity of sympathy and opinion.

The picture, of course, has its dark side. Crowded populations live and work under conditions of misery and disease and often of sin. Civilized nations show callous disregard for the rights of weaker or barbarous people. And over the civilized world itself there still broods the danger of annihilating war, more terrible because of the inventions of this scientific age.

Happily this survey may close with a chronicle of a great step toward removing this last danger. The Hague Conference of 1899, called in the interests of peace, did not find it possible to make any advance toward disarmament, but it did provide for a permanent international tribunal for arbitration between such nations as may choose to avail themselves of it. It is of supreme consequence that machinery is ready so that two nations at difference may escape war without loss of dignity, if they both desire. Even more significant and hopeful, however, is a long series of arbitration treaties between nations, two and two, beginning with the Anglo-French treaty of 1903. Despite the terrible Russo-Japanese war, the first years of the 20th century have seen remarkable progress toward the federation of the world.

Bibliography.—Within the space at command, no detailed bibliography is possible. Since the dawn of the scientific study of history, writers have shunned the attempt to cover the complex field of modern history except in co-operative "series." Of such series the most important in English are 'The Cambridge Modern History,' edited by Ward (1903, 12 vols., of which only 5 have appeared by 1905); and 'Periods of European History,' edited by Hassall (1890–2. 8 vols., of which the last 5 belong to our period). Andrews' 'Historical Development of Modern Europe' (1896), Fyffe's 'Modern Europe to 1878' (1884), and Seignobos' 'Europe Since 1814' (1899) deal with the 19th century. Cunningham's 'Western Civilization' (1900), and McVey's 'Modern Industrialism' (1904) treat special phases. For further references the reader may consult the special bibliographies at the close of the articles on leading countries and movements. West's 'Modern History' (a high-school manual, 1904) in an appendix gives a classified bibliography of 150 standard English works.

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History, Logic of. The relation of history to the problems of the philosopher has been mostly confined to those questions which are treated in the philosophy of history. The object of this discipline is to interpret the meaning of mankind's historical development and to comprehend the progress of humanity in the setting of a metaphysical system. It is only in recent times that philosophy has recognized clearly the importance of an entirely different relation. If the philosopher studies in the science of logic the ways of thought and the special methods by which the different special sciences are able to reach the truth it must be logical and thus, ultimately, a philosophical task to examine the methods of historical investigation. The special schemes of the historian's technique belong to historical science proper. But as soon as the attitude which the historian has to take towards the world is in question, we stand before a logical problem which is most nearly connected with the general problem of the meaning of truth. A rich literature devoted to this circle of problems has grown up during the last decade, partly through the activity of philosophers and psychologists, partly from the interests of historians and economists themselves.

Of course, it is possible to take the skeptical attitude and to deny the existence of a particular problem here. We can say that all science has the same kind of task, and that the logical problems are thus not other for history than for the natural sciences. Yet this attitude may lead to two different standpoints. The first is the most popular one. From that it would appear that history is not a real science at all. It collects a mass of material just as the zoölogist collects his specimens; but that kind of treatment which makes zoölogy a real science, the study of the common characteristics and of the underlying laws, is not in question for the historical material. Instead of this an art enters into play, the art of historical presentation. The works of the great historian are thus in first line works of art parallel to the great epic narratives, with only the difference that the epic poems follow the lines of imagination while the historian reconstructs the facts as they may have happened. Scientifically history would thus stand on the lowest level, as a mere collection of facts without that real scientific treatment which makes the value of the other sciences. The best which can be hoped, then, is that it may be brought to a kind of scientific height by introducing as much as possible the results of other sciences such as physics, biology, anthropology, geo-physics, etc., into the explanation of historical happenings. The influences of climate, of race disposition, of technical inventions, and so forth, then become predominant in the scholarly treatment of historical events. It may be said that this low opinion of the pure scientific character of history has been prevalent throughout the whole history of science.

But those who consider the natural sciences as the only type of real scientific work may be led, and have been led frequently in recent times to still another standpoint. They may say that history has the greatest possibility of being a full-fledged science. The only step it has to take is that from the merely descriptive to the law-seeking attitude. The real task of the historian, they say, would be to find the common features which belong to the growth of every nation and to the political and social, artistic and scientific, economic and religious movement of the different periods and of the different communities. As long as isolated processes are described, history indeed remains on a pre-scientific level, but as soon as we recognize characteristic types of development, we reach general laws like those of the biologist or the chemist. The interest concentrates itself then on the psychological factors which moulded the fate of the nations, and especially the life of the masses becomes a true historical agency. That which is unique then becomes insignificant and accidental as compared with the great typical processes which repeat themselves under similar conditions in the most different countries. A kind of natural science of historical nations thus becomes the logical goal.

Those modern movements, however, which have forced the problems of the logic of history to public attention object to both these standpoints because they refuse to admit the first presupposition. They deny that the natural sciences are the only type of a real science. They claim, rather, that this is a prejudice which has been suggested to the world by the overwhelming influence of the Aristotelian logic on the one side, and the impressive triumphs of natural science on the other. They hold that there exist two types of scientific thought in principle commensurable, and that the historical way of thinking is in its importance and in its logical right perfectly coördinate with naturalistic thought. Yet here again a variety of standpoints have been taken.

The simplest presentation of this doubleness of logical method is offered by those who hold that the whole separation is to be deduced from the doubleness of the logical attitude. They say that we can take with reference to everything in the universe either the attitude of interest in the general law or the attitude of interest in the particular thing. The one interest can never be substituted for the other. In the one case the particular object is for us only a sample illustration for a general relation. We seek the law which expresses that relation and inhibits therefore the interest in the special chance case which is before us. That is the attitude of the naturalist. On the other hand we may give our whole attention to the particular object before us in its uniqueness, and there is no doubt that our practical interests of life force on us just this attitude. Our earth may be astronomically not more important than any other planet, but our practical interest belongs to this planet alone. Our friends may be to the biologist not more instructive than any other group of organisms, but for our friendship those particular men have their unique position and cannot be replaced by other chance copies. To develop systematically this interest in the particular is the function of the historian, and anything which has its particular existence is possible historical material. Yet it is evident that no science can have the task of describing every particular pebble on the beach. There must be a principle of selection, and this is given in the reference to our values. The men who have relation to that which is valuable in the world, to the development of state and law, of art and science and religion, are to be selected for the historian's account. And this ultimate reference to values binds the particular objects together, while it is evident that the law of natural science brings the facts under a point of view under which they have no special value at all, but are indifferent objects of theoretical observation. The antithesis is thus complete. The naturalist seeks the general, the historian seeks the particular. The naturalist refers everything to the law, the historian everything to the value. Both groups of interest create logically independent systems of knowledge. Their difference is thus in no way a difference of material, as there is nothing in the world which cannot be considered from both points of view. The sun which the astronomer studies in relation to the astronomical laws as a chance case of a general relation which holds for myriads of suns, may be at the same time the object of interest for those who ask about the development of this one particular sun which gives us light. And on the other hand, even the Napoleon of the historian may be brought under the laws of biology from the standpoint of the naturalist.

Others who welcome this sharp separation feel doubtful whether it is really the logical attitude which determines the difference and not the content. They claim that it is not true that natural science has to deal with laws only. Natural science may very well give its attention to particular objects too, and the development of our sun or our earth or our mankind is not history but natural science. The true difference, they say, lies rather in the doubleness of the objectifying and the subjectifying attitude.

The sun and earth are for us all objects, but men and their work can be considered in a double way. We can consider our neighbors as objects, as phenomena which we describe and explain, but we can consider them also as subjects of will which we understand and interpret and appreciate, and this doubleness of attitude reaches over the whole of mankind. Wherever there is will, there the object can be taken as a subject and it is claimed that the work of the naturalist is the study of the world in so far as it is conceived as a system of objects, while the study of the historian is the world in so far as it is conceived as a system of will relations. Only subjects of will would thus be able to enter into history at all. And the task of the historian is to understand the systematic relations between the purposive actions. The naturalist starts from the objects of his perception and seeks their causes and their effects. The historian starts from those will demands which reach him as the political, legal, artistic, scientific, economic, religious demands of his social world, and he seeks to interpret them by connecting them with the purposes of the past. The naturalist explains, while the historian interprets intentions and links the will purposes into a connected unity.

Bibliography. — Windelband, 'Naturwissenschaft und Geschichte'; Simmel, 'Probleme der Geschichtsphilosophie'; Rickert, 'Greazen der naturwissenschaftlichen Begriffsbildung'; Münsterberg, 'Psychology and Life'; Lamprecht, 'What is History?'

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History, Great Events of. The following list gives only those important events which have affected or changed the subsequent history of nations. The cross references will refer the student to the special information concerning these epoch-making occurrences, and the following special articles may also be consulted: HISTORY, ANCIENT; MEDIÆVAL; MODERN; WARS OF THE WORLD; PEACE TREATIES; REPUBLICS, HISTORY OF; EXPLORATIONS IN THE 19TH CENTURY; POLAR RESEARCH; JUDAISM—JEWISH HISTORY; CRUSADES; CROMWELL; GUNPOWDER; THIRTY YEARS' WAR; SEVEN YEARS' WAR; NAPOLEON; WATERLOO, BATTLE OF; CRIMEA; AMERICA, DISCOVERY AND COLONIZATION OF; DISCOVERIES OF AMERICA TO 1562, SPANISH AND PORTUGUESE; COLONIAL WARS IN AMERICA; NAVY OF THE UNITED STATES, HISTORY OF; UNITED STATES, WARS OF THE; DECLARATION OF INDEPENDENCE; SLAVERY IN THE UNITED STATES; CONFEDERATE STATES OF AMERICA; MONROE DOCTRINE; UNITED STATES—THE AMERICAN REVOLUTION; THE WAR WITH FRANCE; WAR OF 1812; MEXICAN WAR; SLAVERY; CAUSES OF THE CIVIL WAR; RECONSTRUCTION; WAR WITH SPAIN; ETC.; TREATIES OF THE UNITED STATES WITH FOREIGN NATIONS; THE EASTERN QUESTION; THE OREGON QUESTION; DICTATORSHIPS IN LATIN-AMERICA; EMANCIPATION IN LATIN-AMERICA; PEKING, SIEGE OF; BOERS; SOUTH AFRICAN WAR; RIEL'S REBELLION; ETC.

B. C.
1615 Exodus of the Children of Israel from Egypt.
1111 Mariner's compass (q.v.) discovered.
753 Rome (q.v.) founded.
603 Geometry and Maps (qq.v.) first used.
551-479 Confucius (q.v.) flourished.
400 Battle of Marathon.
538 Fall of Babylon (q.v.).
636 Accession of Alexander (q.v.); Grecian Empire.
63-44 Cæsarian era; Britain invaded; Gaul conquered.
A. D.
33 The Crucifixion of Christ (q.v.).
451 Battle of Chalons.
570-623 Mohammed (q.v.) flourished.
800 Charlemagne (q.v.), Emperor of the West.
967 Egypt conquered by the Turks.
1066 Battle of Hastings in England.
1201 Crusades (q.v.) in Holy Land begun.
1234 Gunpowder (q.v.) first used by Genghis Khan.
1453 End of the Roman Empire in the East.
1455-85 War of the Roses in England.
1492 Columbus discovered America.
16th Cent. Period of Reformation (q.v.) in Europe.
1588 Destruction of the Spanish Armada.
1618-1648 Thirty Years' War (q.v.).
1619 Beginning of Slavery (q.v.) in America.
1642 Beginning of the Civil War in England.
1627 Barometer and Thermometer (q.v.) devised.
1648-52 Civil War of the Froude in France.
1642-1724 Newton (q.v.) discovered gravitation.
1713 Peace of Utrecht ending War of Spanish Succession (q.v.).
1741-48 War of the Austrian Succession.
1756-63 The Seven Years War (q.v.).
1776 Declaration of Independence (q.v.).
1789-1802 French Revolution.
1804-1815 Napoleon (q.v.) Emperor of France.
1812-14 War of 1812 (q.v.).
1815 Battle of Waterloo (q.v.).
1819 Electro-Magnetism discovered.
1821-29 Greek War of Independence.
1831-39 Belgian war of Independence.
1845-48 Mexican War (q.v.) with the United States.
1853-55 Crimean War.
1857-59 Indian Mutiny and War.
1861-65 Civil War (q.v.) in United States.
1863 Battle of Gettysburg (q.v.).
1866 Laying of first Atlantic Cable.
1868-99 Cuban War of Independence.
1870-71 Franco-Prussian War (q.v.).
1877-78 Russo-Turkish War.
1883-84 War in the Sudan.
1894 War between Japan and China.
1895 Roentgen discovery of X-rays (q.v.).
1897 War between Turkey and Greece.
1898 Spanish-American War began.
1898 Hawaii (q.v.) annexed to the United States.
1899 Peace Conference at The Hague (q.v.).
1899-1900 War between England and Boers.
1902 First Anglo-Japanese Alliance. See ANGLO-JAPANESE TREATIES.
1903 Panama Canal treaty signed. See PANAMA CANAL.
1903 Pacific Cable completed.
1904-5 War between Japan and Russia, terminated 5 Sept. 1905 by Treaty of Portsmouth (q.v.). See MANCHURIA.
1905 Second Anglo-Japanese Alliance (q.v.).
1906 Earthquake and fire, San Francisco, Cal. See EARTHQUAKE.
1906 Palma, President of Cuba, resigns; United States assumes control.

Hitchcock, hĭch'kŏk, Charles Henry, American geologist: b. Amherst, Mass., 23 Aug. 1836. He was a son of Edward Hitchcock, geologist (q.v.). He was graduated from Amherst College in 1856, was assistant State geologist of Vermont in 1857–61, State geologist of Maine 1861–2, and of New Hampshire 1868–78. In 1868 he was appointed professor of geology in Dartmouth College. In connection with his survey of New Hampshire, he maintained, during the winter of 1870, a meteorological station on Mount Washington, the earliest high-mountain observatory in the United States. He became known as a compiler of geological maps, and for his investigations regarding the geology of the crystalline schists, ichnology, and glacial geology. The location of the terminal glacier in the United States was first suggested by him. He was a founder of the Geological Society of America, and in 1883 president of the American Association for the Advancement of Science. His publications include: 'Elementary Geology' (1861, with E. Hitchcock); 'Mt. Washington in Winter' (1871); and a 'Report on the Geology of New Hampshire' (1873–8), with folio atlas, his most valuable work.

Hitchcock, Edward, American Congregational clergyman and geologist: b. Deerfield, Mass., 24 May 1793; d. Amherst, Mass., 27 Feb. 1864. He was principal of the academy in his native place 1815–18; pastor of the Congregational Church in Conway, Mass., 1821–5; professor of chemistry and natural history in Amherst College 1825–45, and president of Amherst College and professor of natural theology and geology 1845–54. He was appointed State geologist of Massachusetts in 1830, of the First District of New York in 1836, and of Vermont in 1857. In 1850 he was commissioned by the government of his native State to examine the agricultural schools in Europe. His life was in a great measure identified with the history of Amherst College. Connected with it almost from the beginning, in his own presidency he procured for it buildings, apparatus, and funds to the amount of $100,000, doubled the number of students, and established it on a solid pecuniary as well as literary and scientific basis. His earliest scientific publications were the 'Geology of the Connecticut Valley' (1823), and a 'Catalogue of the Plants within Twenty Miles of Amherst' (1829). Later works were: 'Lectures on Diet, Regimen, and Employment' (1831); 'Lectures on the Peculiar Phenomena of the Four Seasons' (1850); 'Reports on the Geology of Massachusetts' (1833–35–38–41); 'Illustrations of Surface Geology' (1857); 'Elementary Geology,' which passed through 25 editions in America, and one third of that number in England; 'Religion of Geology and its Connected Sciences' (1851); and 'Reminiscences of Amherst College' (1863). Dr. Hitchcock suggested as well as executed the geological survey of Massachusetts, the first not only in the long series of scientific surveys in the United States, but the first survey of an entire State under the authority of government in the world. He was the first to give a scientific exposition of the fossil footprints of the Connecticut Valley, and with him ichnology as a science began.

Hitchcock, Ethan Allen, American soldier: b. Vergennes, Vt., 18 May 1798; d. Sparta, Ga., 5 Aug. 1870. He was a grandson of Ethan

Allen (q.v.), and was graduated at West Point in 1817, entering the corps of artillery as a third lieutenant. In 1829 he became the military commandant of the corps of cadets, in which office he continued until 1833. He served in Florida against the Indians, and in the war with Mexico, where he received two brevets, one as colonel and another as brigadier-general. In 1855 he printed for private circulation a pamphlet in support of his opinion that genuine alchemy was not an art for making gold, but that the alchemists were students of man, whose perfection was symbolized by their "philosopher's stone." He subsequently published: 'Remarks upon Alchemy and the Alchemists' (1857); 'Swedenborg a Hermetic Philosopher' (1858); 'Notes on the Vita Nuova of Dante' (1866).

Hitchcock, Ethan Allen, American politician: b. Mobile, Ala., 19 Sept. 1835. He received a secondary education, was in mercantile business at St. Louis, Mo., in 1855–60, then went to China to enter a commission house, of which firm he became a partner in 1866. In 1872 he retired from business, in 1874 returned to the United States, and in 1874–97 was president of several manufacturing, mining, and railway companies. He was appointed envoy extraordinary and minister plenipotentiary to Russia in 1897, and in February 1898 ambassador extraordinary and minister plenipotentiary, the first ambassador accredited from the United States to the court of Russia. In 1898 he was nominated and confirmed as secretary of the interior, and held that position till 4 March 1907.

Hitchcock, James Ripley Wellman, American art critic: b. Fitchburg, Mass., 3 July 1857. He was graduated at Harvard in 1877, and was art critic of the New York *Tribune* 1882–90. He has written: 'The Western Art Movement' (1885); 'A Study of George Inness' (1885); 'Madonnas by Old Masters' (1888), the text to photogravures; 'The Future of Etching'; 'Some American Painters in Water Colors'; 'Etching in America'; 'Notable Etchings by American Artists'; etc.

Hitchcock, Roswell Dwight, American Congregational clergyman: b. East Machias, Maine, 15 Aug. 1817; d. Somerset, Mass., 16 June 1887. Graduated from Amherst College in 1836 and from the Andover Theological Seminary in 1838, he also studied at Halle and Berlin (1847), in 1845–52 was pastor of the First Congregational Church at Exeter, N. H., and in 1852–5 professor of revealed religion in Bowdoin College. In 1855 he became professor of church history at the Union Theological Seminary, of which institution he was elected president in 1880. He became president of the Palestine Exploration Society in 1871, and vice-president of the American Geological Society in 1880. An editor of the 'American Theological Review'; he wrote: 'The Life, Character, and Writings of Edward Robinson' (1863); 'Complete Analysis of the Holy Bible' (1869); and 'Socialism' (1879). With Eddy and Madge, he compiled 'Carmina Sanctorum' (1885); and 'Eternal Atonement,' a volume of sermons, appeared in 1888.

Hittell, Theodore Henry, American historian: b. Marietta, Pa., 5 April 1830. In 1852 he was admitted to the bar at Cincinnati, in 1855 removed to California, in 1855–61 was connected with the *Bulletin and Times* of San Francisco and from 1862 practised law. He was State senator in 1880–2. He wrote a 'History of California,' his chief work; and compiled 'The General Laws of California,' known as 'Hittell's Digest,' and 'Hittell's Codes and Statutes of California.'

Hittites, hit'its, the name of several peoples mentioned in the Old Testament, and in Egyptian and Assyrian inscriptions. In the Old Testament the name is applied to three more or less distinct groups, namely, the "children of Heth" from whom Abraham purchased a burying-place; a people or group of peoples which inhabited Palestine before the Hebrews and resisted their invasion; a kingdom in northeastern Syria, with which Solomon formed marriage alliances. The first group dwelt around Hebron in southern Palestine, and the Hittites mentioned in connection with David, of whom the chief was Uriah, may be their descendants. The second group of Hittites dwelt among the mountains of central Palestine, and the third group, united in some sort of empire, had their seat still farther north. Of this Hittite empire we learn more from the Egyptian and Assyrian records than from the Old Testament. The Heta, according to the hieroglyphic inscriptions, offered a vigorous resistance in northern Syria to the Egyptian king Thutmosis III. (18th dyn.: c. 1560 B.C.), and to his successors of the 19th dynasty, Sethos I., Rameses II. and III., c. 1350–1200 B.C. Carchemish, Kadesh, and Hamath were among their chief cities. The cuneiform inscriptions contain notices of a people called Hatti who frequently fought with the Assyrians from the time of Tiglath-pilesar I. (c. 1100 B.C.) till that of Sargon II. (721–704 B.C.), after which they are no more heard of. The Hittite monuments and inscriptions which have been found in Carchemish, Hamath and neighboring places, as well as throughout Asia Minor, appear to belong to the Assyrian period.

Hittorf, Jacques Ignace, French architect: b. Cologne 1792; d. 1867. He studied his profession in Paris and was employed on many public buildings and places, doing work on the Bois de Boulogne, the Champs-Elysées and the Church of Saint Vincent de Paul. Among his publications may be mentioned 'Architecture Antique de la Sicile'; 'Architecture Moderne de la Sicile' and 'Architecture polychrome chez les Grecs.'

Hitzig, Ferdinand, German theologian: b. Hauingen, Baden, 23 June 1807; d. Heidelberg, 22 Jan. 1875. He was educated at Heidelberg, Halle and Göttingen. He went to Zurich in 1833 as professor of theology, where he remained until 1861, when he returned to Heidelberg. He was quite a voluminous writer on the Old Testament, composing commentaries on the Minor Prophets (1838); Jeremiah (1841); Ezekiel (1847); Ecclesiastes (1847); Daniel (1850); Song of Solomon (1855). He made a translation of the Psalms in 1835.

Hive-bee. See HONEY-BEE; BEE-CULTURE.

Hives. See URTICARIA.

Hoactzin, hō-ākt'zīn or -āk'zīn, a singular South American bird (*Opisthocomus cristatus*) of the size of a pheasant. It is brown streaked with white, and the head has a movable crest. It is interesting principally from the extraordinary way in which the fledglings, as soon as they leave the nest (in a tree), scramble about the branches by aid of their wings used like hands, by reason of the fact that they have a temporary claw on both the index and pollex. The food of these birds is mainly leaves and fruit; and a strong musky odor is given off by the adults, so that in British Guiana they are called "stinking pheasants."

Hoadley, hōd'lĭ, **George**, American lawyer: b. New Haven, Conn., 31 July 1826; d. Watkins, N. Y., 27 Aug. 1902. He was graduated at Hudson College, Ohio, in 1844; studied law at Harvard, was admitted to the bar in 1847 and joined a law firm in Cincinnati of which Salmon P. Chase (q.v.) was the leading member. He was appointed judge of the superior court of Cincinnati in 1859, and re-elected in 1864. He took a leading part among the "Barnburners" (q.v.), was a War Democrat, and during the War joined the Republican party. He defeated Foraker in a contest for the governorship of Ohio in 1883, but failed of re-election in a struggle against the same candidate.

Hoadly, Benjamin, English Anglican prelate: b. Westerham, Kent, 14 Nov. 1676; d. Chelsea 17 April 1761. He was educated at Cambridge; took orders in 1700, and after being settled in London distinguished himself in controversy with Bishop Atterbury and others. A staunch Low-Churchman, he was appointed bishop of Bangor in 1715. A sermon preached before the king of 1717 gave rise to the "Bangorian Controversy" regarding the divine authority of the king and the church. He was translated to the see of Hereford in 1721, to Salisbury in 1723, and Winchester in 1734.

Hoang-ho. See HWANG OR HOANG-HO.

Hoar, Ebenezer Rockwood, American jurist: b. Concord, Mass., 21 Feb. 1816; d. there 31 Jan. 1895. He was the son of Samuel Hoar (q.v.), was graduated at Harvard (1835), and subsequently admitted to the bar. He rose to be judge of the court of common pleas (1849), judge of the State supreme court (1859), and attorney-general of the United States (1869), and was a member of the Joint High Commission that framed the Treaty of Washington (1873–5).

Hoar, George Frisbie, American statesman: b. Concord, Mass., 29 Aug. 1826; d. Worcester, Mass., 30 Sept. 1904. Senator Hoar's paternal and maternal inheritance was very remarkable. His grandfather was an officer in the Revolutionary army and his father, Samuel Hoar, was one of the ablest lawyers and statesmen of his time, a member of Congress from Massachusetts, and a man of great learning and force of character. Senator Hoar's mother was a daughter of Roger Sherman, a signer of the Declaration of Independence. He was graduated from Harvard in 1846, studied law there, and began his law practice in Worcester, Mass. The young man was early attracted to politics and identified himself with the Free Soil party, and his purpose in 1895 — so characteristic of his whole career — is thus stated by himself: "All of us Free Soilers were drawn into politics by a great issue. It

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GEORGE F. HOAR.

was to prevent slavery being extended into the new territory between the Mississippi and the Pacific. We were all ardent advocates of freedom. The party and the movement were new, and we were stirred by high ideals. Among the young men who went into the new movement at that time were my brother, Ebenezer Hoar, Erastus Hopkins, Anson Burlingame, Whittier, Lowell, Longfellow, and many others that became well known. There were no offices to gain. There was simply a cause to work for. In the campaign of 1850 the Free Soilers did not carry a single State, only a few Congressional districts." He was a member of the Republican party from the first, and in 1852 was elected to the Massachusetts house of representatives; in 1857 to the State senate. In the intervals of service he practised law. In 1860 he was city solicitor. He presided over the Republican conventions in Massachusetts in 1871, 1877, 1882 and 1885; was a delegate to his party's national conventions in 1876, 1880 (the chairman in that year), 1884, 1888, 1892 and 1896. He served in the national House of Representatives for four successive Congresses, 1869-77, elected as a representative of the Worcester district; in 1877 he was elected to the Senate, and was reelected in 1883, 1889, 1895, and 1901, serving his country continuously as a national legislator since 1869, having represented Massachusetts for a longer period in the national Congress than any other representative from that State. In 1876, he was one of the managers on behalf of the House in the Belknap impeachment trial, and was also a member of the Electoral Commission (q.v.), which decided the Hayes-Tilden contest for the Presidency, the other Republican members of that famous body being Senators George T. Edmunds, O. P. Morton and Frederick T. Frelinghuysen, and Representative James A. Garfield. In the Senate he was chairman of the judiciary committee, and of the committee on privileges and elections, and a member of other important committees. He was known as the old man eloquent of the Senate, having served in that body for 37 years and taken part in all the great questions that have been before the country during that time. He was a determined opponent of the retention of the Philippines, and independent enough to state his views fearlessly in the support of his own theory that the United States should leave the islands to the control of the Filipinos and prevent interference from foreign nations, but his honesty and sincerity were unquestioned and he always retained the confidence of his party and the respect of all. He was a thorough American and believed in the future of his country and placed its welfare above all personal considerations. "The lesson which I have learned in life, which has been impressed upon me daily and more deeply as I grow old," he said in his autobiography, "is the lesson of Good Will and Good Hope. I believe that to-day is better than yesterday, and that to-morrow will be better than to-day. I believe that, in spite of many errors and wrongs, and even crimes, my countrymen of all classes desire what is good, and not what is evil."

Senator Hoar was an idealist, and was not to be turned aside, even by his loyal love of party, from following his sincere convictions. He demanded justice for the negroes and the Indians, openly declared his sympathy for Cuban and Filipino, and as firmly opposed religious intolerance in Massachusetts because his actions were controlled by reasons which he considered were founded in righteousness and truth, and therefore not subject to change.

Senator Hoar was a man of considerable scholarship and took great delight in literary and historical studies. He was a member of several historical and scientific societies, and took much interest in their work. He was president of the American Historical Society, president of the American Antiquarian Society, regent of the Smithsonian Institution in 1880, and trustee of the Peabody Museum of Archæology. He received the degree of LL.D. from the College of William and Mary, Amherst, Yale and Harvard. In 1903 he published 'Autobiography of Seventy Years,' which first appeared in 'Scribner's Magazine' as a serial. The same year, in a speech in his home city of Worcester, Senator Hoar, as if in anticipation of his approaching dissolution, thus summed up the creed of his career:

"If my life has been worth anything, it has been because I have insisted, to the best of my ability, that these three things — love of God, love of country, and manhood — are the essential and fundamental things, and that race, color, and creed are unessential and accidental."

Although 78 years of age, he was in good health until the death of his beloved wife in 1903; their devotion had led many to predict that neither would long survive the other. Senator Hoar was taken seriously ill in June 1904, but lingered until 30 September, when he died at Worcester, Mass.

His death was the occasion of a remarkable display of panegyric in the press of both Republican and Democratic parties. It possessed the peculiar quality of reconciliation, one party regretting what the other considered his noblest quality. The only flaws in his judgment, said the Republican press, were his disagreements with the party leaders on the Philippine and Panama issues; but to the Democratic press his noble loyalty to the right on these occasions was convincing proof of his lofty statesmanship. The Democratic press regretted his inability to see any good in their party, while to Republican journals this virtue redeemed his errors of judgment on the matters of party policy.

One journal said: "As long as the confidence and affection of all the people are given to such a man, it is foolish and false to assume that the old standards are departing and the old ideals becoming broken. The people still know a man when they see him. Still they respect and honor the statesman who loves the republic better than he does himself, who never falters in his service, to whose fingers gold does not cling, and whose never-forgotten ideal is the people's welfare. While they honor such qualities above all others, pure and able statesmen will continue to come to their service," sentiments which were summarized in Ex-President Cleveland's statement that "Senator Hoar's ability, his high-mindedness, and his freedom from political trickery, furnish an example of a useful life which may well be imitated by all those entrusted by their countrymen with public duties."

George Edwin Rines,
Editorial Staff 'Encyclopedia Americana.'

Hoar, Samuel, American lawyer and legislator: b. Lincoln, Mass., 1778; d. 1856. He was graduated at Harvard in 1802 and three years later entered upon a highly successful career as a lawyer. He served two terms as a State senator and was chosen by the Massachusetts legislature to challenge the constitutionality of certain laws in South Carolina relating to the imprisonment of free negroes. He was subsequently excluded from South Carolina courts by the State legislature.

Hoarhound. See HOREHOUND.

Hobart, Garret Augustus, American lawyer and politician: b. Long Branch, N. J., 1844; d. Paterson, N. J., 2 Nov. 1899. He was graduated at Rutgers College, New Jersey, in 1863, and admitted to the bar in 1866. At Paterson, where he made his home till his death, he enjoyed a successful law practice. He became successively city attorney, prosecuting attorney for Passaic County, a member of the State Assembly 1873–8, and of the State Senate 1879–85. During his several terms he was speaker of the Assembly and president of the Senate. In 1896 he was nominated at St. Louis for vice-president on the ticket with William McKinley, whose intimate friend he was, and was elected to that office.

Hobart, George Vere, American journalist, playwright, and author: b. Cape Breton, N. S., 16 Jan. 1867. He was educated in Nova Scotia, later coming to the United States as a telegraph operator for the United Press. He became editor of the Cumberland Sunday 'Scimitar,' later writing for the 'Herald,' *Evening News* and 'American' of Baltimore. Since then he has been writing for the Hearst newspapers the humorous sketches, 'John Henry' and 'Dinkelspiel.' He has written 'Many Moods and Many Meters' (1899), and 'Li'l Verses for Li'l Fellers' (1903), both poems; the 'Dinkelspiel' series (1900); the 'John Henry' books (1901–4), and the plays, 'After Office Hours,' 'Miss Print,' 'Hodge, Podge & Co.,' 'Sally in Our Alley,' etc.

Hobart, John Henry, American Protestant Episcopal bishop: b. Philadelphia 14 Sept. 1775; d. Auburn, N. Y., 10 Sept. 1830. He was educated at the College of Philadelphia (now the University of Pennsylvania), and the College of New Jersey (now Princeton), and after trying commercial life in his brother-in-law's counting house, went back to Princeton as a tutor for two years, and was ordained deacon in 1798 and priest in 1801. After brief periods of pastoral service in Pennsylvania, New Jersey, and Long Island, he became assistant in Trinity Parish, New York, where he remained until his elevation to the episcopate, combining with his other duties a prominent share in the legislative councils of the church, as deputy to the General Conventions of 1801 and 1804, and secretary to the House of Deputies in the latter year. In 1811 he was consecrated as bishop-coadjutor in the diocese of New York, and upon the death of Bishop Moore in 1816, succeeded him both in the full charge of the diocese and in the rectorship of Trinity Church. He also gave provisional episcopal care at different times to New Jersey and Connecticut. He was very active in promoting the establishment of the General Theological Seminary, and upon its location in New York became professor of pastoral theology. Hobart College also owed much to him, a debt recognized by the taking of his name, when, in 1852, the original title of Geneva College was changed to Hobart Free College. He wrote or edited a number of theological works, some of which, especially his 'Companion for the Festivals and Fasts' (1805), reached several editions. His 'Apology for Apostolic Order' (1802) is still used as a text-book.

Hobart, the capital of Tasmania, and up to 1881 called HOBART TOWN, is situated at the foot of Mount Wellington (4,166 feet high), on the Derwent River, 12 miles from its outlet in Storm Bay on the south coast. It has handsome public buildings, including government house, the government offices, parliament houses, Episcopal and Catholic cathedrals. There are important domestic manufactures, and in connection with its considerable shipping interests, a fine harbor with modern accommodations. Hobart is connected by rail with Launceston. Pop. (1903) 31,400.

Hobart College, a Protestant Episcopal institution, located at Geneva, N. Y. In 1825 it was chartered as Geneva College; but in 1852 the name was changed to Hobart Free College, and in 1860 to Hobart College. Bishop Hobart (q.v.) had aided the school by advice and by money. An endowment from Trinity Church, New York, had greatly assisted the institution. The college offers scholarships and prizes to worthy students, and the departments are all well sustained. The courses lead to the degrees of A.B., B.S., and Ph.B. There are about 44,000 volumes in the library. In 1904–5 the school had 17 professors and instructors and 105 students. The graduates number nearly 1,500.

LANGDON C. STEWARDSON,
Registrar.

Hobart Pasha, AUGUSTUS CHARLES HOBART-HAMPDEN, third son of the Earl of Buckinghamshire, English sailor: b. Waltham-on-the-Wolds, Leicestershire, 1 April 1822; d. Milan, Italy, 19 June 1886. He entered the English navy as midshipman 1836 and retired as captain at the conclusion of the Crimean War in 1863. During the American Civil War he took the name of 'CAPTAIN ROBERTS' and was given command of a blockade runner, an account of which is to be found in his 'Sketches of My Life' published posthumously. In 1867 he entered the Sultan's service, reorganized the Turkish navy, and fought the Russians on the Black Sea in the War of 1877–8. He was made Pasha (1869) and marshal of the Turkish Empire (1881).

Hobbema, Meindert, mīn'dĕrt hŏb'ē-mā, Dutch landscape painter: b. Amsterdam, 1638; d. there 7 Dec. 1700. He was considered, next to J. Ruysdaal, the best of the Dutch landscape-painters, and as a colorist reckoned even superior to Ruysdaal. The figures in his landscapes are painted mostly by Berchem, Van de Velde, Lingelbach, and J. Van Loo. His paintings consist chiefly of forest scenes, ruins, villages, etc. Some of the most celebrated works of this master are to be found in public or private galleries in France, Germany, and Holland. His greatest painting is 'A View in Holland,' with figures painted by Adrien van de Velde.

Hobbes, John Oliver. See CRAIGIE, PEARL MARY TERESA.

Hobbes, Thomas, English moralist, philosopher, and political scientist: b. within the borough of Malmsbury, Wiltshire, 5 April 1588; d. Hardwicke, Derbyshire, 4 Dec. 1679. Thomas Hobbes is eminent as writer on the theory of government, on psychology, and on metaphysics, and as master of a vigorous and picturesque English style. He was born in the year of the Spanish Armada, 1588, and lived to be 91 years old, active to the end in mind and in body. He was the son of a poor English vicar, was educated by his uncle, a prosperous glover, and spent the last five of his student years at Magdalen College, Oxford. The Oxford of that period was given over to a restricted and arid scholasticism, barring out mathematics, for example, as a black art; and Hobbes retained through life a vivid memory of the pedantry and narrowness of the Oxford of his youth. At the end of these student years, in 1608, he was employed by Cavendish, afterwards Earl of Devonshire, as tutor to his son; and he remained for the next 20 years in the service of this same great family and throughout his life, in close and friendly connection with it. For two years he traveled with his pupil on the continent, and then followed 18 years in England—a service terminated only by the death of his former pupil and constant friend, the second Earl. During these years, Hobbes devoted himself to classical study, which bore fruit in his vigorous translation of Thucydides, published in 1628. The three succeeding years were spent on the Continent, at first in travel with another English youth, later in the eager study, mainly at Paris, of mathematics and natural science. Hobbes himself tells us with what astonishment and delight he first, in 1628, when he was 40 years old, saw and read Euclid's 'Elements.' In 1631 he became tutor to the third Earl of Devonshire, son of his late patron and first pupil. With him he made, in 1634, a third continental journey, learned to know Galileo during his sojourn in Italy, and was admitted, in Paris, to the fellowship of a group of mathematicians and scientists. He must have been pondering on problems of politics and of psychology in the intervals of his study of physics and geometry, for his next book, which circulated in manuscript as early as 1640, set forth his theory of human nature and of the body politic. The publication even privately of this doctrine brought its author into prominence and strongly influenced the course of his life.

The psychology of Hobbes forms the basis both of his political and of his metaphysical doctrine. He distinguishes the 'cognitive (or conceptive)' faculty from the 'motive' faculty of the mind, and recognizes five senses, to which he adds 'a sixth sense, but internal, * * * commonly called remembrance.' He defines the affective consciousness as 'motion about the heart,' which "when it helpeth is called pleasure * * * but when it hindereth the vital motion is called pain." And he ends with a discussion of the passions which reduces will to desire and conceives each emotion from a narrowly individualistic standpoint. "To endeavour" he says, "is appetite"; and, in the race of life, "continually to out go the next before is felicity."

The foundation of the political system of Hobbes is the teaching that men "are by nature equal," and self-seeking; that "many men at the same time have an appetite to the same thing; which yet very often they can neither enjoy in common, nor yet divide"; that consequently "every man is enemy to every other" and that "during the time men live without a common power to keep them all in awe, they seek such a Common Power, as may be able to defend them from invasion of foreigners and are in that condition which is called War." "The only way," Hobbes continues, "to erect such a Common Power, as may be able to defend them from invasion of Foreigners and the injuries of one another * * * is to confer all their power and strength upon one man or upon one Assembly of men, that may reduce all their Wills, by plurality of voices, unto one Will." Hobbes accordingly conceives of a government as formed by a mutual contract of individuals, of whom each seeks simply his own preservation, happiness, and security. The contract, he insists, is between each individual "subject" and every other—not at all, between subject and sovereign. It is made, he says, "by covenant of every man with every man * * * as if every man should say, *I authorize* and give up my Right of Governing myself to this Man, or to this Assembly of men, on this condition, that thou give up thy Right to him." Upon this theory, that the covenant of every citizen with every other underlies government, Hobbes bases his well-known doctrine of the absolute right of the sovereign. For, he argues, all the governed "are bound, every man to every man to Own and be reputed Author of all, that he that already is their Sovereign, shall do, and judge fit to be done." In other words "every Subject is Author of every Act the Sovereign doth."

Hobbes asserts unambiguously the subordination of church to state. "The Kingdom of Christ," he declares, "is not of this world; therefore neither can his ministers (unless they be Kings) require obedience in His name." It follows, he teaches, "that every Christian Sovereign [is] the supreme Pastor of his own Subjects"; and that every subject is bound to obey the command of his sovereign with regard not only to the forms of religious worship but to the nature of the doctrines openly professed. Such conformity to the will of even an "infidel sovereign" does not conflict, Hobbes insists, with our duty to God. For God requires of us only faith and obedience to his laws. "And when the Civil Sovereign is an Infidel, every one of his own Subjects that resisteth him sinneth against the Laws of God (for such are the Laws of Nature) and rejecteth the counsel of the Apostles that admonisheth all Christians to obey their Princes. * * * And for their *Faith* it is internal and invisible; they have the license that *Naaman* had, and need not put themselves into danger for it. But if they do, they ought to expect their reward in Heaven, and not complain of their

Lawful Sovereign, much less make war upon him."

It is not possible, within the limits of this article, to outline the ingenious argument by which Hobbes seeks to foist upon a present generation, the responsibilities of a social contract which a past generation made. Still less is it possible to present an adequate criticism of the conception of Hobbes. Psychologists and sociologists have long since agreed that his psychology and his political theory are alike defective: that societies and governments grew, and are not manufactured: and that sympathy no less than selfishness is a basal instinct. Yet Hobbes's theory of society is still worth studying, not only because it is expressed in such vigorous English, nor even mainly because of the influence it exerted on Rousseau and Spinoza (qq.v.), but primarily because it so ruthlessly depicts society as it would be if men were no more than self-seeking and egoistic.

It is evident that the brilliant attempt of Hobbes to justify the absolute supremacy of the monarch could find little favor in England in the years of the Parliamentary struggle with Charles I. Hobbes, who was morbidly timid, believed that he stood in personal danger and betook himself, a voluntary exile, to Paris where he spent 11 years in the society, on the one hand, of French men of science and letters, and on the other hand, of the English royalists. In 1646 Hobbes became the tutor of the young prince, later Charles II. He published in the meantime an epitome in Latin, 'De Cive,' of his doctrine of government, and afterward the earlier work already referred to. In 1651 he brought out the work by which he is best known, 'Leviathan, Or, The Matter, Form and Power, of a Commonwealth.' This book is the most popular, forcible, and detailed discussion of the political theory of Hobbes. It is prefixed by several chapters which are properly psychological, and which embody an egoistic and sensationalistic psychology full of acute introspection and of keen discrimination. The later chapters of 'Leviathan' include suggestions of materialistic doctrine. In spite of its monarchical tendency, 'Leviathan' was violently opposed by the influential clerical party among the English royalists in Paris. Hobbes concluded that he would be safer even in Puritan England, returned accordingly, and lived unmolested under the Cromwells. At the Restoration, in 1660, he regained the royal favor and he never afterward lost the protection of his old pupil, Charles II.

The metaphysical doctrine of Hobbes is expounded in two books published a few years after his return to England: 'De Corpore,' which appeared in 1655, and a translation, 'Concerning Body,' published a year later. This teaching is succinctly stated in these words: "The world (I mean * * * the whole mass of things that are), is corporeal, that is body; * * * and that which is not body is no part of the universe." The doctrine of Hobbes is, in other words, frankly materialistic; he teaches that the innumerable realities which go to make up the universe are, one and all, non-spiritual, or material. So-called spirits are, he holds, merely subtle and intangible bodies; and even God, the First Cause of the universe, is body. The philosophy of Hobbes becomes in its detail a system of mechanics or of physics; for, since all reality is physical, laws of space or of motion must be ultimate laws.

The metaphysical doctrine of Hobbes deserves more attention than it often receives, because it is so thoroughgoing and internally consistent a system of materialism. The arguments, implicit rather than explicit, on which Hobbes bases it are none the less, in the view of the writer of this notice, unsound. In brief, Hobbes argues for materialism partly because of the untrustworthiness of consciousness, and partly on the ground that physical motions are admitted to be cause of consciousness. 'It is evident,' he says, while describing the phenomenon of vision, in the second chapter of 'Human Nature,' "that from all lucid * bodies, there is a motion produced to the eye, and through the eye to the optic nerve, and so into the brain * * * and thus all vision hath its original from * motion." From similar observations he concludes that ideas (or in his own words, apparitions or phantasms) "are nothing really but motion * ." The reasoning that consciousness because *conditioned by* motion is, therefore, *identical with* motion is evidently illicit; and it is observable that Hobbes, when he tries to define body, motion, and space, really conceives them in terms of ideal reality.

Just before the appearance of the metaphysical works, in 1654, an essay 'Of Liberty and Necessity,' written by Hobbes eight years before in the course of a private discussion with Bishop Bramhall, was published without the knowledge and consent of the author. It was followed in 1656 by a longer and more polemical work, 'The Questions Concerning Liberty, Necessity, and Chance, clearly Stated and Debated between Dr. Bramhall * * and Thomas Hobbes.' The unambiguous teaching of these works is a determinism grounded in psychology, the doctrine "that voluntary actions have all of them necessary causes and are therefore necessitated."

Most of the works which Hobbes published from this time onward are, indeed, controversial in character. Most bitter of them are the books and essays on mathematical subjects, maintaining against Wallis and Ward, Savilian professors in Oxford, the possibility of squaring the circle. The titles of two of these works are an indication of the spirit in which Hobbes wrote them: 'Six Lessons to the Professors of the Mathematics * * * in the chairs set up by * * * Sir Henry Savile in the University of Oxford'; and 'Στιγμαι or Marks of the Absurd Geometry, Rural Language, Scottish Church Politics and Barbarisms of John Wallis.' Hobbes, who was, after all, no trained mathematician, was always worsted in these mathematical contests, but never acknowledged himself defeated.

More serious than the justified criticisms of Ward and Wallis on the mathematics of Hobbes were the attacks upon the orthodoxy and the morality of his teaching. These attacks, and especially the abortive attempt to suppress 'Leviathan' by act of Parliament, caused Hobbes great uneasiness. In the Appendix which he added to his translation of 'Leviathan' into Latin (published 1668) he argued that the teaching of 'Leviathan' is not heretical, and that there remains no English court of heresy; and he wrote at the same time a very vigorous 'Answer to a Book Published by Dr. Bramhall * * * called Catching of the Leviathan,' a book in which the Bishop of Derry had maintained "that the Hobbian principles are destructive to Christianity and to all religion." Nobody doubts today that these charges are unfounded. Hobbes, it is true, inculcated a materialistic philosophy and an egoistic and necessitarian ethics; but upon these doctrines he himself based both the philosophical conclusion that God exists, and an ethical system which exhorts to justice and social virtues, even while it derives these virtues from purely selfish instincts. It is necessary to suppose that many of the men who decried Hobbes had never read him; and that the epithets 'free-liver,' and 'atheist,' which writers of his own and the following century heaped upon him were due, in part at least, to the fact that Hobbes remained throughout his life in some sense under the protection of his former pupil, Charles II. Very unjustly, therefore, he was held responsible for the lax morals of the court. It should be added that from this time onward Hobbes failed to gain from the censor license to publish any work on a political or on an ethical subject. The chief of the works, written at this period but published after the death of Hobbes, is 'Behemoth: The History of the Causes of the Civil Wars of England * * * from the Year 1640 to the year 1660.'

Hobbes spent the last four years of his life with the family he had so long served, that of the Earl of Devonshire. In these later years he returned to the classical studies of his youth, publishing when he was 87 years old, 'The Iliads and Odysses of Homer, translated out of Greek into English, with a large preface concerning the Virtues of an Heroic Poem.' In his very last year he wrote a sketch, in Latin metre, of his own life. He had feared many things, and death most of all, but he died quietly after a short illness, in 1679.

Bibliography.— The authoritative edition of Hobbes is that of Sir William Molesworth: 'English Works' (in eleven volumes); 'Opera Latina' (in five volumes)— London, 1839–1845. A recent reprint of the 'Leviathan' is that of Thornton (Oxford, 1881). Selections, mainly from the ethical and political writings, are those of E. H. Sneath (1898), and F. J. E. Woodbridge (1903). 'The Metaphysical System of Hobbes' edited by M. W. Calkins (Chicago 1905) contains the important chapters of 'Concerning Body.' For biography and criticism the reader is referred to G. C. Robertson, 'Hobbes' (1886); Leslie Stephen, 'Hobbes' (1884); and Tönnies, 'Hobbes, Leben und Lehre' (1896). For complete list of the writings of Hobbes and for further references to his critics, one should consult the works just cited, and the Bibliography of Benjamin Rand, published as Vol. III., Pt. I. of Baldwin's 'Dictionary of Philosophy and Psychology.'

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Hob'ble-Bush, a viburnum (*V. alnifolium*) of the southern interior of the United States, whose branches often stretch along the ground and root at the other end, tripping up the unwary; hence it has such other names as warfaring-tree, tanglefoot, and devil's-shoestrings. The branches are long, flexuous, and reddish in color, and the leaves are nearly orbicular and turn to a deep red in the autumn. See Viburnum.

Hobkirk's (hŏb'kerks) **Hill, Battle of**, in the Revolution, 25 April 1781. After Guilford Court-house (q.v.), Greene marched toward the British position at Camden under Rawdon, and encamped at Hobkirk's Hill, about 1½ miles north. He had 940 men in line, prudently encamping in order of battle; and some militia just arrived who took no part in the battle. His trains and artillery had not come up, and a renegade drummer boy informing Rawdon of this, the latter took 960 men, and making a detour to the right through the woods in front of Greene, drove in Greene's pickets with so sudden an onslaught that the Americans had barely time to form. Greene ordered the First Maryland to charge bayonets and William Washington to take the British in the rear with his cavalry, while Ford and Campbell executed flanking movements on Rawdon's wings. But Ford was killed, one of the First Maryland's captains was shot, the men fell into disorder, and Col. Gunby ordered the regiment to form on the rear companies instead of moving the latter forward; the retiring men were seized with a panic, the famous veterans broke, and though soon re-formed, the position was dangerous and Greene had to retreat. Gunby was court-martialed, but acquitted of anything but grave misjudgment. Greene's loss was 135, besides missing militia; Rawdon's 220 (his own figure) or 258 (Tarleton's). Consult Dawson, 'Battles of the United States' (New York 1858); Carrington, 'Battles of the American Revolution' (New York 1877).

Hoboken, hō'bō-kĕn, N. J., city in Hudson County; on the Hudson River. It is the terminus of the Delaware, L. & W. R.R. It is opposite New York city, north of and adjoining Jersey City, and has on the north and west the Palisades. Its area is about one square mile. It has electric railway connections with a number of the cities and towns of the State, and by direct ferries with the business district of New York. The principal streets run north and south, nearly parallel with the river. Its long waterfront gives it excellent shipping facilities; and here are located the docks of the ocean steamship lines; the North German Lloyd, the Thingvalla, the Netherlands-American, and the Hamburg-American. The land upon which Hoboken is located as well as much of that adjoining, once formed a part of the territory of New Netherlands. It was early known as Hobocan Hacking, which means "the land of the tobacco-pipe." The tobacco-pipes which were made by the Indians from the stone found in the vicinity gave rise to the name. In 1630 Michael Pauw, of Holland, purchased from the New Netherlands Company a tract of land a part of which is the site of the present city of Hoboken. The land around was soon cultivated and as New Amsterdam grew in numbers and importance, the gardens across the river became more valuable. John Stevens (q.v.), in 1804, purchased the land upon which the city now stands, and began the town. At this time and for some years after the Elysian Fields of Hoboken were much used as pleasure grounds by New Yorkers. At first Hoboken was a part of the town of North Bergen, but on 28 March 1855 it was incorporated as a city. The disastrous fire at the wharves of the North German Lloyd Steamship Company, which occurred in 1900, destroyed considerable of the city property and three steamers. The estimated number of lives lost was 200. The chief manufactures of Hoboken are iron products, leather, silk, lead-pencils, caskets, wall-paper, beer, shipbuilding and repairing, and chemicals. It has extensive coal yards, and large lumber and brick yards. The drainage of the lowlands is now (1903) under consideration, and by this means a large tract of land will be reclaimed and the sanitary conditions of the city improved. The city is the seat of the Stevens Institute of Technology (q.v.), and of the Sacred Heart Academy. It has Saint Mary's hospital, public and parish schools, and several fine church buildings. The government is vested in a mayor, who holds office two years, and a city council. The mayor appoints the school, library, fire, and health commissioners, also the assessors. The police commissioners are appointed by the mayor and approved by the council. The council elects the inspectors, the city clerk and his assistants. Pop. (1890) 43,648; (1900) 59,364; (1905) about 65,000.

Hob'son, John Atkinson, English social economist: b. Derby, England, 6 July 1858. He was graduated at Oxford University, and from 1887 to 1897 taught English literature and economics for the University Extension Delegacy, and the London Society for the Extension of University teaching. He is one of the foremost of economic writers in England and, as a socialist, advocates the monopolistic control of industries by government, whether municipal, or national. Among his works are 'The Physiology of Industry: Being an Exposure of Certain Fallacies in Existing Theories of Economics' (with A. F. Mummery, 1889); 'The Evolution of Modern Capitalism' (1894); 'The Social Problem: Life and Work' (1901); and 'Imperialism' (1902).

Hobson, Richmond Pearson, American naval constructor: b. Greensboro, Ala., 17 Aug. 1870. He was graduated at Annapolis Naval Academy in 1889 and took a post-graduate course at the Ecole Nationale Supérieure des Mines, and the Ecole d'Application du Génie Maritime in Paris. During the war with Spain he was present at the bombardment of Matanzas and distinguished himself by his heroism in sinking a collier across the entrance to Santiago Harbor, on the night of 3 July 1898, for the purpose of preventing the exit of Cervera's fleet. He resigned from the navy in 1903.

Hobson's Choice, a proverbial expression, denoting "without an alternative." It is said to have had its origin in the practice of Hobson, a carrier at Cambridge, England, in Milton's time, who let horses to the students, and obliged his customers to take the horses in rotation, that they might be worked equally. Milton wrote two epitaphs upon him.

Hoche, Lazare, lä-zär ōsh, French soldier: b. Montreuil 25 June 1768; d. Wetzler 19 Sept. 1797. He took service in the French guards when 16 years old, and at the revolution joined the popular party. He greatly distinguished himself at the siege of Thionville and the defence of Dunkirk, and shortly afterwards, when scarcely 25 years of age, received the command of the army on the Moselle. In 1793 he drove the Austrians out of Alsace, and soon after was arrested by the Jacobins and imprisoned at Paris. In 1794 he was released, and appointed commander of the army destined to quell the rising in the west, and afterwards to that in La Vendée. In 1796 he conceived the plan of attacking Britain, and making a descent on Ireland, but expired suddenly while in camp with his army of invasion.

Hockey, a game of ball known as hurley in Ireland and shinty in Scotland, dating in its present form from about 1883, when a definite code of rules was drawn up by the Wimbledon Club. According to standard rules the game is played between two teams of 11 players each, on a ground 100 yards long by 50 to 60 yards wide. A goal is erected at each end of the field, and consists of two uprights 12 feet apart supporting a horizontal bar 7 feet from the ground. In front of each goal a line 12 feet long is drawn parallel to the goal-line and 15 yards from it; and from each end of this line, with the corresponding goal-post as centre, a segment of a circle is drawn outwards to meet the goal-line. Thus, a kind of semicircle flattened at the top is drawn in front of each goal, and no goal is scored unless the ball is hit from within this line or striking-circle. The ball used is an ordinary cricket ball painted white; and each player is provided with a stick, curved at the end, without any metal fittings, and not too thick to be passed through a ring two inches in diameter. The players are arranged on the field as in Association football, namely, goal-keeper, two backs, three half-backs, five forwards. The game is started by one player of each side bullying the ball in the centre of the ground, that is, by first striking the ground with his stick and then striking his opponent's stick three times, after which either may strike the ball. When the ball is driven between the goal-posts under the bar by a stroke from within the striking-circle, a goal is scored, and the game is won by the side with a majority of goals scored. The ball may be caught or stopped with any port of the body, but it must not be carried, kicked, or knocked on except with the stick; it must be played from right to left only. The goal-keeper is allowed to kick the ball away in defending his goal. Ends are changed at half-time.

Hock'ing, Joseph, English nonconformist clergyman and novelist: b. St. Stephens, Cornwall, 1859. He was educated at Owens College, Manchester, and entered the nonconformist ministry in 1884. Among his many published books are: 'Story of Andrew Fairfax' (1903); 'The Scarlet Woman' (1899); 'The Purple Robe' (1900); 'The Madness of David Baring' (1900); 'Greater Love' (1901); 'Lest We Forget' (1901). He is a brother of S. K. Hocking (q.v.).

Hocking, Silas Kitto, English Methodist clergyman and novelist: b. St. Stephen's, Cornwall, 24 March 1850. He was ordained a minister in the Methodist Free Church in 1870, and after holding pastorates in Liverpool, Manchester, and elsewhere, resigned from the ministry in 1896. He is a prolific writer and several of his books have been much read in America. Among them may be named 'Alec Green' (1878); 'For Light and Liberty' (1890); 'One in Charity' (1893); 'A Son of Reuben' (1894); 'God's Outcast' (1898); 'The Awakening of Anthony Weir' (1901) 'Gripped' (1902).

Hocking River, a stream which has its rise in Fairfield County, Ohio, and flows southeast into the Ohio River. The whole length is about 80 miles; it is navigable for about 70 miles. Along the shore, in the upper part of the course, is the Hocking Canal.

Hocking Valley Railway Company, The. The Mineral Railroad Company was incorporated 14th April 1864, to build a railroad from Columbus to Athens, Ohio, but beyond making preliminary surveys and securing some rights of way, nothing was done toward the construction of the line. Mr. M. M. Greene, who was operating salt works at Salina (now Beaumont), Ohio, in the Hocking Valley, seven miles north of Athens, in 1867, took up the project, and on 26 June of that year, by decree of the Franklin County Common Pleas Court, the name was changed from Mineral Railroad Company to Columbus & Hocking Valley Railroad Company. In 1868 the line was opened for traffic from Columbus to Lancaster, and in 1869 was completed as far as Nelsonville, where it reached the coal field.

Construction was finished 25 July 1870, to Athens with a branch from Logan to Straitsville, in the coal district. The annual report of the president for the year 1870 stated: "That the company owned 12 locomotives, eight passenger cars, three baggage cars, 279 coal, 60 box, and 26 flat cars, in addition to which, private parties furnished 403 coal cars, and that with all this equipment, together with 150 other cars furnished by connecting lines, the company was unable to supply the demand for coal and would have to provide more coal cars." The gross earnings of the line for 1870 amounted to $372,229.

In the year 1871, the gross earnings increased to $548,942 and the president's report for that year stated that a valuable trade for coal had been commenced through Cleveland to points on the Lakes. The report further stated that the heavy traffic made it necessary to renew some of the rails, and that, in order to have a test between iron and steel, 50 tons of steel rails were purchased as an experiment and laid in sidings in Columbus yard under the heaviest wear of any part of the road.

The coal business of the line developed rapidly, the gross earnings for the year 1872 being $854,892. The company trebled its number of coal cars and began to feel the need of proper outlets for traffic to points beyond Columbus, connecting lines being either unable or unwilling to furnish cars for the business offered their lines. It was thereupon determined to undertake the construction of a line to supply the great demand of the Lakes and the Northwest for Hocking Valley coal, and Toledo was selected as the most appropriate port. Accordingly on 28 May 1872, the Columbus & Toledo Railroad Company was incorporated by M. M. Greene, P. W. Huntington, B. E. Smith, W. G. Deshler, James A. Wilcox, and John L. Gill, and a preliminary survey was at once made.

The line was permanently located from Columbus to Toledo on 15 Oct. 1873. The financial panic of 1874, however, made it necessary to defer for nearly a year the construction, which was commenced 17 Aug. 1875; on 15 Oct. 1876, the line from Columbus to Marion was opened for traffic, and on 10 Jan. 1877, the first regular train ran through to Toledo, where the company had acquired valuable frontage on the Maumee river for the construction of docks.

The Columbus & Hocking Valley and Columbus & Toledo Railroad companies entered into a contract 22 Feb. 1877, providing for the joint management of the two lines and for the joint use of terminal property and facilities in Columbus.

During the year 1877, extensive docks were constructed at Toledo, and connecting lines at Toledo furnished an outlet to points in Michigan and Canada. In the meantime, the Columbus & Hocking Valley Railroad had continued to prosper. In 1877, the Monday Creek and Snow Fork branches in the coal field were partially constructed and opened and seven iron furnaces were in blast in the coal region.

The Ohio & West Virginia Railway was incorporated 21 May 1878, to build from Logan, in the Hocking Valley, to Gallipolis, on the Ohio river, and some little grading was done upon this line, but no further progress was made until one year later, 21 May 1879, when Hocking Valley interests took up the project, amended the charter to extend from Gallipolis to Pomeroy, and commenced construction. The line was opened for traffic 15 Oct. 1880, from Logan to Gallipolis, and 1 Jan. 1881, to Pomeroy.

The Columbus & Hocking Valley, and Columbus & Toledo Railroad companies, and The Ohio & West Virginia Railway Company were consolidated 20 Aug. 1881, under the name of the Columbus, Hocking Valley & Toledo Railway Company.

In 1895, the Wellston & Jackson Belt Railway was built by the Hocking Valley Company from McArthur Junction to Jackson, through the Jackson County coal field, affording a valuable feeder to the line, and was opened for traffic to Wellston 1 Dec. 1895, and to Jackson 10 Feb. 1896.

During the past few years radical improvements have been made in the capacity of the line for handling traffic; 40 ton coal cars to the number of nearly 6,000 have been added to the equipment, mogul freight engines have been superseded by consolidation engines of greater capacity, making a large increase in the loading of freight trains; improved machinery for handling coal and iron ore has been placed on the company's docks at Toledo, and the yards, sidings, and station facilities of the line have been increased to take care of the constantly growing traffic.

Of the five seams of bituminous coal mined in the State of Ohio, four are to be found on the line of the Hocking Valley Railway, and through its connection with the Kanawha & Michigan Railway at Athens it also receives shipments of coal and coke from the Kanawha

& New River districts of West Virginia. Through its control of dock facilities at various points on the Great Lakes it has been enabled to transport coal for shipment by lake to the amount of nearly 2,000,000 tons during the navigation season of the year 1904.

The Hocking Valley is the longest line of railway entirely within the limits of the State of Ohio, and occupies a central position from the Ohio river to Lake Erie, passing through the capital, with branches in the populous regions of the coal fields. In 1905 the total mileage of the Hocking Valley Railway was 344.7, made up as follows: Toledo to Pomeroy, 250.8 miles; Athens branch, 20.9 miles; Jackson branch, 17.3 miles; other branches, 43.7 miles. For the year ending 30 June 1905, the gross earnings were $6,013,214. The operating expenses were $4,067,901, thus showing net earnings of $1,945,313, which with other income of $382,230 shows the total net income of the company for that year, $2,327,543.

F. B. SHELDON,
Assistant to President.

Hodder, Alfred, American author: b. Celina, Ohio, 18 Sept. 1866; d. New York 3 March 1907. In 1886–9 he read law in the office of Senator Teller, in 1889 was admitted to the bar at Denver, Col., studied in the Harvard graduate school in 1890–1, and was Morgan fellow there 1891–2. He was for a time lecturer in English literature and drama at Bryn Mawr College, contributed extensively to the New York 'Nation,' and published 'The Powers that Prey' (with Josiah Flynt, 1900), a collection of stories of the criminal classes, and 'The Specious Present' (1901), a metaphysical treatise.

Hodge, Archibald Alexander, American Presbyterian divine: b. Princeton, N. J., 18 July 1823; d. Princeton 11 Nov. 1886. He was the son of Charles Hodge (q.v.) and was graduated at Princeton College 1841, where he became assistant professor. In 1847 after graduation in the Theological Seminary of the same place he went to Allahabad, India, as a missionary. He stayed in Asia for three years and returning home held pastoral charges in Maryland, Virginia, and Pennsylvania until 1877, when he became his father's assistant at Princeton Seminary, succeeding in 1878 to the chair of didactic and exegetical theology made vacant by his father's death. Among his works the most important are 'Outlines of Theology' (1870); 'The Atonement' (1886).

Hodge, Charles, American Presbyterian theologian: b. Philadelphia 28 Dec. 1797; d. Princeton, N. J., 19 June 1878. He was educated in Princeton College, graduating in 1815. In 1816–19 he studied in the theological seminary at Princeton, in 1820 was appointed instructor there, and two years later made professor of Oriental and biblical literature. In 1840 he was transferred to the chair of didactic and exegetical theology in the seminary, and 12 years afterwards appointed to the additional chair of polemical theology. In 1825 he founded the 'Biblical Repertory,' afterwards was renamed 'Biblical Repertory and Princeton Review,' and merged in 1872 in the 'Presbyterian Quarterly and American Theological Review.' From the foundation till 1872 he was editor of and chief contributor to the 'Review,' and two of his works, 'Princeton Theological Essays' (1846–7); and 'Essays and Reviews' (1857), were compiled from his numerous articles in that periodical. Other works are: 'Commentary on the Epistle to the Romans' (1835; enlarged, 1866); 'Constitutional History of the Presbyterian Church in the United States' (1840–41); 'The Way of Life' (1842); 'Systematic Theology' (1871–2), a comprehensive treatise giving an exposition of Calvinistic theology; and 'What is Darwinism?' (1874).

Hodge, Frederick Webb, American ethnologist: b. Plymouth, England, 28 Oct. 1864. He was brought to this country at the age of seven years, and was educated at Washington, D. C. In 1884 he received appointment to the United States Geological Survey, in 1886 became secretary of the Southern Archæological Expedition, and in 1889, was appointed to the Bureau of Ethnology, Smithsonian Institution. He has written various papers on the Indians of the southwest.

Hodge, John Aspinwall, American Presbyterian theologian: b. Philadelphia, Pa., 12 Aug. 1831. He was graduated from the University of Pennsylvania (1851) and from Princeton Theological Seminary (1856). After 35 years of pastoral work he was appointed in 1893 professor of biblical instruction and church polity in Lincoln University. Among his works are 'What is Presbyterian Law?' (1882); 'Theology of the Shorter Catechism' (1888); 'The Ruling Elder at Work' (1897).

Hodges, George, American Episcopal clergyman: b. Rome, N. Y., 6 Oct. 1856. He was graduated from Hamilton College, Clinton, N. Y., in 1877, and from the Berkeley Divinity School, Middletown, Conn., in 1881. He was assistant rector of Calvary Church, Pittsburg, Pa., 1881–9, and rector 1889–94, in the year last named becoming dean of the Episcopal Theological School in Cambridge, Mass. He has published among other works: 'Christianity Between Sundays' (1892); 'The Heresy of Cain' (1894); 'In the Present World' (1896); 'Faith and Social Service' (1896); 'The Battles of Peace' (1897); 'The Path of Life' (1897); 'William Penn' (1900). He is one of the most prominent members of the Low Broad Church School in the Episcopal Church.

Hodgetts, hŏj'ĕts, **Edward Arthur Brayley**, English journalist: b. Berlin, Germany, 12 June 1859. He has been connected with several influential London journals in the capacity of correspondent and was foreign editor of the New York *World* in 1894. Among his published books are 'Liquid Fuel' (1890); 'Round About Armenia' (1896); 'A Russian Wild Flower' (1897); and a translation of 'The Swiss Family Robinson' (1897).

Hodgkin, hŏj'kĭn, **Thomas**, English historian and banker: b. Tottenham, Middlesex, 29 July 1831. He has been for many years the senior partner in a banking firm at Newcastle-on-Tyne, but since 1874 has given his time to historical writing. He has published 'Italy and her Invaders,' a work of much importance, of which eight volumes have already appeared (1880–99); 'Dynasty of Theodosius' (1889); 'Life of George Fox' (1896); 'Life of Charles the Great' (1897); etc.

Hodgkin's Disease. See PSEUDOLEUCÆMIA.

Hodgkinson, hŏj'kĭn-sŏn, **Eaton,** English engineer: b. Anderton, Cheshire, 1789; d. 1861. After a somewhat desultory education, and the pursuit of independent investigations in mechanics he was appointed in 1847 professor of the mechanical principles of engineering at University College, London. He was one of the royal commission appointed in 1847 to inquire into the application of iron in railroad building. His principal experiments led him to the determination of the "neutral line" in the section of fracture, an important step in the progress of engineering science. Among his many writings is 'Researches on the Strength and Other Properties of Cast Iron' (1846).

Hodgson, hŏj'sŏn, **Shadworth Hollway,** English metaphysician: b. Boston, Lincolnshire, 25 Dec. 1832. He was educated at Rugby and Oxford and is the author of 'Time and Space' (1865); 'Principles of Reform in the Suffrage' (1866); 'The Theory of Practice' (1870); 'The Philosophy of Reflection' (1878); 'The Metaphysic of Experience' (1898); etc.

Hodograph, hŏd'ō-grăf, the term for a velocity diagram which facilitates the study of kinematics. It signifies the curve along which the extremities of lines drawn from a fixed point pass and exhibit in direction and magnitude the velocities of a moving object at the different points of its orbit or path.

Hoe, Richard Marsh, American inventor: b. New York 12 Sept. 1812; d. Florence, Italy, 7 June 1886. He was the son of Robert Hoe (q.v.). In 1846 with his brother Peter S. he perfected a rotary printing-press which was called "Hoe's lightning press." Subsequently the two brothers invented the Hoe web-perfecting press. These were especially adapted to newspaper printing and made a revolution in that art. The sons of Richard M. Hoe and of Peter S. Hoe conducted the business after the death of the brothers, and added various improvements to the original Hoe printing-press. The factory in New York in 1903 was said to be the largest printing-press works in the world.

Hoe, Robert, American inventor: b. Leicestershire, England, 1784; d. 1833. He came to the United States in 1803, was for a time a joiner, and later entered partnership with his brothers-in-law, Matthew and Peter Smith, for the sale of a hand printing-press, the invention of the latter. He took over the business in 1823. The original Hoe printing-press was designed and built by him.

Hoe, Robert, American manufacturer: b. 1839. He is a nephew of Richard M. Hoe (q.v.). He became the head of the Hoe firm, and maintained its high position among establishments of its class. A founder of the Grolier Club of New York, he was also its first president. He published an edition (1880) of Maberley's 'Print Collector.'

Hoe'ber, Arthur, American artist: b. New York 23 July 1854. He studied under Beckwith in New York and under Gérôme at the Ecole des Beaux Arts, exhibited for the first time at the Salon in 1882, and is a contributor to most American exhibitions. He is art critic to the *Commercial Advertiser.* Among his writings are 'Treasures of the Metropolitan Museum of Art'; and 'Painting in the 19th Century in France, Belgium, Spain and Italy.'

Hoey, Frances Sarah Johnston, Irish novelist: b. near Dublin 1830. She was married to A. M. Stewart in 1846, and to John Cashel Hoey in 1858. Among her books, which have circulated in America as well as in England, are: 'A House of Cards'; 'A Golden Sorrow'; 'No Sign'; 'A Stern Chase'; 'His Match and More.'

Hofer, hō'fĕr, **Andreas,** Tyrolese patriot: b. Sankt Leonhard 22 Nov. 1767; d. Mantua 20 Feb. 1810. He was landlord of the inn "Am Sand" at Sankt Leonhard, and hence often known as "Sandwirt." In 1796 he led a rifle company against the French on Lake Garda, and after the Peace of Lunéville was prominent in the organization of the Tyrol militia. In 1809 he led in an insurrection of the Tyrolese for shaking off the yoke of Bavaria, to which their country had been transferred by the Treaty of Presburg. In a short time, with intermittent assistance from the Austrians, he defeated the French and Bavarian troops, and nearly the whole country was liberated. Hofer then carried on the military and civil administration, till the Peace of Vienna was proclaimed. Misled by false reports he commenced hostilities anew, and thus forfeited the protection of the amnesty. He remained concealed for some time, but was at last betrayed to the French, and carried to Mantua, where he was tried by a court-martial and shot. His family was indemnified for the loss of their property by the Emperor of Austria in 1819, and his son ennobled. The career of Hofer furnished material for tragedies by Immermann and Auerbach. Consult the studies by Heigel (1874) and Stampfer (1891).

Hoff, hŏf, **William Bainbridge,** American naval officer: b. Philadelphia, 1846; d. Washington, D. C., 23 May 1903. He entered the naval service in 1860, and in 1863 was graduated from the Naval Academy. He took part in several naval campaigns during the Civil War, and at the torpedo school and on the United States steamship Dale he gave his attention to the instruction of seamen in gunnery. In 1893 he was marine commissioner to Great Britain for the World's Fair at Chicago, and was retired in 1897. He was the author of 'Elementary Naval Tactics'; and 'Avoidance of Collisions at Sea.'

Hoffman, hŏf'man, **Charles Fenno,** American poet and novelist: b. New York 1806; d. Harrisburg, Pa., 7 June 1884. He entered Columbia College, and studied law at Albany, being called to the bar in 1827. In 1830 he became joint-editor of a New York journal, and three years later started the 'Knickerbocker Magazine.' For many years he edited the 'American Monthly Magazine,' also. In 1840 his mind began to give way, and from that time till his death he was an inmate of Harrisburg lunatic asylum. His first separate publication was 'A Winter in the West' (1835), followed in 1837 by 'Wild Scenes in Forest and Prairie,' and in 1840 by the novel 'Greyslaer: a Romance of the Mohawk,' which met with immediate and remarkable success. An earlier novel, 'Vanderlyn,' appeared in the 'American Monthly Magazine' during 1837. Several of his songs have gained great popularity. His published volumes of verse include: 'The Vigil of Faith' (1842); 'The Echo' (1844); 'Lays of the Hudson, and other Poems' (1846); 'Love's Calendar, and other Poems' (1848).

Hoffman, Eugene Augustus, American Episcopal clergyman: b. New York 21 March 1829; d. near Plattsburg, N. Y., 17 June 1902. He was educated at Rutgers and Harvard colleges and at the General Theological Seminary. He held successive rectorships at Elizabeth, N. J., Burlington, N. J., Brooklyn, N. Y., and Philadelphia, and in 1879 was appointed dean of the General Theological Seminary, New York, and with others of his family, heavily endowed that institution. Dean Hoffman built Christ Church and rectory at Elizabeth, N. J., and also churches at Woodbridge and Milburn, N. J. He was the author of 'Free Churches' (1858); and 'The Eucharistic Week' (1859 and 1893).

Hoffman, Murray, American jurist: b. New York 29 Sept. 1791; d. Flushing, L. I., 7 May 1878. He graduated from Columbia College in 1809; was admitted to the bar, became assistant vice-chancellor of the superior court of New York in 1839, serving till 1843, and was elected judge in 1853, holding that position for eight years. He wrote: 'Office and Duties of Masters in Chancery and Practice in the Master's Office' (1824); 'A Treatise on the Practice in the Court of Chancery,' in three volumes (1834-40); 'Reports of Cases, Court of Chancery' (1839-40); several treatises on Church Law and numerous other works.

Hoffman, Richard, American pianist and composer: b. Manchester, England, 24 May 1831. He came to New York in his 16th year. He received early instruction from Rubinstein, Liszt, Thalberg, Döbler and Meyer. After his arrival in America he made a tour of the country as a soloist, and later accompanied Jenny Lind on her tours; he also played with Gottschalk and Von Bulow in New York in 1875. Later he became an important figure in American musical life. He has composed music for the piano, songs, anthems, ballads and church music.

Hoffman, William M., American inventor: b. Buffalo, N. Y., 1853. He received only a limited education and began to earn his living when nine years of age. He prospered until he was 20, when misfortune overtook him and he became a fireman on the Erie Railroad. The clumsiness in the action of the piston rod which runs to the driving-wheels of an engine, involving such a waste of power, attracted his attention and decided him to build an engine in which there should be no such starting and stopping, but in which the power should create a direct rotary movement. He studied for eight years the technical branches of engineering, and at the end of this period became chief engineer of a large tannery in Buffalo. He there invented a new set of "fleshing" and "putting out" machinery for use in a tannery, and sold the invention to obtain funds with which to experiment on his engine. He went to Detroit in 1886 and organized a company to produce his engines. He spent the first funds in experiments, and built five models, all of which refused to stir when connected up, nor were they in any way operative. In the winter of 1898-9 he went to Buffalo, there producing No. 6, which was a partial success. It was of a type in which the piston revolved in the cylinder, and showed a great advance over his previous models in control and speed and in sustaining varying loads. The internal friction made in this "annular cylinder" type was too great, and he set out to lessen it or do away with it altogether. Hoffman worked day and night, and when exhausted would ride on a trolley car all over the city till his brain became clear again, then would go back to work. It was on one of these rides that he thought out the principle which, with a few perfections, achieved the long-sought end. Hoffman thought that if the piston would not revolve inside the cylinder, the cylinder might revolve around the piston, and he immediately designed an engine in which the cylinder revolved around the eccentric abutment by introducing radial wings extending from the shell toward and against the stationary eccentric core. This engine, though proved by actual test of 18 months to be a success, was such a disappointment to Hoffman that he mortgaged all his property and returned the money which he had borrowed from financiers in August 1902 to further his investigations. Hoffman's son Bertram and Randl Riehl then joined him, and together, in July 1904 they brought out a 28 h.p. engine which was put into operation in the basement of the Ellicott Square Building in Buffalo and which has proved a success. He then made a twelfth and last design in a 300 h.p. compound engine, which is the largest of its type ever built and which, it is claimed, shows an economy of 33 per cent and a saving in floor space of 80 per cent as compared with the highest type of reciprocating engine, while the friction load has been reduced to 1.1 per cent. All of Hoffman's patents have now been merged into one company, of which he is president.

Hoffmann, August Heinrich, ow'goost hin'-rih hŏf'män, usually known as HOFFMANN VON FALLERSLEBEN, German poet and philologist: b. Fallersleben, Hanover, 2 April 1798; d. Corvei 19 Jan. 1874. He studied at Göttingen and Bonn, was appointed in 1823 custodian of the university library at Breslau, and in 1830 became extraordinary, in 1835 ordinary professor of the German language and literature in the university of that city. He resigned his librarianship at Breslau in 1838, and in 1842 was removed from his chair without a pension because of the liberal political views represented in his 'Unpolitsche Lieder' (1840-1). He led a wandering life till 1845, when he obtained the right of domicile in Mecklenburg. In 1848 he was granted a pension by the Prussian government, and from 1860 he was librarian to the Duke of Ratibor. Of his original writings the best known are his songs, not a few of which, especially that beginning 'Deutschland, Deutschland über Alles' (1841), have long received emphatic popular approval. For several of them he composed tunes. They were published in several volumes, among these being: 'Gedichte' (1827); 'Alemannische Lieder' (1827); 'Hundert Schullieder' (1848); 'Deutsches Volksgesangbuch' (1848); 'Soldatenlieder' (1851); 'Kinderwelt in Liedern,' and 'Alte und Neue Kinderlieder' (1873). A complete edition of his 'Kinderlieder' was prepared by von Donop in

1877. 'Mein Leben' (1868; abridged edition continued to his death, by Gerstenberg, 1892-4), is autobiographical. Consult also the 'Life' by Wagner (1869).

Hoffmann, Heinrich, German painter: b. Frankfort-on-the-Main, 18 Oct. 1814. Beginning life as a room decorator, in 1843, he adopted landscape painting as his profession and studied under Jacob Becker with that end. Long wanderings and careful studies of nature in the Taunus Mountains, in Obenwald, and the Black Forest, as well as in the valleys of the Rhine and Mosel, were followed by extensive travels in Switzerland and the Tyrol. The results of this preparatory training appeared in his first large canvas in which the old romantic spirit was blent with an independent and realistic presentation of nature which at once attracted public attention. He has produced numberless Alpine and forest landscapes, moonlight and street scenes, most of which are in private collections at Frankfort.

Hofmann, August Wilhelm, von, German chemist: b. Giessen 8 April 1818; d. Berlin 5 May 1892. He studied law, obtained the degree of doctor of philosophy, became assistant under Liebig in the Giessen Laboratory, and in 1845 became professor of chemistry in the University of Bonn. The same year he was appointed superintendent of the new Royal College of Chemistry in London, and in 1853 became professor of chemistry in the Royal School of Mines, though still remaining at the head of the College of Chemistry. In 1861 he was elected president of the London Chemical Society, and in 1863 was appointed to the chair of chemistry in the University of Berlin, where he remained till his death. In 1864 he built a laboratory at Bonn and became its director, and in 1868 founded the German Chemical Society. He was judge of several industrial expositions and was a member of many scientific societies, and for his valuable services was ennobled in 1888. A statue of him is in the National Gallery of Berlin. He wrote: 'A Handbook of Organic Analysis' (1853); 'Introduction to Modern Chemistry' (1865); 'Zur Errinnerung an vorangegangene Freunde' (1889); etc.

Hofmann, Heinrich, German painter: b. Darmstadt 19 March 1824. In his native town he began his studies as a copper-plate engraver, but subsequently under Schadow and Hildebrande turned his attention to painting, to which henceforth he devoted his life. After extensive travels in Europe, which included a residence of four years in Italy, he settled at Dresden as professor of painting in the Academy there. The most famous of his pictures are: 'The Burial of Christ'; 'King Enzio in Prison'; 'The Betrayal of Christ,' in the Darmstadt Gallery; 'The Finding of Christ in the Temple,' in the Dresden Gallery; 'Christ Preaching on the Lake,' in the Berlin National Gallery; 'Venus and Cupid'; 'Romeo and Juliet'; 'Othello and Desdemona'; and 'Christ in Gethsemane.' All the creations of Hofmann testify to his sense of refined beauty and are rather remarkable for harmonious coloring and delicacy than for originality of design or composition, as he clings to the tradition of the classic period in the ideal character of his conceptions. His works are popular and have been engraved and photographed more extensively perhaps than those of any contemporary German painter of his order.

Hofmann, Josef, yō'sef, Polish pianist: b. Cracow 20 Jan. 1877. He studied with his father, a professor in the Warsaw Conservatory and director of the Warsaw opera, appeared as a pianist in public at the age of six, became known as one of the most notable of musical prodigies, visited the United States in 1887-8, and was there prevented from playing through the action of the Society for the Prevention of Cruelty to Children. After a period of study, two years of which were spent as a pupil of Rubinstein, he made his début as a virtuoso at Dresden in 1894. His recitals in New York in 1901 showed him to be one of the leading modern pianists. His compositions include some interesting works for the pianoforte.

Hog-feeding. See NUTRITION OF FARM ANIMALS.

Ho'gan, John Joseph, American Roman Catholic bishop: b. Bruff, County Limerick, Ireland, 10 May 1829. He came to St. Louis, Mo., in 1848, studied at the Roman Catholic theological seminary there, was ordained priest in 1852, and built and became pastor of St. Michael's Church of St. Louis. In 1868 he was consecrated bishop of St. Joseph, Mo., and in 1880 was transferred to the see of Kansas City.

Hogarth, hō'gärth, **David George,** English archæologist: b. Barton-on-Humber, Lincolnshire, 23 May 1862. He was educated at Oxford and has since conducted excavations at Paphos, Alexandria, Fayum and elsewhere in the East. He was director of the British School at Athens 1897-1900 and has published: 'Devia Cypria' (1890); 'Modern and Ancient Roads in Asia Minor' (1892); 'A Wandering Scholar in the Levant' (1896); 'Philip and Alexander of Macedon' (1897); 'The Nearer East' (1902).

Hogarth, William, English painter and engraver: b. London 10 Nov. 1697; d. there 25 Oct. 1764. He studied art at Sir James Thornhill's school, James Street, Covent Garden. About 1720 he set up for himself, and designed plates for booksellers, the chief of which are the illustrations to Gray's edition of 'Hudibras' (1726). He had ample employment for what are called "conversation pieces," that is, groups of family portraits, united by some common occupation or interest, but never cared greatly for this branch of art. In March 1729 he married clandestinely the daughter of Sir James Thornhill, and shortly afterward began to display his extraordinary faculty for depicting the vices and follies of his time. In 1730-1 he painted 'A Harlot's Progress,' a series of six pictures, like many of his other works, engraved by himself. It was published in April 1732. The 'Harlot's Progress' was followed by other satiric delineations, such as 'A Midnight Modern Conversation' (1734), 'Southwark Fair' (1735), 'A Rake's Progress' (1735), 'The Distressed Poet' (1736), 'The Four Times of the Day,' and the 'Strolling Actresses Dressing in a Barn' (1738). With less success he also produced the large canvases still in St. Bartholomew's Hospital — the 'Pool of Bethesda' and the 'Good Samaritan,' both executed in 1736; and also painted several portraits. The series of graphic satires was, however, continued by the 'Enraged Musician' (1741) and the famous 'Marriage à la Mode' (his masterpiece), six pictures now in the National Gallery, and engraved by various hands in 1745. 'Industry and Idleness,' 12 plates, followed these in 1747; 'Calais Gate' (1749) came next, and in 1750 the fine plate known familiarly as the 'March to Finchley.' The minor plates of 'Beer Street' and 'Gin Lane' and the set called 'The Progress of Cruelty' belong to 1751. In 1752 Hogarth published his 'Analysis of Beauty,' a treatise containing many shrewd remarks, but confused and illiterate in its style, and the cause of much ridicule. After this he produced (with the aid of Grignion and others) the four prints of the 'Election Series' (1755–8), the 'Cockpit' (1759), etc. In 1762–3 he became involved in a miserable quarrel with Wilkes and Churchill, the result of which, on his side, was the well-known portraits of Wilkes, and of Churchill as a bear ('The Bruiser').

Most of Hogarth's pictures, which now enjoy a much higher repute for technique than formerly, are preserved in public or private collections in Britain. He was entirely uninfluenced by foreign art. His powers of invention and combination were extraordinary; and as a humorist and social satirist with the pencil he has never been surpassed. There can be no doubt also that he genuinely desired to assist by his work in the reformation of manners. Consult the biographies by Sala (1866) and Dobson (1879).

Hoge, hōg, **Moses Drury,** American Presbyterian clergyman: b. Hampden-Sidney, Va., 17 Sept. 1819; d. Richmond, Va., 1899. He was graduated at Hampden-Sidney College and Seminary and was pastor of the Second Presbyterian Church in Richmond, Va. (1845–85). He ran the blockade in a ship from Charleston during the Civil War and secured from England a large number of copies of the Holy Scriptures for distribution among the Confederate soldiers, the British and Foreign Bible Society making a special grant at his request. After the war he was instrumental, especially during the session in 1874 of the Southern Presbyterian Church, in reconciling differences with the Northern Presbyterian Church.

Hogg, James, Scottish poet, familiarly known as "The Ettrick Shepherd": b. Ettrick, Selkirkshire, 25 Jan. 1770; d. Altrive, on the Yarrow, 21 Nov. 1835. After receiving a very scanty education, he began to earn his bread by daily labor as a shepherd. His early rhymings brought him under the notice of Sir Walter Scott, by whose advice he published a volume of ballads called 'The Mountain Bard.' He then went to Edinburgh, where he published the 'Forest Minstrel' (1810), and started a weekly periodical entitled 'The Spy.' The appearance of the 'Queen's Wake' in 1813, with its charming ballad of Kilmeny, established Hogg's reputation as a poet. In 1815 he published 'Pilgrims of the Sun,' followed by 'Mador of the Moor'; the 'Poetic Mirror' (a collection of imitations of living poets); 'Queen Hynde,' and 'Dramatic Tales,' as well as by 'The Brownie of Bodsbeck,' etc. From 1817 he held the farm of Altrive from the Duke of Buccleuch at a merely nominal rent; but his farming schemes never throve, and he was generally in narrow circumstances.

Hogg, James Stephens, American politician and lawyer: b. near Rusk, Tex., 24 March 1851; d. Houston, Tex., 3 March 1906. He took up the practice of law, and was justice of the peace in Wood County 1873–5, and county attorney 1878–80. In 1880 he was district attorney in the 7th judicial district of Texas; in 1886 became attorney-general of the State and from 1890 to 1895 was governor. He was one of the Democratic governors who objected to the use of United States troops by President Cleveland at the time of the Pullman strike in 1894. After serving as governor he returned to the practice of law, and remained active in politics, being prominent as a public speaker.

Hog'nose, a North American colubrine serpent (*Heterodon platyrhinus*), so-called because of its upturned pig-like snout. It is usually about two feet long, gray marked with brown bars, but sometimes is so dark that the whole surface appears blackish; and dwells and seeks its prey mainly in the woods and thickets. When alarmed — and it is extremely timid — it hisses violently (whence other rustic names such as "blowing-adder"), and expands and flattens the head and neck by inhaling air and stretching out the ribs, giving itself a most ugly aspect. If these tactics do not succeed in terrifying the enemy sufficiently, the snake begins a series of astonishing contortions and twistings which end in the animal throwing itself upon its back and seeming dead until a chance of escape offers. Two or three other species are known in the South and West, all of which are regarded as poisonous by most country people, but are really quite harmless.

Hogs, or Swine, hoofed quadrupeds of the family *Suidæ*, including several genera and many species and domesticated races. The males are called "boars," the females "sows," the young "pigs," and the flesh "pork." The hogs proper, both wild and tame, belong to the genus *Sus*, represented in the wilderness of the Old World by the wild boar (*S. scrofa*), which is, or was, known throughout southern and central Europe, Algeria, Asia Minor, and southwestern Asia; and by the Indian boar (*S. cristatus*) of India and Indo-China. The wild boar stands from 30 to 40 inches high at the shoulder and will weigh on the average about 250 pounds. His snout is longer, his ears shorter than those of the domestic hog. He roots up the ground in a different manner, ploughing it in furrows; his tusks are larger, some of them being 10 inches in length, bent circularly, and exceedingly sharp at the points. The young wild boar, for the first three years of his life, follows the sow, the whole litter living in a herd together, and although the adults are plain iron gray (the male exceedingly large and shaggy) the young are striped and spotted. Old boars range the forest alone and unsupported, dreading no single creature, not even man himself. Hunting this animal has always been a favorite amusement, and in Europe is usually pursued on foot by the aid of large dogs, the hunters armed with strong pikes termed *boarspears*. A chase seldom terminates without the maiming or destruction of some of the dogs, and tests the courage of the men, for a charge from an enraged or wounded boar is a formidable thing. In India the chase is pursued on horseback, the rider using a long spear. Hence the sport is known as "pig-sticking," and it involves much risk and danger, and the death of many horses ripped open by the boar's tusks. In addition to these, a small wild pig inhabits western equatorial Africa; there are two lesser species in India, one not much bigger than a hare; and several in the islands stretching from Sumatra to Japan.

Domestic Races.— Swine everywhere have seemed easily tamable and susceptible to domestication, breeding fertilely in confinement and easily adapting themselves to new environments. Since prehistoric times, therefore, the animal has been raised by man in many parts of the world to supply food. The process of domestication seems to have gone farther toward producing a good pork-making animal in the Orient than in Europe until the revival of agriculture there following the decay of the feudal system. In Great Britain there was early introduced eastern blood called Chinese stock, and it is from the union of these two strains — one derived from the European wild boar and the other from some or many Oriental species — that European and American farmyard swine are descended. The foremost breed, in general popularity, is the Berkshire, which originated in the English County of Berks, but is now universal. The Berkshire hog is of large size, yields pork of great fatness and excellent flavor, grows rapidly and is hardy. It is usually black in color. An American breed, developed first in Ohio, and known as Poland-China, is very similar to the Berkshire, and has been perfected until it has become the principal pork-producing hog of the Mississippi Valley. The English white breeds are led by the Yorkshire, which reaches a larger size than any other kind; and from which has been developed an American strain, called Chester Whites, after the county in eastern Pennsylvania where it originated. New Jersey has a local breed called Durocs, or Jersey red hogs, which have the advantage of great hardiness. For these breeds regular stock-registers have long been maintained. Various other well-known strains of swine in Great Britain and America are the Tamworth, Victoria, Essex, etc. The domestic hog has run wild in various parts of the world. In many of the South Sea islands, and in parts of South America, they have practically returned to a feral condition, and are public game. In the southern part of the United States large numbers of pigs, nominally under ownership, range the woods, picking up their own food of herbage, roots and mast; these become gaunt, thin, high-backed, bristly and develop great running powers, cunning (the intelligence of the whole race is comparatively high), and savagery of disposition; they are locally known as "razor backs."

For the proper care and treatment of hogs raised for their pork see NUTRITION OF FARM ANIMALS.

Domestication has changed the form and proportions of the body, the color, etc.; thus the skull is higher and broader in proportion to its length, and it is more upright in the occipital region. The sow brings forth from the 16th to the 20th week after conception, and has usually two litters in a year. Her offspring are very numerous, a litter consisting of from 10 to even 20; but she can bring up no more than she has teats, which are 12 in number. The natural term of the life of these animals is from 15 to 30 years, and they continue to increase in size and strength until they are from four to five years of age. As might be supposed from their habits, they are much infested by vermin of different kinds, and are also liable to many disorders, particularly those arising from gluttony. Notwithstanding repugnant qualities the hog is of incalculable benefit to mankind. Its flesh is pleasant, substantial and nutritious. Pork takes salt better than almost any other meat, and may be cured and preserved in many ways. The fat (lard) is one of the most important culinary articles; the bristles are used in large quantities in the manufacture of brushes, while the skin is in demand among saddlers, trunk-makers, and manufacturers of small articles of leather, calling for great durability with flexibility and a handsome appearance.

The family includes various wild species more or less closely related to the typical swine, such as the babirussa, peccaries, river-hogs, wart-hogs, etc., elsewhere described.

The principal English works on swine are Long's 'The Book of the Pig' (1889), and Spencer's 'Pigs, Breed and Management' (1897). American works of note are Coburn's 'Swine Husbandry' (1889); Harris' 'On the Pig' (1896), and pamphlets issued by the Department of Agriculture. See NUTRITION OF FARM ANIMALS; PORK; PACKING INDUSTRY.

Hogs'head, a liquid measure formerly in use in England. Its capacity varied in different cases. For beer it was 54 gallons, for rum 45 to 50 gallons, for brandy 45 to 60 gallons, and for different kinds of wine it varied from 46 to 93 gallons. In the United States the measure is still in use, being equivalent to 63 American gallons or 52.485 imperial gallons; for tobacco it varies from 750 pounds in some States to 1,200 pounds in others.

Hohenlinden, ho-ĕn-lĭn'dĕn, Germany, a village of Bavaria, 20 miles east of Munich, celebrated for the victory gained by the French under Moreau over the Austrians under the Archduke John, 3 Dec. 1800. The French took nearly 80 pieces of cannon, 200 caissons, and more than 10,000 prisoners, with three general officers.

Hohenlohe-Schillingsfürst, hō-ĕn-lō'ė shĭl'lĭngs-fürst, **Chlodwig Karl Victor**, PRINCE VON, German chancellor: b. Rotenburg-an-der-Fulda March 1819; d. Ragatz, Switzerland, 6 July 1901. He took courses in law and political science at Heidelberg, Göttingen and Bonn. He entered public life and became in 1866 prime minister of Bavaria. In 1874 he was German ambassador at France and in 1885 became governor-general of Alsace-Lorraine. In 1894 he was appointed chancellor and resigned in 1900.

Hohenstaufen, hō'ĕn-stow-fĕn, **House of**, a German dynasty reigning from 1138 to 1254. After the death of the Emperor Henry V. (1125), his two nephews, Frederick II., duke of Swabia, and Conrad, duke of Franconia, aspired to the German crown; but were opposed by the directors of the election, the Archbishop of Mayence and the papal legate; and Lothaire of Saxony was elected. This circumstance, with the demand made by the new emperor of the restitution of all the possessions acquired by the lords of Hohenstaufen during the preceding reign, produced a fierce war between the emperor and the two brothers. Lothaire preserved himself by a union with Henry the Proud, duke of Bavaria, to whom he gave his daughter and the Duchy of Saxony. The Peace of Mühlhausen (1135), between Lothaire and Conrad, put an end to this Ten Years' war. Conrad renounced his title of King of Italy which he had taken, but received the first rank among the dukes, and both he and his brother regained all their lands. After Lothaire's death (1137) Conrad, duke of Franconia, of the house of Hohenstaufen, was raised to the throne of Germany, with the title of Conrad III.

After the death of Conrad III. (1152) the confidence which was felt in the Hohenstaufen family caused the choice to fall on his nephew, Frederick III. of Swabia, called Barbarossa (the Red-beard), who was followed by Henry VI. (1190), and he again by Otto IV. (1197) and Frederick II. (1215–50), all belonging to the same house. After the death of Frederick II. his son Conrad was acknowledged as his successor, with the title of Conrad IV., by most of the states of the empire: but Innocent IV. laid him under an interdict, and declared him to be deprived of all his lands. The conflict between Conrad and the Pope lasted until the latter's death in 1254. The fame of the house of Hohenstaufen is based upon the political greatness to which the Fredericks in particular attained; their success in reducing to order all the states of the empire; the encouragement which they gave to commerce and trade, and their efforts to promote the sciences and arts.

Hohenzollern, hō'ĕn-tsōl-lĕrn, Germany, a province of Prussia, formed in 1849 by the union of the two principalities of Hohenzollern-Hechingen and Hohenzollern-Sigmaringen. It consists of a narrow irregular strip of country encircled by Würtemberg and Baden. Area 441 square miles; pop. (1900) 66,783. The princely family of Hohenzollern dates from Thassilo, Count of Zollern, who died about 800 A.D., after having founded a castle near Hechingen, on the Zollern hill in the Swabian Alb. The fine Hohenzollern castle of 14th century architecture, built in the latter half of the 19th century, occupies the site of the ancient family-seat. There have been several lines and branches of the Hohenzollerns, the first separation taking place about 1165, when Frederick IV. founded the elder or Swabian and Conrad III. the younger or Franconian line. The elder line was subdivided, in 1576, into the branches of Hechingen and Sigmaringen. Frederick VI., the representative of the younger line, in 1415 received from the Emperor Sigismund the investiture of the electorate of Brandenburg, thus founding the reigning dynasty of Prussia. The two branches of the elder line continued unbroken till 1849, when the reigning princes ceded their respective rights and principalities to the king of Prussia, who in 1871 became emperor of Germany. The main branch of the Hohenzollerns is now represented by the imperial family of Germany. See GERMANY.

Hoisting Apparatus, mechanical devices for lifting and moving laterally heavy weights. They are known under various names and include cranes, derricks, overhead trolleys, crane-derricks, etc. The smaller are operated by hand power, the larger by steam or electric power. By their aid the heaviest weights may be readily lifted to any desired height and "slewed" into any desired position. Their use dates from the most ancient times, and they are now in constant and general use all over the world.

Derrick.— This is the simplest form of a machine for hoisting. The name is derived from a family by that title who adapted its form from the early English style of gallows, and the name has now come into common use. In form the derrick is like the letter V, one side being fixed immovably by guy ropes, the other hinged to the bottom of this fixed upright, so that it can be raised or lowered at will. This movable jib is somewhat shorter than the upright and the whole apparatus is on a platform which can turn laterally in a circle. Through the top of the jib is run a pulley block, a rope passing through this and down to the base of the upright, where it is wound about a cylinder, or winch. This, when revolved by hand or other power, winds up the rope or cable, thus raising the weight attached to the other end of the rope. The jib is lowered or raised to get the proper angle for picking up the article to be lifted. This simple form of hoister is in constant use by builders in constructing modern high buildings. By its use, heavy or light weights can be quickly lifted from the ground to the top of even 30-story structures. Derricks are commonly made of wooden spars, unless the work to be done is very heavy or the jib exceedingly long. In such case, a tubular iron spar is used. Hoisting engines of such power and facility of control are now made that they enable the operator to move the jib up or down or sideways easily and quickly. The "stiff-leg" derrick has its upright firmly braced by timbers running from the top to the ground, but this form is not common except in stone quarries or in some work where the derrick is stationary. The more common form is the guy-rope derrick, where strong wire cables extend from the top of the upright to the ground. With this arrangement, the hoisting machine can be moved and located in a fresh position easily. Derricks that will lift and swing to position weights of from 5 to 50 tons are now made in this country. In the contemplated work on the Panama Canal, derricks capable of moving 100-ton loads of stone and rock are to be built, with a radius of over 100 feet for the jib.

Crane.— Thus named because the arm or boom resembles the neck of the crane, which raises and lowers its neck to lift objects from the ground. It differs from the derrick in not having any mast or upright, usually. In the common form of crane the whole apparatus is centered upon a heavy platform which is itself on wheels. The engine which operates the winch also slews the boom in a circle, and, in some cases, moves the whole outfit along the rails upon which the wheeled platform rests. At the base of the boom, on the platform, is an inverted "V" horse, to which are attached the pulley blocks through which run the ropes for raising and lowering objects to be lifted. In large foundries, ship-yards and like places, the locomotive crane runs upon a track which usu-

FORTY TON LOCOMOTIVE CRANE.

IN USE BY THE U. S. GOVERNMENT AT PORT ROYAL, S. C.

ally extends the length of the yard or shop, or perhaps clear around it. Under its own steam, the ponderous machine runs along this track to the object it is desired to move. Steam power then slews the machine laterally so that the end of the jib or boom is over the object, when the latter is attached to the rope running over the end of the jib, the winch turned by the engine and the object lifted into the air. A second rope over another winch then raises the jib to the desired height and the machine runs back over the track to the point desired, where the object is deposited. The utmost expertness and delicacy of handling is acquired by the operator of this steam locomotive crane, which will thus grasp and carry where desired objects weighing often 50 tons or more. The common size is the one capable of lifting five tons only, though there are at Port Royal, in the United States navy yards, several large cranes which just as easily lift 50 tons. This latter machine has a boom 85 feet long and will travel under its own steam along the track 50 feet per minute. It will hoist a 40-ton load seven feet per minute and slew, or turn, a complete revolution in two minutes. The smaller cranes are much used on flat cars as wrecking apparatus for railroads, in excavating and dredging and in heavy construction work. Scores were used in digging the subway for New York city. A small 5-ton locomotive crane costs about $7,500. This style of hoisting apparatus is peculiarly the product of American genius and machines made in America are found in all large contracts for bridge building, railroad construction and like work in every corner of the world. A new machine for placer mining installed in New Mexico in the summer of 1903 adopts this form of crane, using the water over and over for sluicing the sand. It also operates a clam-shell shovel. In more difficult digging the "orange peel" form of shovel is used, the crane raising a ton or more of earth in the shovel and depositing it where desired.

Overhead Trolleys.—In the yard of a shipbuilding company at New London, Conn., has been installed a system of overhead hoisters which combine the advantages of both the derrick and the crane advantageously. The two enormous steamships, Minnesota and Dakota, were constructed by its aid solely. The two ships were built side by side and one trolley system served for both. By this method there are three steel spars, each 120 feet long, each supporting a steel cross-yard 174 feet long. These masts are braced by immense steel guy ropes or cables. The distance between the masts is 300 feet and the tops of the yards, or jibs, are 84 feet from the ground. The working field of the trolleys is a rectangle 600 feet long and 174 feet wide. Along the jibs a track made of wire rope is laid, on which a carriage is swung, suitably centred and controlled. On the main mast, just below the yard, is the house containing the operator and engine. This one man controls the trolley carriages on all the jibs, the raising or lowering and slewing of the jibs and masts and the return of the trolley carriages to the point desired. All is done swiftly and accurately, each carriage being capable of carrying 5,000 pounds. This system can operate four of these trolleys when desired.

Crane-derrick.— This is a combination of the crane and the derrick, as its name indicates. It resembles a figure 4 in construction. The mast can be slewed, but the yard or jib is a fixture and cannot be raised or lowered. Near the juncture of the jib and mast is the house in which sits the operator and where the engine is located. Along the under side of the jib is suspended a wire cable track on which runs a grappler carriage. The jib is usually very long, at least 60 feet, and the grappler runs to the end of this or to such point as is desired to be attached to the object to be lifted. This form of hoister is much used in bridge building and in places where a long reach of jib is desired.

At least 25,000 hoisting machines of these various types are made annually in the United States, one fifth of which are exported. About $25,000,000 is the annual expenditure for this class of machines, aside from the cost of hoisting engines, ropes, wire cable and the other appurtenances of the trade. The largest locomotive cranes cost $50,000 and the small wooden derrick $300 to $1,000. The industry has grown to enormous proportions and new improvements in methods of hoisting are constantly being made for special purposes.

PUTNAM DREW.

Hokusai, hō-koo-sä'ē. See JAPANESE ART.

Holacan'thus. See BUTTERFLY-FISH.

Holbach, Paul Heinrich Dietrich, powl hīn'rĭн dēt'rĭн hōl'bäн (Fr. ōl-bäk), BARON VON, German philosophical writer: b. Heidelsheim, in the Palatinate, 1723; d. Paris 21 June 1789. He was educated in Paris, where he passed the greater part of his life. He was the centre of a circle of men of wit, but of free thinking principles, using his great fortune, says Rousseau, generously, and appearing to advantage in the learned society which he gathered round his table. He was the author of a great number of works, most of which were anonymous or pseudonymous. The principal work attributed to him, which appeared in 1770 under the name of M. Mirabaud, and excited much attention in the learned world, is the 'Système de la Nature ou les Lois du Monde physique et moral.' He afterward published 'Système social, or Principes naturels de la Morale et de la Politique'— a development of the previous work, showing the application of the principles promulgated in it to morals and politics; 'Bons Sens, or Idées naturelles opposées aux Idées surnaturelles'; 'Eléments de la Morale universelle'; etc. According to Holbach matter is the only form of existence, and everything is the effect of a blind necessity.

Holbein, Hans, hänts hōl'- or hōl'bīn, the Elder, German painter: b. Augsburg 1460; d. Alsace 1524. His art training began under the influence of Martin Schongauer, but he quickly launched out into a new style, which left ancient precedents behind. He developed a dramatic energy, a clear and lifelike coloring and pre-eminent distinction of expression which rendered him the acknowledged head of a new school. His figures took the attitude of life. The pictures over the altar in the Cathedral at Augsburg, painted in 1493, are good specimens of his best work; in them are portrayed incidents in the life of Virgin Mary. To the same class belong the remains of an altarpiece in the Dominican Church at Frankfort-on-Main, representing scenes of the Passion (1501); 16 paintings of the Passion in the Munich Gallery; the portrait of the artist with his two sons, in the gallery at Augsburg. His later pictures show traces of the influence exercised by the Italian renaissance, and those painted about 1512 and later are vastly superior to his early work. Among them is his 'Fount of Life' (1519), now in the royal gallery at Lisbon; the altarpiece 'St. Sebastian' (1515), at Augsburg; the altarpiece 'St. Katharine,' in the same gallery; etc. In such works the bold and devotional conception, delicacy and directness of expression, ease of drawing and splendor of coloring, are beyond praise. Excellent also are some of his preliminary sketches and outlines, and in Basle, Berlin, and Copenhagen are collections of his pencil sketches, the most remarkable of which is that at Berlin. Consult: Woltmann, 'Holbein und seine Zeit' (1866).

Holbein, Hans, the Younger, German painter: b. Augsburg 1497; d. London Nov. 1543. He probably received instruction in painting from his father, and about 1515 went to Basle, where he engaged in illustrating books. At Basle he also painted his earliest portraits, and in 1517 went to Lucerne. Here he painted the house of Jacob von Hertenstein, designed windows, and executed other works. Returning to Basle in 1519, he became a burgher in the following year, and during a seven years' residence in that city he executed many works of great importance. In 1526 he went to England. Letters from his friend Erasmus, whose famous 'Praise of Folly' he had illustrated, procured him the patronage of the chancellor, Sir Thomas More, who employed him to delineate the portraits of most of his own personal friends about the court, and introduced him to the notice of Henry VIII., who was a liberal encourager of the fine arts. Among the portraits produced by him during this period are those of More, Archbishop Warham, Bishop Fisher, and several other distinguished persons. From 1528 till 1532 he was again in Basle, but in the latter year he returned to England, where he was destined to spend nearly all the remainder of his life. Holbein painted most of the principal English nobility, whose portraits place him among the world's greatest portrait-painters. Some of his earlier productions, especially his 'Dance of Death,' are also celebrated. In 1538 he completed and published this series. Among the pictures of Holbein's last period are 'The Ambassadors' (1533), and portraits of Hans of Antwerp (1532), English Lady and Gentlemen (1534), Sir Richard Southwell (1538), Duke of Norfolk (1539), Thomas Cromwell, Lady Jane Seymour, Henry VIII. (1542, unfinished), and others. Comparatively few of Holbein's pictures are still extant in England, great numbers of them having been destroyed by Puritan fanatics, or sold and dispersed over Europe. Many of them also perished in the great fire in London in 1666. Holbein also excelled in wood-engraving, and before his visit to England had produced a large number of wood-cuts. He was one of the earliest to paint portraits in miniature. See Woltmann, 'Holbein und seine Zeit' (1874); Wornum, 'Life and Works of Holbein' (1867); Knackfuss, 'Holbein der Jüngere' (1896).

Holberg, Ludwig, lood'vĭg hŏl'bĕrg, Baron, Danish author: b. Bergen, Norway, 3 Dec. 1684; d. Copenhagen, 28 Jan. 1754. He studied at Copenhagen, Oxford and Paris, and after paying a six months' visit to Rome returned to Copenhagen in the end of 1716. In 1718 he was appointed to an ordinary professorship in the university of that city, where after this date he chiefly resided till his death. In 1735 he was unanimously elected rector, and in 1737 treasurer of the university, and in 1747 was raised to the rank of baron. Holberg's numerous productions in various departments of literature as well as the important and salutary influence which he exercised upon his countrymen, place him in the front rank of the literary men of his age. He was extremely versatile — now devoted to history, now to poetry, and now to the drama; but during his whole life he was a sworn enemy to pedantry, theological disputatiousness, and scholastic metaphysics. His works may be divided into four classes — poems, stage pieces, philosophical treatises, and historical works. His poems are chiefly of a satirical nature. The most celebrated among them is 'Peder Paars,' a comic heroic poem in 14 cantos, still regarded throughout the Scandinavian countries as a masterpiece, and the hero of which has become the national comic impersonation in Denmark. It has been translated into several languages. Almost equally famous is his 'Nicholas Klimm's Subterraneous Travels,' a satirical romance in prose, originally written in Latin, but translated into seven modern European languages shortly after it appeared, into Danish first by Baggesen (1789). His numerous stage pieces are either comedies or farces, and nearly all characterized by true comic power. Among his philosophical writings the most important is his 'Moral Reflections' (1744). His historical works include: 'The Political, Ecclesiastical, and Geographical Condition of the Danish Monarchy,' a work of great value as a source of reference; 'A General History of the Jews,' and 'A History of Famous Men and Famous Women' (1739–45).

Hol'brook, John Edwards, American naturalist: b. Beaufort, S. C., 30 Dec. 1794; d. Norfolk, Mass., 8 Sept. 1871. He was graduated from Brown in 1815, from the medical school of the University of Pennsylvania in 1818, began practice at Charleston, S. C., in 1822, and in 1824 was appointed to the chair of anatomy in the Medical College of South Carolina, a post he held for over 30 years. In the Civil War he was head of the South Carolina examining board of surgeons. His 'American Herpetology, or a Description of Reptiles Inhabiting the United States' (1842), won for him recognition among European scientists. He published but 10 numbers of his 'Ichthyology of South Carolina' (1854 *et seq.*), when the Civil War compelled its discontinuance.

Hol'comb, Silas Alexander, American jurist: b. in Gibson County, Indiana, 25 Aug. 1858. He received a common school training, studied law in Nebraska, and in 1891 was made judge of the 12th judicial district. He was governor of Nebraska from 1894 to 1898, having been elected by fusion of the Populist and Democratic voters. He has been justice of the supreme court of Nebraska from 1900.

Hol'combe, Chester, American diplomatist and author: b. Winfield, N. Y., 16 Oct. 1844. He was graduated at Union College in 1861; and served as interpreter and secretary to the United States Legation in China, 1871–85. Becoming an authority on the Chinese and Chinese affairs, in 1896 he acted for the Chinese government in its financial embarrassments. He has published: 'Travels in Western China' (1875); 'The Practical Effect of Confucianism upon the Chinese Nation' (1882); 'The Real Chinaman' (1895); 'The Real Chinese Question' (1899).

Holden, hōl'dĕn, **Albert J.,** American musician: b. Boston 1841. He studied music in New York, and since 1855 has been organist at the Church of the Divine Paternity and at the Church of the Puritans. He has composed more than 300 anthems, hymns and other church music, but his compositions are not confined to sacred music; they include songs, ballads, and choruses; he has also edited and compiled numerous collections.

Holden, Albert W., English painter: b. London 6 July 1848. He studied drawing and antiquities at the British Museum, and gained a studentship at the Royal Academy of Arts, where he afterward exhibited. He has painted historical and humorous genre pictures, and has a high reputation as a portrait painter. Since 1887 he has been professor of fine arts, King's College, London. Among the well known works he has exhibited are: 'A Bank Holiday' (1883); 'Naughty Polly' (1898); 'The Annunciation' (1896); etc.

Holden, Edward Singleton, American astronomer: b. St. Louis, Mo., 5 Nov. 1846. He was graduated at Washington University in 1866, and at the United States Military Academy in 1870; was professor of mathematics at the Naval Academy in 1873–81; and director of the Washburn Observatory (Madison, Wis.) in 1881–5. In 1885–7 he was president of the University of California, and in 1888–98 director of the Lick Observatory, on Mount Hamilton, San José, Cal. It was in connection with the Lick Observatory that his most important work was done, and his services to astronomy found recognition in America and from European states. Among his publications are: 'Index Catalogue of Nebulæ' (1877); 'Life of Sir William Herschel' (1881); 'Astronomy' (with S. Newcomb, 1892); 'Mountain Observatories' (1896); 'Essays in Astronomy' (1900).

Holden, Sir Isaac, English inventor: b. Hurlet, near Paisley, 7 May 1807; d. Reighley, Yorkshire, 13 Aug. 1897. While a worker in a cotton mill in Paisley he fitted himself for the post of a teacher. While conducting an experiment he discovered the lucifer match, but he secured no patent on the invention, the financial benefit of which fell to others. Subsequently he was manager, then owner of a wool-combing establishment, and by his mechanical improvements made significant changes in that industry. His shops at Bradford, with branches at Croix and Rheims, eventually became the largest of the kind in the world. He was several times elected to Parliament in the Liberal interest.

Holder, hōl'dėr, **Charles Frederick,** American naturalist: b. Lynn, Mass., 5 Aug. 1851. He studied at the United States Naval Academy, but resigned in 1871; in 1871–5 was assistant curator of the American Museum of Natural History, from that time turned his attention to lecturing and literary work, and became known as a leading writer on popular science. At Pasadena, Cal., whither he removed in 1885, he became president of the board of education, professor of zoology in Throop University, and honorary curator of the university museum. Among his publications are: 'Elements of Zoology' (1885); 'Living Lights' (1887); 'Louis Agassiz, his Life' (1892); 'Along the Florida Reef' (1892); 'Stories of Animal Life' (1900); 'Half-Hours with Nature' (1901).

Holds'worth, Annie E., English novelist: b. Jamaica. She was married to Eugene Lee-Hamilton, the poet, in 1898. She has been coeditor of 'The Woman's Signal,' with Lady Henry Somerset, and is the author of the popular novels: 'Joanna Traill, Spinster'; 'The Years that the Locust Hath Eaten'; 'Spindles and Oars'; 'The Gods Arrive' (1897); etc.

Hole, Samuel Reynolds, English Anglican clergyman: b. 5 Dec. 1819; d. Rochester, Eng., 27 Aug. 1904. He was educated at Oxford, took orders, was ordained in 1845 and was vicar of Caunton, 1845–87. From 1887 he was dean of Rochester Cathedral. He visited the United States on a lecture tour in 1896, where his humorous, anecdotical lectures were very popular. He was a recognized authority on rose culture and wrote: 'A Book about Roses,' which has reached its 15th edition; 'The Memories of Dean Hole'; 'More Memories'; 'Addresses to Working Men'; 'A Little Tour in America'; 'Our Gardens' (1899); 'Then and Now' (1901); etc.

Hole, William, English painter: b. Salisbury 7 Nov. 1846. He was destined for the profession of engineering but after a journey to Italy turned his attention to art. He studied at the Edinburgh school of art, and in 1889 was elected member of the Royal Scottish Academy. His versatility is shown by the excellence of his work in portrait, genre and fresco, while as an engraver he has made many famous plates after such masters as Millet, Constable and Millais. Among his best known paintings are: 'The End of Forty-Five' (1879); and 'News of Flodden' (1886).

Holguin, ōl-gēn', Cuba, city in the province of Santiago de Cuba; about 25 miles by rail south by west of Gibara, its port; and 70 miles northwest of the city of Santiago de Cuba. Fertile agricultural lands are in the vicinity, also on the southwest is a hilly section bordering on the interior mountain range. A noted cave is in the vicinity. The trade is chiefly in sugar-cane and tobacco. Pop. 6,500.

Hol'ibut. See Halibut.

Hol'iday, any day set apart as a religious or national festival. (See Festivals.) Certain days are fixed by law as bank-holidays for England and Scotland, and it is enacted that all business transactions which would have been valid on any such holiday shall be held as valid if performed on the day following. Thus, when a bill of exchange becomes due, or notice of dishonor falls to be given, on a bank-holiday, the bill is payable, or the notice stands good on the following day. The days fixed for England are Easter Monday, the Monday in Whitsun Week, the first Monday in August, and the 26th of December if a week-day. These are in addition to Christmas Day, Good Friday, and other holidays previously established. The days fixed as bank-holidays for Scotland are New Year's

Day, Good Friday, the first Monday of May, the first Monday of August, and Christmas Day; and if either New Year's Day or Christmas Day falls on a Sunday, the Monday after is held as a holiday. The same act empowers the sovereign to appoint by proclamation a special day to be observed as a bank-holiday, and to alter by order in council any of the days settled by the act.

In the United States there is no national holiday, not even 4 July. The 53d Congress passed an act making Labor Day a public holiday in the District of Columbia, and various States have followed with a similar act. The proclamation of the President designating a day of Thanksgiving only makes it a legal holiday in the District of Columbia and in the Territories. New Year's Day is a legal holiday in all the States except Massachusetts, Mississippi, and New Hampshire. Lincoln's Birthday (12 Feb.) is a legal holiday in Connecticut, Illinois, Minnesota, New Jersey, New York, North Dakota, Pennsylvania, Washington, and Wyoming. Washington's Birthday (22 Feb.) is a legal holiday in all the States except Mississippi. Decoration Day (30 May) in all the States except Alabama, Florida, Georgia, Idaho, Louisiana, Mississippi, North Carolina, South Carolina, and Texas. Independence Day (4 July) in all the States and Territories. Labor Day (in general, the first Monday in September) in all the States except Arizona, Mississippi, Nevada, and North Dakota. Election Day and Christmas Day are generally observed as legal holidays in all the States and Territories. There are various States holidays, such as Patriot's Day (19 April) in Massachusetts, Pioneer's Day (16 Aug.) in Utah, All Saints' Day (1 Nov.) in Louisiana, Admission Day (9 Sept.) in California, and Confederate Memorial Day (10 May) in North and South Carolina. Every Saturday after 12 o'clock noon is a legal holiday in New York, New Jersey, Pennsylvania, Maryland, Tennessee, Virginia, in the city of New Orleans and in Newcastle County, Delaware.

Holinshed, hŏl'inz-hĕd, **Raphael** or **Ralph**, an English chronicler: d. about 1580. He is only known by his 'Chronicles of Englande, Scotlande, and Irelande,' the first edition of which, known as the "Shakespeare edition," because it is the one the poet is supposed to have used in collecting material for his historical plays, was published in London in 1577. In the preparation of this work Holinshed was assisted by several of the most learned men of the day.

Holl, Frank, English portrait and genre painter: son of Francis Holl, an eminent engraver: b. London 4 July 1845; d. there 31 July 1888. He was a very successful student at the Royal Academy, and exhibited constantly from his student days. Among his best-known pictures are: 'Faces in the Fire'; 'Fern-Gatherers'; 'No Tidings from the Sea'; 'Leaving Home'; and the 'Gifts of the Fairies.' In the later portion of his career he devoted himself to portraiture, in which he greatly excelled, and painted many of the celebrities of the day.

Holland, Edmund Milton, American actor: b. New York 7 Sept. 1848. He began his professional career at Barnum's Museum in 1866, was later for 13 years a member of Lester Wallack's company, and as a member of the Madison Square company from 1882 created the parts of Captain Redwood in 'Jim the Penman,' Colonel Moberley in 'Alabama,' and the title-role in 'Colonel Carter of Cartersville.' In 1895-7 he starred with his brother Joseph, and later (1901) appeared as Eben Holden in the dramatization of Irving Bacheller's book of that name.

Holland, Frederic May, American author: b. Boston 2 May 1836. He was graduated from Harvard in 1859, entered the ministry of the Unitarian Church in 1862, but resigned in 1874. His publications include: 'The Reign of the Stoics' (1879); 'Frederick Douglass, the Colored Orator' (1895); and 'Liberty in the Nineteenth Century' (1899).

Holland, Henry Richard Vassall Fox, 3D Lord, English statesman: b. Wiltshire 21 Nov. 1773; d. 22 Oct. 1840. He succeeded to the peerage by the death of his father when less than one year old. In 1798 he took his place in the House of Lords, and as the nephew of Charles James Fox was at once acknowledged as a Whig leader. In 1806 he was commissioner for settling disputes with the United States; was lord privy seal in 1806-7; and chancellor of the duchy of Lancaster. He made Holland House the resort of the wit, talent, and beauty of his day. He was the author of: 'Life of Lope de Vega' (1806); 'Three Comedies from the Spanish' (1807); 'Foreign Reminiscences' (1850); 'Memoirs of the Whig Party' (1852).

Holland, John P., American inventor: b. 1841. As one of the most successful designers in the interesting field of submarine navigation, Holland is well known. His first boat was built in 1875; a second was launched in 1877, and a third in 1881. After a series of severe tests, the Holland boat was ordered by the United States government for the navy in 1900. In 1903 eight of the submarines were put in commission. These have a speed varying from 8.87 to 8 knots, a horse-power of 160 (with one exception), and a displacement in general of 122.55 tons. For some time the inventor was interested in the Holland Submarine Boat Company, but from this he has now retired to devote his time independently to submarines and flying devices. His more recent designs call for smaller and more compact vessels, with much less complicated mechanism, power of remaining longer submerged, and increased safety in operation. See Submarine Navigation, History of.

Holland, Josiah Gilbert, American editor and author: b. Belchertown, Mass., 24 July 1819; d. New York 12 Oct. 1881. He began the study of medicine in 1840, in 1844 was graduated from the Berkshire Medical College, and entered practice at Springfield, Mass. The years that followed were discouraging, for patients did not come to the young doctor. With true Yankee versatility he turned his hand to anything,—taught district school, was a traveling writing-master, and a daguerreotypist. Of his boyish mortification at being a mill hand he has written in 'Arthur Bonnicastle.' He tried editorial work, and started 'The Bay State Weekly Courier,' which ran for six months. Subsequently he taught at Richmond, Va., and for 16 months was superintendent of public schools at Vicksburg, Miss. All these varied experiences gave him the knowledge of American life and appreciation of workaday struggles which later made the value of his poems, essays, and novels. In 1849–66 he was assistant editor of the Springfield *Republican*, and from 1851 also part owner of that journal. It was largely due to his influence that the *Republican* became so widely known and popular a journal. In it his 'Letters to Young People Married and Single: By Timothy Titcomb' first attracted readers by their vivacious style, moral sincerity, and good common sense. Later, in book form (1858) they had a great and immediate success.

In 1870 Dr. Holland was one of the founders and became editor of 'Scribner's Monthly,' later the 'Century Magazine,' and the editorship of this periodical he retained till his death in 1881. Holland's novels: 'Arthur Bonnicastle' (1873); 'Sevenoaks' (1876); and 'Nicholas Minturn' (1877), although showing his quick and sympathetic observation and containing fine passages, have been less popular than his poems. The latter, in their constant appeal to the moral sense, and in their accurate portrayal of the homely and picturesque in New York life, found many admirers. Several of the short lyrics, with 'Bittersweet' (1858); 'Kathrina' (1868), and 'The Mistress of the Manse' (1871), came as messages of an American poet who understood and honored his own people. Consult the 'Life' by Plunkett (1894).

Holland, Thomas Erskine, English jurist: b. Brighton 17 July 1835. He studied at Oxford, was called to the bar in 1863, in 1874 became a reader in English law at Oxford, and shortly afterward professor of international law. The University of Perugia appointed him to an honorary professorship in recognition of his attainments. His best-known work is his 'Elements of Jurisprudence' (1880; 9th ed. 1900), to which was awarded the Swinney prize (1894), decennially bestowed for the best book published on jurisprudence, and which is now a standard text-book in England and the United States. He wrote further: 'An Essay on Composition Deeds' (1864); 'Essays on the Form of the Law' (1870); 'The European Concert in the Eastern Question' (1885); 'Studies in International Law' (1898), and other works.

Holland, William J., American Presbyterian clergyman and educator: b. Jamaica, W. I., 16 Aug. 1848. He was graduated from Amherst College in 1869, from the Princeton Theological Seminary in 1874, entered the ministry of the Presbyterian Church, and was a pastor at Pittsburg, Pa., in 1874–91. In 1891–1901 he was chancellor of the Western University of Pennsylvania (Allegheny), and in 1897 was appointed director of the Carnegie Museum at Pittsburg. In 1887 and 1889 he was naturalist of the United States eclipse expeditions to Japan and West Africa respectively. A recognized authority on museum administration and zoology, he wrote numerous scientific papers in learned publications, and 'The Butterfly Book' (1898).

Holland, a popular designation for the Kingdom of the Netherlands, derived from the provinces of North and South Holland, formerly constituting a feudal countship allied to the Holy Roman-German Empire, and from 1806–10 with other parts of the Netherlands, Hanover, and Oldenburg, ruled by Louis Bonaparte as the Kingdom of Holland. The region is the seat of the hardy and industrious Dutch race and of the Dutch language called by the natives *Nederduitsch*, a dialect of Low German phonology, with evolutionary periods of Old, Middle, and Modern, and an interesting historical and varied literature. See NETHERLANDS.

Holland, Mich., city, in Ottawa County, at the head of Black Lake, which is really an arm of Lake Michigan, and on the Père Marquette railroad; about 80 miles west of Lansing and 25 miles southwest of Grand Rapids. It has direct communication by steamers with Chicago, Milwaukee, and other lake ports. Holland was settled in 1847 by a Dutch colony, and many of its inhabitants are of Dutch descent. In 1867 it was chartered as a city. It is located in an agricultural region, once a lumber section. The manufactures are largely articles made of wood, but the beet-sugar industry is growing in importance. The chief manufacturing establishments are planing-mills, furniture, tub, and basket factories, flour-mills, tanneries, wood-working machinery shops, pickling-plants, beet-sugar factory, grain elevators, and creameries. The manufacture of launches is also an important industry of Holland. The trade is chiefly in the manufactures, and in grain and vegetables. The city owns and operates the electric-light plant and the waterworks. Holland is the seat of the Western Theological Seminary and of Hope College, both under the auspices of the Reformed Church in America. It has a number of fine public buildings, and a free public library. The summer resorts on Black Lake add to the industrial wealth of the city. Pop. (1890) 3,945; (1900) 7,790.

Holland-linen, a fine and close fabric, so called from its first being manufactured in Holland; also a coarser linen fabric, unbleached or dyed brown, used for covering furniture, carpets, etc.

Hol'lander, Jacob H., American economist: b. Baltimore, Md., 23 July 1871. He was educated in the Baltimore schools and graduated from Johns Hopkins University in 1891, receiving his Ph. D. degree in 1894. His ability as economist and financier was soon recognized, and he became associate professor of finance at Johns Hopkins. In 1897 he was appointed secretary of the Bimetallic Commission abroad and was chosen chairman of the Baltimore municipal lighting commission in 1900. In the same year the secretary of war appointed him special commissioner to revise the laws relating to taxation in Puerto Rico, and while engaged in this service he was made treasurer of Puerto Rico by President McKinley.

Hollar, Wenzel or **Wenceslaus**, vĕnt'zĕl or wĕn'sĕs-lâs hŏl'lär, Bohemian engraver: b. Prague 13 July 1607; d. London 28 March 1677. He accompanied the Earl of Arundel, English ambassador to Germany, to London, who employed him to engrave some of the pictures of his collection. Among his numerous works, which are greatly esteemed for their delicate, firm and spirited execution, and which include some 2,740 plates, are the set of 28 plates, entitled, 'Ornatus Muliebris Anglicanus,' representing the dresses of Englishwomen of all ranks and conditions in full-length figures; Holbein's 'Dance of Death,' etc.

Holleben, hōl'lā-bĕn, **Theodore von**, German diplomat: b. Stettin, Pomerania, 10 Sept. 1838. He was educated at the universities of Heidelberg, Berlin, and Göttingen; became an officer in the Body-Guard Hussar Regiment; and took a distinguished part in the Franco-Prussian War. He entered the diplomatic service in 1872; was *chargé d'affaires* at Peking, China, 1873-4, and at Tokio, Japan, in 1875; minister at Buenos Ayres in 1876-84; at Tokio 1885-9; and at Washington, D. C., 1892-3. In 1897 he became ambassador extraordinary and plenipotentiary to the United States. At the command of Emperor William he, together with Secretary Hay, of the State Department, had charge of the arrangements for the official reception of the emperor's brother, Admiral Prince Henry, in February 1902. Failing health caused his resignation, and in 1903 he was succeeded by Baron Speck von Sternberg.

Hol'ley, Alexander Lyman, American engineer: b. Lakeville, Conn., 20 July 1832; d. Brooklyn, N. Y., 29 Jan. 1882. He was graduated at Brown University in 1853, and became editor of 'The Railroad Advocate' in 1850, changing its name to 'The American Engineer.' He introduced into the United States in 1865 the Bessemer steel process, erecting the first Bessemer works in the country at Troy, N. Y. He was lecturer on the manufacture of iron and steel at Columbia University 1879-82. Holley secured many patents, the most important probably being that for the detached converter-shell, an improvement in the Bessemer process. He published with Z. Colburn: 'Railway Economy: a Report on European Railways' (1858); 'American and European Railway Practice' (1860); 'A Treatise on Ordnance and Armor' (1865); etc. In 1890 a bronze bust of Holley was placed in Washington Square, New York, by the mechanical engineers of the United States and Europe.

Holley, Marietta, American author, known by her pseudonym, 'JOSIAH ALLEN'S WIFE': b. near Adams, Jefferson County, N. Y., 1844. She began her literary career as a contributor to the 'Christian Union,' the 'Independent,' 'Peterson's Magazine,' and other periodicals; and in 1873 published her first book, 'My Opinions and Betsy Bobbet's,' which in a measure recalled the 'Widow Bedott Papers' of F. M. Whitcher. This was followed by a series of works containing many touches of distinctive and genuine humor: 'Samantha at the Centennial' (1876); 'My Wayward Pardner' (1880); 'Miss Richard's Boy' (1882); 'Sweet Cicely' (1885); 'Miss Jones's Quilting' (1887); 'Samantha at Saratoga' (1887); 'Poems' (1887); 'Samantha Among the Brethren' (1891), considered by many her best volume; 'Samantha at the World's Fair' (1893), and others. Her writings have had large sale, and been translated into several foreign tongues.

Hollidaysburg, hŏl'ĭ-dāz-bĕrg, Pa., borough, county-seat of Blair County; on the Juniata River, and the Pennsylvania railroad; about 82 miles east of Pittsburg and five miles south of Altoona. Rich coal-fields, iron-ore beds, and limestone quarries are in the vicinity. The chief manufactures are foundry products, agricultural and mining implements, nails, and furniture. Hollidaysburg Female Seminary is a prosperous institution. Pop. 3,000.

Hol'lins, Alfred, English musician: b. Hull 1865. He was born blind, and was educated at an institution for the blind in York, and at the Royal Normal College for the Blind in Upper Norwood, where he specialized in music (piano and organ); he also studied music in Germany. He was popular at the English and German courts, where he gave recitals; and was for a time organist at the United Free Saint George's Church in Edinburgh. He visited America in 1886 and 1888, and his organ compositions are widely known and liked throughout the United States.

Hollins, George Nichols, American naval officer: b. Baltimore, Md., 20 Sept. 1799; d. there 18 Jan. 1878. He entered the navy as midshipman in 1814, and while assigned to the President, Stephen Decatur, was captured by the English and held prisoner at Bermuda until the conclusion of peace. He served also in the Algerine war of 1815, later assumed command of an East Indiaman, and in 1844 attained commander's rank. In 1855, on complaint of American residents who claimed they had been injured by the local officials, he bombarded Greytown, Nicaragua. At that time Nicaragua was under English protection, and the property and lives of English residents having been imperiled, international complications with Great Britain arose. Hollins was commissioned commodore in the Confederate navy at the outbreak of the Civil War, attacked the Federal blockading squadron at the passes of the Mississippi River, and was appointed flag-captain of the New Orleans station. He was superseded in 1862.

Hol'lister, Cal., town, county-seat of San Benito County; on the Southern Pacific railroad; about 80 miles southeast of San Francisco, and 35 miles east by south of Santa Cruz. It is situated in a rich agricultural region, noted for its fruit. The chief industrial interests of the town are connected with dairying, fruit-growing, and the shipment of grain and live-stock. Pop. (1900) 1,315.

Holloway, hŏl'ō-wā, **Laura Carter**, American author: b. Nashville, Tenn., 22 Aug. 1848. She was at one time editor of the 'Home Library Magazine' of Chicago, Ill., was for 12 years associate editor of the Brooklyn *Daily Eagle*, and collaborated with Anton Seidl in the preparation of musical terms for the 'Standard Dictionary.' She wrote: 'Ladies of the White House' (1870); 'The Mothers of Great Men and Women' (1884); 'The Home in Poetry' (1884); 'Chinese Gordon' (1885); 'The Buddhist Diet Book' (1887); and other volumes.

Holloway, Thomas, English patent medicine proprietor and philanthropist: b. Devonport 22 Sept. 1800; d. Tittenhurst 26 Dec. 1883. About 1837 he began to sell his well-known ointment, and soon afterwards brought his pills to the notice of the public. He ultimately succeeded in amassing a very large fortune which he partly devoted to benevolent objects. The Royal Holloway College for Women, on the equipment and endowment of which he expended about $4,000,000 was opened on 30 June 1886. It contains a collection of pictures valued at $500,000. Near it is a sanitorium founded by him for the mentally afflicted of the lower middle class.

Holls, hōlz, **George Frederick William**, American lawyer and statesman: b. Zelienople, Pa., 1 July 1857; d. Yonkers, N. Y., 23 July 1903. He was graduated from Columbia in 1878, and from the law school there two years later. He was admitted to the bar and established a large law practice in New York city, becoming senior member of the firm of Hollis, Wagner & Burghard; in his later life he visited Europe frequently and became widely known there, especially in Germany where he established a branch of his law firm. He was prominent in philanthropic work, being for years an officer of the Legal Aid Society and a director of the Charity Organization Society. He was also an active member of the Republican party, and much in demand as a campaign speaker, especially as he could address the Germans in their own language. In 1893 he was a delegate-at-large to the New York Constitutional Convention, where he was chairman of the committee on education, a member of the committee on cities, and author of several amendments. His frequent visits abroad gave him a wide and intelligent interest in international questions, and at the time of the Hague Conference he was very influential in arousing interest and obtaining a large delegation from the United States. He was secretary of the American delegation at the Conference (1899), was the American member of the committee which drafted the arbitration treaty, and author of the clause on «Special Mediation.» He was afterward appointed a member of the permanent international court of arbitration. A few months before his death President Roosevelt asked him to umpire the adjustment of claims between Germany and England and Venezuela, but he declined. He has written: 'Sancta Sophia and Troitza' (1888); 'Compulsory Voting' (1891); and 'The Peace Conference at the Hague and Its Bearings on International Law and Policy' (1900).

Hol'ly, James Theodore, American Protestant Episcopal bishop: b. Washington, D. C., 3 Oct. 1829. He was of African Roman Catholic parentage, but withdrawing from the Roman Catholic Church, entered the Episcopal Church in 1851, studied for the ministry and in 1856 became rector of St. Luke's, New Haven, Conn. In 1874 he became missionary bishop of Haiti.

Holly. See AQUIFOLIACEÆ.

Holly Springs, Miss., a point on the Mississippi Central Railroad, about 40 miles southeast of Memphis and about 25 miles south of Grand Junction, on the Memphis & Charleston Railroad, and an important strategical point. After the battle of Iuka, 19 Sept. 1862, and the Confederate defeat at Corinth, 3-4 Oct. 1862, the Confederates fell back to Holly Springs. Early in November Gen. Grant had concentrated an army of 30,000 men in the vicinity of Grand Junction to make a movement along the line of the Mississippi Central Railroad in the direction of the rear of Vicksburg. On 8 November Gen. McPherson, with 10,000 infantry and 1,500 cavalry, advanced from Grand Junction southward and pushed the Confederates under Gen. Pemberton back to Holly Springs. The main body of Grant's army moved forward, and Pemberton, abandoning Holly Springs, fell back to Grenada, Grant following to Oxford, 30 miles beyond Holly Springs. There he arrived 5 December, and arranged with Gen. Sherman a combined movement on Vicksburg. Grant was to move directly south on the line of the railroad and take the place in rear; Sherman to move a force from Memphis, accompanied by a gunboat fleet, to descend the Mississippi and attack in front. A depot of supplies was established at Holly Springs, guarded by Col. Murphy, with two regiments of Wisconsin infantry and a regiment of Illinois cavalry, and Grant was about to move forward from Oxford, when Gen. Earl Van Dorn, at the head of 3,500 cavalry, dashed into Holly Springs at daylight, 20 December, and attacked Murphy, who had been warned of the impending danger on the 19th, but neglected to take the necessary precautions and was surprised. He made a feeble resistance and surrendered his infantry; the cavalry cut its way out and escaped with the loss of only seven men. Van Dorn took about 1,500 prisoners, destroyed stores to the value of $1,500,000, and left town in the afternoon. This disaster, in connection with Forrest's raid into West Tennessee, which destroyed Grant's communication, forced him to abandon his movement on Vicksburg and fall back to Grand Junction, leaving Pemberton at liberty to concentrate his forces at Vicksburg against Sherman. Sherman was informed of Grant's failure, but the information reached him after his bloody repulse at Chickasaw Bluff, 27-28 Dec. 1862. Consult: 'Official Records,' Vol. XVII.; Greene, 'The Mississippi.'

E. A. CARMAN.

Hol'lyhock, a tall and rather coarse flowering plant (*Althæa rosea*) of the mallow family, said to be a native of China, but now cultivated all over the world as an ornament of old-fashioned gardens. It rises in a single leafy stalk, sometimes to the height of six or eight feet, studded with large single or double flowers, in varieties from white to yellow, scarlet and purple. Although rather difficult to start and slow of growth, it remains a hardy and easily nurtured perennial of highly effective beauty when suitably placed.

Holm, Saxe, a pseudonym affixed to a collection of 'Stories' (1st series 1874; 2d 1878), originally published in 'Scribner's Monthly' and generally believed to be by Helen Hunt Jackson (q.v.).

Holman, hōl'man, **William Steele**, American politician: b. Veraestau, Dearborn County, Ind., 6 Sept. 1822; d. Washington, D. C., 22 April 1897. He studied at Franklin College (Ind.), was admitted to the bar, and began practice at Aurora, Ind. In 1847-9 he was prosecuting attorney, in 1850 a member of the State Constitutional convention, in 1851-2 of the State legislature. He was a judge of the court of common pleas in 1852-6, in 1856 was elected as a Democratic representative to Congress, where with the exception of eight years, he served until his death. His vigilance in opposing unnecessary appropriations and doubtful measures obtained for him the sobriquets of "The Watchdog of the Treasury," and "The Great Objector."

Holman-Hunt, William. See HUNT, WILLIAM HOLMAN.

Holmes, hōmz, **Abiel,** American Unitarian clergyman and annalist: b. Woodstock, Conn., 24 Dec. 1763; d. Cambridge, Mass., 4 June 1837. He was graduated at Yale College in 1783, and became subsequently a tutor in the college, pursuing at the same time his theological studies. In 1785 he was settled over a parish at Midway, Ga., where he remained till 1791. Returning north he became pastor of the first parish in Cambridge, and continued to fill the office till 26 Sept. 1832. Besides publishing a 'Life of President Stiles' in 1798, he was the author also of 'Annals of America' (1805), which gave him a high reputation for care and accuracy. It was republished in England in 1813. He contributed frequently to the collections of the Massachusetts Historical Society, in Vol. XXVII. of which will be found a complete list of his publications.

Holmès, ō-mĕs', **Augusta Mary Anne,** French composer: b. Paris 1847; d. there Jan. 1903. She studied composition with Lambert, Klose, and César Franck, and began her career as a pianist. Her first work of magnitude was a setting of the psalm 'In Exitu,' sung for the first time in 1873. She later wrote considerable music, including 100 songs, characterized by much grace of expression. In the larger forms her compositions include the well-known symphony 'Hero et Léandre'; three other symphonies, 'Lutèce,' which in 1879 won third prize in an open competition directed by the Paris municipality, 'Les Argonautes' and 'Irlande'; the symphonic poems, 'Les Sept Ivresses,' 'Roland,' 'Pologne,' 'Au Pays Bleu'; an ode of triumph, 'Patrie'; a four-act lyric opera, 'Le Montagne Noire' (Grand Opera 1895), and an allegorical cantata, 'La Vision de la Reine.'

Holmes, Burton, American traveler and lecturer: b. Chicago 8 Jan. 1870. After a secondary education at Chicago he traveled in all the countries of continental Europe, as well as in Japan, Algeria, Tunis, Morocco, Corsica, Greece, and Thessaly, Hawaiian Islands, the Yellowstone Park, the Grand Cañon of the Colorado, the Philippines, and China. About 1890 he became known as a platform lecturer, giving in popular form the results of his observations.

Holmes, Mary Jane Hawes, American novelist: b. Brookfield, Mass. She was married to Daniel Holmes, a lawyer of Brockport, N. Y., where she has since resided. She has published many volumes of domestic fiction which have had an extraordinarily wide circulation but in which the literary element is slight. Among her novels are: 'Tempest and Sunshine' (1854) (perhaps the best known of them all); 'Lena Rivers' (1856); 'Marian Gray' (1863); 'Milbank' (1871); 'Queenie Hetherton' (1883).

Holmes, Nathaniel, American jurist and Shakespearian scholar: b. Peterboro, N. H., 2 Jan. 1815; d. Cambridge, Mass., 26 Feb. 1901. He was graduated from Harvard in 1837 and after admission to the bar in 1839 began to practise in St. Louis. He was judge of the supreme court of Missouri 1865–9, and Royall professor of law at Harvard 1868–72. He retired from his profession in 1883 and henceforth devoted himself to study and authorship. He was a strong believer in the Baconian theory of the origin of Shakespeare's plays, which he defends in his work, 'The Authorship of Shakespeare' (1866). In 1888 he published 'Realistic Idealism in Philosophy Itself.'

Holmes, Oliver Wendell, American poet, essayist and physician: b. Cambridge, Mass., 29 Aug. 1809; d. Boston, Mass., 8 Oct. 1894. He was the son of Rev. Abiel Holmes (q.v.), minister of the first parish in Cambridge, and on the maternal side was a descendant of Anne Bradstreet (q.v.) and related to the orator Wendell Phillips, the poet Richard Henry Dana, and the theologian, Dr. Channing. He was educated at Phillips Academy, Andover, and at Harvard, and was graduated from the latter in 1829 in a class which contained several who afterward became famous. In the next year he became well known through his poem 'Old Ironsides,' first published in the Boston *Advertiser*, and which prevented the breaking up of the famous frigate Constitution. He spent a year in the Harvard Law School but soon turned his attention to medicine and after studying in Paris three years returned to America where he received his degree of M.D. in 1836, the same year in which his first volume of poems appeared. He was professor of anatomy and physiology at Dartmouth College 1839–40. He married in the last named year and established a practice in Boston, becoming in 1847 professor of anatomy and physiology in the Harvard Medical School, a post which he resigned in 1882, when he was at once made professor emeritus. In 1849, and for several succeeding years, he made his summer home at Pittsfield, Mass., the scene of his novel 'Elsie Venner.' He was one of the first contributors to the 'Atlantic Monthly' when it was established in 1857, the opening chapter of his 'Autocrat of the Breakfast Table' appearing in the first issue. It is this work, which has found innumerable readers both at home and abroad, by which he will be longest remembered. These brilliant, conversational papers were followed in 1859 by a similar series, 'The Professor at the Breakfast Table,' and these in 1872, by 'The Poet at the Breakfast Table.' Many of his best poems were scattered through these volumes. In 1861 appeared his novel 'Elsie Venner: a Romance of Destiny,' and in 1868 'The Guardian Angel,' a less striking fiction than its predecessor, but like that exhibiting a remarkable series of studies of character. 'A Mortal Antipathy' (1885) was his only other essay in fiction. His volumes of verse 'Urania' (1846), and 'Astrea' (1850), had made him well known as a poet ere he appeared before the public as the kindly breakfast table autocrat, and he continued to write poetry at frequent intervals for the rest of his life. He was especially happy as the poet of occasions, but much of his verse, witty and sparkling as it is, is ephemeral from its very nature and not destined to endure. In such serious poems,

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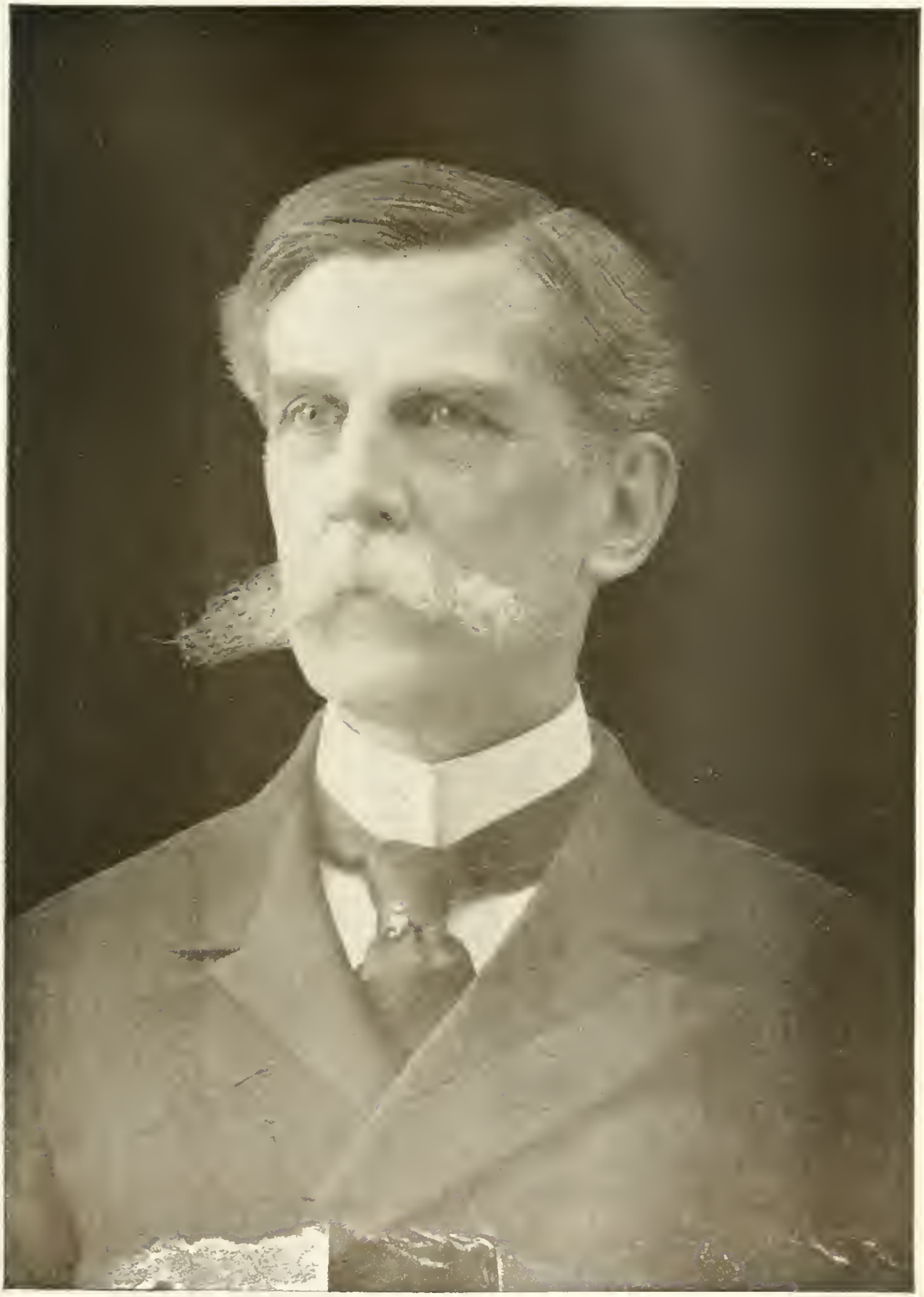

Photographed by Notman.

OLIVER WENDELL HOLMES,

ASSOCIATE JUSTICE OF THE UNITED STATES.

however, as: 'The Chambered Nautilus'; 'The Voiceless'; 'The Last Leaf'; 'The Iron Gate'; and one or two hymns, he takes high rank among the poets of his time, while such poems as 'The One Hoss Shay'; 'Evening, By a Tailor,' and 'Parson Turell's Legacy,' to name no others, are inimitable examples of humorous verse. His later collections of poems comprise: 'Songs in Many Keys' (1861); 'Songs of Many Seasons' (1875); 'The Iron Gate' (1880); and 'Before the Curfew' (1887). As a physician and medical lecturer he was very successful, and among his purely professional works may be named: 'Lectures on Homeopathy and Its Kindred Delusions' (1842); 'Currents and Counter Currents in Medical Science' (1861); 'Border Lines in some Provinces of Medical Science' (1862); 'Medical Essays,' a reissue of some of his earlier work (1883). Still other volumes by Dr. Holmes are: 'Soundings from the Atlantic' (1864), a series of essays originally contributed to the 'Atlantic Monthy,' where the bulk of his writing first appeared; 'Mechanism in Thought and Morals' (1871); lives of 'John Lothrop Motley' (1879); and 'Ralph Waldo Emerson' (1884); 'Our Hundred Days in Europe' (1888); a sprightly record of a short visit to England in 1886, on which occasion honorary degrees were conferred upon him by the universities of Cambridge, Oxford and Edinburgh; and 'Over the Teacups' (1891). His 70th birthday was celebrated by a breakfast given in his honor by the publishers of the 'Atlantic Monthly,' and on this occasion the poet read his poem 'The Iron Gate,' which many persons have considered even finer than 'The Chambered Nautilus' which Holmes himself preferred to any other verses of his. At its best Holmes's prose style is thoroughly admirable, characterized as it is by an unerring sense of the value of words and their fitness for conveying a desired impression, and illumined by the interfused play of a delicate fancy and the most sparkling humor. Next to 'The Autocrat' must be ranked 'The Guardian Angel' among his prose works, the same kindly tolerant spirit being dominant in both, and the same shrewd, wholesome perception of character. In much of his earlier poetry, excepting in his lyrics, Holmes uses the formal ten-syllabled iambic pentameter of the 18th century, but in his hands the measure seems at times more flexible than when used by Pope and his school, and it is at all events relieved from solemnity by his ever present humor. 'Urania' is the best-known of his earlier efforts in this manner, and 'The Schoolboy' (1878) his most notable later one, this latter having been written for the centennial anniversary of Phillips Academy at Andover. Holmes's special characteristic was kindliness, which found its expression as well in his verse as in his prose, and in his ordinary living. He could be keenly satirical on occasion but he never became in the least cynical. Perhaps no American writer, not even Longfellow or Lowell, ever won the English heart so completely as Holmes. Longfellow found a wide hearing in England for his poetry, it is true, and Lowell was thoroughly appreciated by the upper class Englishman of his time, but Holmes was the most generally beloved of the three. In his own country Holmes's gentle, tolerant writing did not a little toward softening the asperities of controversy and liberalizing unconsciously the heart of Puritan New England. Consult: Morse, 'Life and Letters of Oliver Wendell Holmes' (1896); and lives by Kennedy (1883); E. E. Brown (1884).

Holmes, Oliver Wendell, Jr., American jurist: b. Boston 8 March 1841. He was graduated from Harvard in 1861, and in the same year entered the army as lieutenant of the 20th Massachusetts regiment. He was wounded at the battles of Ball's Bluff, Antietam, and the second battle of Fredericksburg, and was mustered out of the army in 1864, with the rank of brevet lieutenant-colonel. He then studied at the Harvard Law School, and was admitted to the bar in 1866, beginning his practice in Boston. He was editor of the 'American Law Review' (1870–3); became professor at the Harvard Law School in 1882, and in the same year justice in the Massachusetts supreme court; in 1899 he was appointed chief justice of the same court. His decisions in this position gave him wide fame among lawyers, and were characterized by originality and literary finish. In several cases his decisions were in favor of organized labor; his position being that workingmen had a right to combine and to "support their interests by arguments, persuasion, and the bestowal or refusal of those advantages which they otherwise lawfully control, so long as they do no violence or threaten no violence." In August 1902, he was appointed a member of the United States Supreme Court. He has published: 'The Common Law' (1881), lectures delivered before the Lowell Institute; and a collection of speeches (1900); he also edited the 12th edition of Kent's 'Commentaries' (1873).

Holmes, Theophilus Hunter, American soldier: b. Sampson County, N. C., 1804; d. near Fayetteville, N. C., 21 June 1880. He was graduated from the United States Military Academy in 1829, served in the Florida war, the occupation of Texas, and the Mexican War, and at the beginning of the Civil War was major and superintendent of the general recruiting service. On 22 April 1861, he resigned his commission in the United States army, forthwith was appointed brigadier-general in the Confederate forces, and organized several North Carolina regiments. He was in command at Aquia Creek, and, promoted major-general, was in command of the trans-Mississippi department from September 1862 to March 1863, was commissioned lieutenant-general, and 3 July 1863 lost heavily in an unsuccessful attack on Helena, Ark.

Holmes, William Henry, American geologist: b. Harrison County, Ohio, 1 Dec. 1846. He was graduated at the McNeely Normal College in 1870, in 1872 was made an assistant on the United States geological survey, and in 1880–9 was a geologist on the survey. In 1889–98 he was archæologist to the United States bureau of ethnology, directing explorations, and in 1894–8 also curator of anthropology in the Field Columbian Museum of Chicago, and professor of anthropic geology in Chicago University. In 1898 he was appointed head curator in the department of anthropology in the United States National Museum. His chief works are: 'Archæological Studies among the Cities of Mexico'

(1895): and 'Stone Implements of the Potomac-Chesapeake Tidewater Province' (1897).

Holocaine. See COCAINE.

Holocephali, hŏl-ō-sĕf'a-lī. or **Chimæroidea**, a group of small shark-like fishes of bizarre appearance occurring in the deeper portions of all colder seas, including in all about seven species, five in American waters. They have a cartilaginous skeleton, are of no value as food, and are known to fishermen as rat-fish and elephant-fish (q.v.). The name Chimæra, given to one genus, emphasizes the strange appearance of these fishes. See ICHTHYOLOGY.

Holophytes, hō'lō-fīts. See FUNGI.

Holostei, hō-lŏs'tẹ-ī, a group of fishes, the bony ganoids, largely fossil, represented by the garpikes. See ICHTHYOLOGY.

Holothuria, hŏl-ō thū'rĭ a, echinoderms of the class *Holothuroidea*, popularly called "sea-cucumbers," from their resemblance in shape and rough skin to that vegetable, in which the body is long, cylindrical, somewhat worm-like, less radiated than other echinoderms with a thick muscular body-wall of longitudinal and transverse muscles. The skin is usually thick, tough, and imbedded in it are in certain forms calcareous plates, wheels and anchors. The mouth is surrounded with a circle of ten branched tentacles, adapted both for respiration and for seizing the food, which consists mainly of foraminifera. The intestine is very long and slender, thus in *Thyone briareus*, which lives in mud and sand on the coast south of Cape Cod, the intestine in an individual three or four inches long is nearly seven feet in length; it opens at the end of the body, and connects with the "respiratory tree," by which the water is introduced into the interior of the body. Unlike other echinoderms the so-called madreporic body is internal. Holothurians move by tubes or ambulacra feet which are filled with water, and when distended act as suckers to drag the animal over the bottom. These suckers are either arranged in five rows or with three rows on the ventral surface, and two above, the latter in some form obsolete, or they are scattered irregularly over the surface of the body, while in *Caudina arenata* of the New England coast there are no suckers. A tendency to bilateral symmetry is seen in a form like *Psolus*, which has a creeping disk and three rows of suckers on the flattened disk-like under side.

The holothurians undergo a metamorphosis, somewhat like that of the starfish; but the transparent larva called "auricularia," is barrel-shaped; what corresponds to the hoops of the barrel being bands of cilia, while the ear-like projections in certain forms give it the name auricularia. Before the larva is fully grown, the body of the young holothurian begins to bud out from near the side of the larval stomach, the calcareous cross-like plates are deposited, and the tentacles begin to grow out. Finally after the larval body is absorbed the young holothurian sinks to the bottom. The degree of metamorphosis is less marked than in other echinoderms, while in two forms development is direct, the young growing in a marsupium or brood-pouch. A form (*Cladodactyla crocea*) living in the south seas at the Falkland Islands, carries its young in a sort of nursery where they are densely packed in two continuous fringes adhering to the dorsal tubes. Holothurians are remarkable from the fact that when captured they eject their intestine, a new one in time being regenerated. The large forms lying about on the coral reefs are known to harbor a small slender fish (*Fierasfer*) which lodges in their cloaca or in the branchial tree. Many of the species are very large, being nearly two feet in length. A common species on the Florida keys and reefs is *Holothuria floridana;* it lives in water only a few inches deep and can be picked up in large numbers; it is fully 15 inches in length, and lives on foraminifera. It has been collected, dried and a shipload exported to China, but the trepang or beche-de-mer of commerce is either of two species (*H. edulis*, and *H. tremula*) inhabiting the Pacific Ocean (see TREPANG). A California species is also dried and exported by the local Chinese.

The class of *Holothuroidea* is divided into two orders: (1) *Actinopoda* represented by *Holothuria, Cucumaria, Thyone, Psolus*, etc.: and (2) *Paractinopoda*, of which *Synapta* is an example, the common form living in sand at low water on the New England coast being *Leptosynapta girardii*. A few forms inhabit great depths. Remains of holothurians have been found fossil: certain calcareous plates attributed to them occurring in the Carboniferous, Lias, Jura, and Cretaceous strata. Minute calcareous bodies referable to *Synapta*, etc., have been detected in the Paris Eocene limestones.

Holst, hōlst, **Hermann Eduard von,** German-American historian: b. Fellin, Livonia, Russia, 19 June 1841: d. Freiburg, Germany, 20 Jan. 1904. He studied history in Dorpat and Heidelberg and in 1865 traveled through France, Italy, etc. His writings were looked upon with suspicion by the Russian authorities and his further stay in that country becoming unsafe, he removed to the United States in 1866. Here he became American correspondent of the 'Kölnische Zeitung,' and sub-editor of the 'Deutsch-amerikanischer Conversations-Lexicon.' In 1872 he was appointed extraordinary professor of history in the University of Strasburg and in 1874 ordinary professor at Freiburg-im-Breisgau. In 1876 he undertook, with means furnished by the Baden government, a journey to London for the purpose of study and in 1878–9 a similar journey to North America at the expense of the Prussian Academy of Science. In 1892 he accepted an appointment in the University of Chicago. He has published: 'Constitutional and Political History of the United States' (1873); 'The French Revolution Tested by Mirabeau's Career' (1894), etc.

Holstein, hŏl'stīn, Germany, a former duchy of Denmark, and member of the Germanic Confederation, since 1866 united to Schleswig-Holstein (q.v.), Prussia.

Holstein Cattle. See DAIRY CATTLE.

Holston, hōl'stŏn, a river which rises in the southwestern part of Virginia, flows south and southwest into Tennessee and unites with the French Broad River about five miles east of Knoxville. The Holston and the French Broad are the head-streams of the Tennessee River. The course of the Holston is through a mountainous country, noted for its beautiful scenery.

It has as tributaries many small mountain streams. Its length is about 200 miles.

Holt, Joseph, American jurist: b. Breckinridge County, Ky., 6 Jan. 1807; d. Washington, D. C., 1 Aug. 1894. He began legal practice at Elizabethtown in 1828, and in 1857 was appointed commissioner of patents. In 1859 he became postmaster-general and in 1860 secretary of war. He was made by Lincoln a judge-advocate general of the army, with colonel's rank, was promoted brigadier, brevetted major-general for distinguished service in the bureau of military justice, and was retired in 1875. With the exception of Cass, he was the only member of Buchanan's cabinet that was not a Confederate sympathizer. Among the courts over which he presided were those before which Fitz-John Porter and Lincoln's assassins were tried.

Hol'ton, Kan., city, county-seat of Jackson County; on the Missouri P., the Chicago, R. I. & P., and the Union P. R.R.'s; about 28 miles north of Topeka and 30 miles west of Atchison. It was settled in 1859 and received its charter in 1870. It is situated in a section noted for good farms. The chief manufactures are flour, wagons, cigars, creamery products, and planed lumber. Its trade is chiefly in wheat, corn, hay, live-stock, and local manufactured products. The government is vested in a mayor, who holds office two years, and a common council. Pop. (1900) 3,082.

Hölty, Ludwig Heinrich Christoph, lood'vĭg hīn'rĭн krēs'tŏf hėl'tĭ, German lyric poet: b. Mariensee, near Hanover, 21 Dec. 1748; d. Hanover 1 Sept. 1776. In 1769 he went to Göttingen to study theology. Here, falling in with Bürger, Voss, the Stolbergs, and other poets of kindred tastes, he became one of the founders of the Göttingen "Hainbund." This league of young enthusiasts was aflame for Klopstock, then considered the greatest German poet for patriotism and for friendship, detested Wieland's sensual poems and his Frenchified manner, read the classics together, and wrote poetry in friendly emulation. Hölty's poems reveal a lovable personality. The strain of sentimentality that runs through all his work is not affectation, as it was with so many of the younger poets of that age in which Rousseau had made sentimentality fashionable, but the true expression of his nature. His range was small; but within its limits his work was excellent, and many of his songs have become the common property of the people. Consult: Voigts, 'Hölty, ein Roman' (1844); Reute, 'Hölty, Sein Leben und Dichten' (1883).

Holub, ho'loob, **Emil,** Austrian explorer: b. Holics, Bohemia, 7 Oct. 1847; d. Vienna 21 Feb. 1902. At 25 he went to South Africa, where he practised in Kimberley and elsewhere as a physician. Later he became engaged in African exploration and in recognition of his services as an explorer received from the Austrian emperor the Order of the Iron Crown. He published 'Beiträge zur Ornithologie Südafrikas'; 'Sieben Jahre in Südafrika' (1881); 'The Colonization of Africa'; and 'From Cape Town to the Maskukulumbe.'

Holy Alliance, an international league proposed by Alexander I., emperor of Russia, 26 Sept. 1815, after the defeat of Napoleon at Waterloo had cleared the way for the execution of his desire of establishing a settled peace in Europe. Alexander, Francis of Austria, and Frederick William III. of Prussia, signed with their own hands, and without the countersign of a minister, the act establishing this alliance, which is said to have been sent to the two latter in the handwriting of the first. It was not wholly published till 2 Feb. 1816, when the text was given in full in the Frankfort *Journal*. It consisted of a declaration, that, in accordance with the precepts of the gospel of Jesus Christ, the principles of justice, charity, and peace should be the basis of their internal administration, and of their international relations, and that the happiness and religious welfare of their subjects should be their great object. Its real aim, however, was to maintain the power and influence of the existing dynasties. It was also stipulated that the three sovereigns should invite others to become members of the Holy Alliance. In Russia and Germany its principles were not discussed except in a spirit of eulogy, but they were uncompromisingly condemned in Britain by many of her foremost statesmen. On 4 Feb. 1823 both Lansdowne and Brougham openly condemned its doctrines in their places in Parliament. Sir James Mackintosh said of the doctrine of legitimacy, in the sense in which it was used by the Holy Alliance, "Sophistry lent her colors to the most extravagant pretensions of tyranny." The events of 1848 broke up the Holy Alliance. It had previously lost much of its authority from the death of Alexander, and the French revolution of 1830. By a special article of the treaty the members of the Bonaparte family were declared incapable of occupying any European throne.

Holy Cross, College of the, an institution in charge of the Fathers of the Society of Jesus, situated at Worcester, Mass. The school was founded in 1843. It has a preparatory department; and the college grants the usual degrees given by classical and scientific institutions. It is self-supporting; up to 1903 it had received no State aid nor any endowments. It has established six fellowships. In 1903 there were connected with the school 28 professors and instructors, and nearly 400 students. The library contained about 25,000 volumes.

Holy Cross, Mount of the, a peak of the Rocky Mountains, in Eagle County, in the State of Colorado. The peak is about 75 miles southwest of Denver, and 20 miles north by west of Leadville. It is 14,006 feet high.

Holy Day, a day set apart in the Catholic Church for the commemoration of some saint or mystery. It is called "of obligation" when attendance at Mass and abstention from servile works are prescribed.

Holy Ghost, or **Holy Spirit,** the third person in the Holy Trinity. The Roman Catholic Church declares the Son to be begotten by the Father, and the Holy Ghost to have proceeded from both. The Orthodox Greek Church maintains that the Holy Ghost proceeds from the Father only; and this is one of the main points of doctrine on which Roman and Greek Catholics differ. The history of the controversy is shortly this: Tertullian and Origen, two distinguished Fathers of the Church in the 3d century, maintained that the Holy Ghost was begotten by the Father through the Son.

Macedonius, bishop of Constantinople in the middle of the 4th century, denied that the Holy Ghost was equal in essence and dignity to God the Father. The Council of Alexandria in 362 declared this bishop and his adherents, the Pneumatomachists, teachers of heresy; and the general council at Constantinople in 381 declared expressly to the whole Christian Church, that the Holy Ghost was the third person of the Trinity, proceeding from the Father, and to be worshipped equally with the Father and the Son. Augustine taught that the Holy Ghost proceeds from the Father and the Son; and the Council of Toledo, in 589, condemned all who believed otherwise. This new formulation of the dogma occasioned a controversy which lasted from the 8th to the 11th century, between the Western or Latin, and the Eastern or Greek Churches, and finally led to their complete separation. The Anglican Church and the Protestant Episcopal Church in the United States use the Greek form of the Nicene Creed. The worship of the Holy Ghost as the third person in the Godhead is common to both Roman and Greek churches, and to the Protestant Trinitarians, being essential to the faith in the divine Trinity. See CREED; TRINITY.

Holy Ghost Flower, or Holy Spirit Plant. See DOVE PLANT.

Holy Ghost, Order of, a former order of Hospitalers, founded by Guy, son of William, Count of Montpellier, in the 12th century, for the relief of the poor, the infirm and foundlings. In the 18th century it was united with the order of St. Lazarus by Clement XIII. Also the name of the principal military order in France instituted in 1578, abolished in 1789, revived at the Restoration, and finally abolished in 1830.

Holy Land, a name given by Mohammedans to Arabia because it was the birthplace of Mohammed; also by Buddhists to India because it was the country of Sakya Muni. It is a common name of Palestine, because the place where Christ lived when upon earth. See PALESTINE.

Holy Orders, the several ranks of the ministry of a church; also the power or authority to exercise that ministry.

In the Roman Catholic Church Holy Orders is one of the sacraments and there are seven orders of the ministry, viz.: priesthood, deaconate, and sub-deaconate: these are the greater or sacred orders; and the four minor orders of lector, acolyte, exorcist, and doorkeeper. Usually the episcopate is classed, not as a separate order, but as the completion and extension of the priesthood. Though every candidate for the priesthood is inducted into the four minor orders and the sub-deaconate and deaconate before he receives priestly ordination, it happens very seldom that a man enters any of those inferior orders intending to remain therein: they are simply steps to the priesthood.

In the Oriental churches, both those in communion with the Roman See — as the Greek Uniate, the Maronite, the United Armenian, etc., and those which are separated from Rome by schism or by heresy, the number of orders is less than in the Latin Church: in all the foregoing churches only four orders, or, counting the episcopate as a distinct order, five orders are recognized; those of bishop, priest, deacon, and lector: and of these the first three, at least, are held to be of divine institution and sacramental.

By the Anglican Church and the Protestant Episcopal Church of the United States three orders are recognized; those of bishops, priests and deacons: but in the 25th of the Articles of Religion those orders are expressly declared to be no sacrament.

The orders of the Oriental churches are generally recognized as valid by the Church of Rome; and when a priest of any of those churches is received into the Roman Catholic Church he is still regarded as a priest: but an Anglican or a Protestant Episcopal minister enters the Latin Church as a simple layman even though he were in Anglicanism a bishop; for Anglican orders have ever been held by Rome to be invalid.

Other Protestan churches, whether episcopal (as the Lutheran) or presbyterial or congregational, do not regard holy orders (or clerical order) as of divine institution or as setting up any essential difference between minister and layman. See CLERGY.

Holy Roman or German-Roman Empire, a title conferred on the German empire in 962 by Pope John XII, at the coronation in Rome of Otho I., who considered himself the lineal representative of the rulers of the ancient Roman Empire which practically had ceased to exist in 476. The designation ended in 1804 with the accession of Francis II. as hereditary emperor of Austria. See HAPSBURG.

Holy Water, in the Greek and Roman Catholic Churches, water which has been consecrated by prayers, exorcism, and other ceremonies to sprinkle the faithful and things used for the church. Some antiquaries think that the use of holy or lustral water was borrowed from the Jews. The Roman Catholic Church considers holy water not only symbolical of the purity of the soul, but in certain cases as effectual in exorcism. At the entrance of all churches is kept a font of holy water, in which those going in and out dip the fingers and bless themselves. The consecration of holy water takes place on Holy Saturday before Easter Sunday.

Holy Week, or Passion Week, is that which immediately precedes Easter. The name Passion Week rather refers to the days following and exclusive of Palm Sunday, since this day, strictly speaking, does not commemorate any incident of Christ's passion, but his triumphant entry into Jerusalem. The three chief days of the week are Maundy Thursday (or Holy Thursday), Good Friday, and Holy Saturday, the most sacred of all being Good Friday. The observance of Holy Week is of very early origin, and it was known as Great Week, Silent Week, Penitential Week, etc. In the ancient Church of Rome, when any of the ordinary Church festivals falls on this week, it is not observed till after Easter. In Rome it used to be observed with much greater solemnity and penitential rigor than now; for the shops are kept open, concerts and other amusements are given, though the theatres are closed. The washing of the feet of poor men is still practised in Roman Catholic churches; and the pope washes the feet of 13 poor persons, all of whom are priests. In Austria the emperor keeps up the old rite of feet-washing with much ceremony.

Holyoake, hōl'ĭ-ōk, **George Jacob**, English political reformer: b. Birmingham 13 April 1817; d. Brighton 22 Jan. 1906. He early became connected with various advance movements in Birmingham. In 1841 he was one of the lecturers chosen to explain Robert Owen's social theories, and next year was imprisoned on a charge of atheism. He supported the Chartist demands, but did not sympathize with their hostility to the Whigs. He took an important part in the agitation for the repeal of the corn laws, and for the repeal of the so-called «taxes upon knowledge.» He was the founder of a purely ethical religion, without theistic element (secularism); and was active as a lecturer and writer in the co-operative movement. His works include: 'The Logic of Death'; 'The Logic of Life'; 'The Trial of Theism'; 'Nature and the Origin of Secularism'; 'Thirty-three Years of Co-operation' (1872); 'History of Co-operation in England, Its Literature and Its Advocates' (1875); 'Among the Americans' (1881); 'Self Help One Hundred Years Ago' (1888); 'The Co-operative Movement of To-day' (1891), a short, useful account of the history of co-operation; 'Sixty Years of an Agitator's Life' (1892), an autobiography; and 'Jubilee History of the Leeds Co-operative Society' (1897).

Holyoke, hōl'yōk, Mass., city in Hampden County; on the Connecticut River, and the New York, N. H. & H. and the Boston & M. R.R.'s; about 75 miles southwest of Boston and 8 miles north of Springfield. Holyoke was settled in the last part of the 17th century by people from Ireland, and for some time it was called Ireland Parish. It was incorporated as a part of West Springfield in 1786; but in 1850 it became a distinct town, with its own government, and it was chartered as a city in 1873. Like the other settlements along the shore of the Connecticut, the inhabitants saw the advantages to be derived from the water-power. At first only the small streams flowing into the Connecticut were dammed, and used for turning machinery; the main stream itself was the great route whereby trade intercourse was established with settlements along its shores. In 1847 the Hadley Falls Company began to devise ways and means of using the water-power of the Connecticut River, which at Holyoke had a fall of about 60 feet. In a few years the dam, 1,000 feet in length, was placed across the river, and the water-power thus obtained gave Holyoke great opportunities for the establishment of manufacturing industries, and they have been well utilized. For some years it was noted for the number and magnitude of its paper-mills; but other industries now enrich the city. Its chief manufactures are paper, paper-products, thread, cotton and woolen goods, knit goods, alpaca, silk, automobiles, machinery, bicycles, wire, belting, screws, bricks, furniture, and school supplies. Some of the public institutions are the College of Music, public library, House of Providence hospital, city hospital, two orphanages located outside the city limits, St. Vincent's for girls and Holy Family for boys. A large percentage of the people are of foreign birth or foreign descent. The school census of 1902 shows the following: Public schools, 3,500 Irish, 3,200 French, 800 German, and 900 American. In the parish schools there were enrolled that same year 3,500 pupils. The law which declares: "No minor who cannot read and write the English language can be employed in any factory or commercial enterprise" is rigidly enforced. Evening schools are provided for those who cannot attend school in the day time. The Holyoke Scientific Society has done special and excellent work in American archæology. It owns a valuable collection of Indian relics. Some of the places of interest near the city, and which may be reached by the electric railway, are Mount Holyoke (q.v.), Mount Tom (q.v.), and Springfield. In 1896 the city charter was revised, and the government is now vested in a mayor, who is elected annually, and a city council. Pop. (1890) 35,637; (1900) 45,712.

Holyoke College, Mount. See MOUNT HOLYOKE COLLEGE.

Holyoke, Mount, a narrow ridge of greenstone, the highest point of which is about 1,120 feet above the sea. It is in Hampshire County, Mass., about one mile east of the Connecticut River, five miles southeast of Northampton, and eight miles northeast of Holyoke. On the summit is a hotel, built in 1821. The hotel can be reached by a carriage road which winds to the top, or by a railway which runs up a steep incline.

Holyrood, hō'lĭ-rood, **Palace and Abbey of**, Scotland, the ancient royal residence at Edinburgh (q.v.).

Homatropin, hō-măt'rō-pĭn. See ATROPINE.

Home, Henry, LORD KAMES, Scottish lawyer and author: b. Kames, Berwickshire, 1696; d. Edinburgh 27 Dec. 1782. He studied law at Edinburgh, and, called to the bar in 1724, soon acquired reputation by a number of publications on the civil and Scottish law. In 1752 he became a judge of session, and assumed the title of Lord Kames. In addition to legal works he published 'Essays on British Antiquities'; 'Essays on the Principles of Morality and Natural Religion,' in which he advocates the doctrine of philosophical necessity; 'Introduction to the Art of Thinking'; and his best-known work, 'Elements of Criticism,' in which, discarding all arbitrary rules of literary composition, he endeavors to establish a new theory on the principles of human nature. In 1776 he published the 'Gentleman Farmer'; and in 1781 'Loose Thoughts on Education.'

Home Education. From the earliest recorded school the conception of education has steadily broadened, till now careful thinkers recognize that education should be for adults as well as for the young, carried on at home as well as in school and through life instead of for a limited course. The agencies for this broader education are in five distinct groups, and workers in this special field after mature deliberation have given to it the name «Home education» because it differs from school education in being carried on at home while the students are engaged in their regular callings, instead of in schools as a chief occupation. The five groups of schools (elementary schools, high schools and academies, colleges, professional and technical schools, universities) might be called the five majors of education, while libraries, museums, study clubs, extension teaching, tests and credentials might be called the five minors.

1. *Libraries.*— This includes reference and lending libraries, magazine and news rooms and all reading of the conventional symbols called print. Reading courses, circles, clubs, and home study from books without instructors belong to this library group, which is the cornerstone of all home education. See LIBRARIES; TRAVELING LIBRARIES.

2. *Museums.*— This includes museums and laboratories of science, art, history, etc. As the library group includes education through the eye by means of conventional symbols, so in its broadest sense the museum group represents education also through the eye from reading the interesting and beautiful language of nature and art; and as reading may often have no direct connection with the public library, so also the museum group may include detached monuments, statues, busts, pictures, and other works of art. See MUSEUMS.

3. *Extension Teaching.*—This includes all agencies which extend personal help or teaching to those who cannot attend regular schools: for example, summer, vacation, Saturday, night schools or classes, extension lectures, correspondence teaching, home study under direction, classes in libraries, Y. M. C. A. or Y. W. C. A. and other organizations. Mere lectures or addresses not accompanied by class or paper work, or instruction in the more limited sense, should be sharply distinguished from extension teaching. They represent the platform and perhaps should be counted as an independent group. Some so-called extension teaching is really little more than lectures, while under the name lecture some excellent instruction is given. The group should perhaps be called "extension teaching and lectures," to keep prominent the difference between the two, while it recognizes as their common distinguishing quality the personal aid and inspiration given by the teacher or lecturer to his class or audience. Lecturers give the inspiration and magnetism of personal contact which cannot be transmitted in print. This personal element, however, is chiefly on the side of the lecturer: the audience is a mass. In extension teaching where the lecturers are to stimulate to personal study and are supplemented by class and written work, the personal element is reciprocal; for the teacher, dealing with each student as an individual, answers his questions, solves his difficulties and is his personal teacher, guide and friend. The lecture is chiefly for inspiration; the teaching, for instruction.

The chief factors in extension teaching are:

Summer Schools.—In the last decade skepticism as to the practical value of summer schools has given way to official recognition by the leading American universities of the demand for such instruction and of the duty to supply it of institutions with buildings, libraries, laboratories, reputation and faculty. Fortunately, many weak institutions, some of them started or maintained from commercial motives and others lacking funds for proper work, have been discontinued as one by one the strongest institutions have offered the needed instruction and thrown open to the public during the summer months their great facilities. See SUMMER SCHOOLS.

Correspondence Teaching.— Commercial experiments have proved that there is a large demand for instruction in many subjects, especially those which add most directly to wage-earning capacity, from those wholly unable to leave their positions to attend any of the established schools. The growth of this demand is evidenced by the great number of advertisements of such instruction and by the marked success of some of the more prominent schools. One of these schools in 1903 had 650,000 students and 114 professors, and upward of 2,000,000 persons were taking correspondence courses in this country. The method having been proved efficient is beginning to be adopted by the endowed institutions; and inevitably as they offer better instruction at less cost and with it their established reputation, correspondence teaching with full recognition of its limitations but also of its possibilities, will become an established and creditable educational factor.

Extension Courses.— In America for the few years near the end of the 19th century hundreds of university extension centres were established, most of them with insufficient knowledge of what a real extension course was and with inadequate facilities and teachers inexperienced in this peculiar but important work. The result predicted naturally followed and most of the organizations which sprung into existence died out. The University of Chicago won first place by the excellence of the work it offered and still carries on. The American Society for the Extension of University Teaching in Philadelphia has been most active and successful of all the voluntary organizations. The New York State extension work was from the first announced to be wholly subsidiary to the more important function of the public library and study clubs. Experience has proved the great merit of the extension method in the hands of skilful teachers with a gift for this difficult kind of teaching, where inspiration is more important than instruction. See UNIVERSITY EXTENSION.

Lectures.—In most cases lecturers have been desultory and have been intellectual entertainments rather than entitled to rank as educational factors. Students of home education, however, recognize the inspirational lecture as a strong lever in their work and are using it more carefully and effectively, and organizing into courses which give better results. The Brooklyn Institute has maintained for many years a remarkable system, giving each year hundreds of lectures from recognized authorities, and in connection with its library and museum affords the best existing example of a great metropolitan home education centre. In New York the free lectures for the people have grown steadily from year to year and exert a great influence for good on the hundreds of thousands who hear them annually. Progressive librarians are more and more feeling the responsibility of guiding the local demand so that the lectures shall become a still more efficient ally of the library in its broad work of giving information, inspiration and intellectual recreation. See also ADULT EDUCATION.

4. *Associations or Clubs.* — This includes all forms of mutual help through associated effort, from the club of two friends in a single house to the great summer schools like Chautauqua, where each July and August thousands gather

from all parts of the country. This work with one's fellows supplies something of the element of residence, which is as valuable a part of the usual college course as are the studies. A certain subtle mental chemistry of the greatest practical value results from contact with other minds pursuing the same studies. If this gives a few weeks actual residence away from home, with daily student life, and a course in such company and surroundings as our best summer schools now offer, the student gets an invaluable taste of real college residence. This mutual help element in home education is chiefly supplied by the numerous literary and study clubs, many of which are coming to give their annual programs, a definite educational value by limiting them to a single worthy subject and supplying members with books, pictures and, if needed, specimens or other aids.

5. *Tests and Credentials.*— The great problem in popularizing education is to secure continuous and systematic study from those lacking the stimulus of the schools. Experience shows that a goal is needed by most people to hold them to completion of what they begin, by giving tests and official recognition, with suitable credentials for work well done. Differing from the other groups their field is to stimulate, test, record, and certify, rather than to give instruction. In spite of the criticisms and abuses of examinations, no satisfactory substitute for the good they accomplish when properly used has yet been found. They are last and least of the minors, but necessary to a complete system.

Educational Factors.— Most well equipped schools have all the factors of home education in active operation, but it is the use of these factors by those who cannot attend schools that constitutes home education. Schools imply residence and are attended consecutively, students advancing stage by stage from kindergarten to university. In home education the student will often use all five minors at once, and in well organized extension courses with lectures, syllabus, class, paper work, directed reading, student club and final examination we have four of the five minors, and in many subjects the museum or laboratory element is also added. A town that aims to provide educational facilities for both old and young at home, through life must make all five groups available. For most places the ideal would be to combine in a single building suitably arranged, the public library, museum, extension, examination, and association or club rooms, thus massing in a single institution, for which the best name is institute, all the essential educational agencies outside regular schools.

While there should be constant co-operation and the utmost harmony between the agencies for home and school education, experience constantly proves that the best results cannot be obtained by putting home education work in charge of school authorities. The obvious reason is that school trustees naturally and properly feel that the school system is the vital part, while libraries, museums, clubs, and extension teaching are only incidentals. The best results are always reached with independent trustees, who regard home education as quite as important as school education, and who devote all their energies to promoting their own work. While two governing boards are thus a necessity, a larger number is more costly and less efficient in administration, so that most close students of this problem advise in all ordinary circumstances the massing of the five minors together under a single board with headquarters in a single building. While in theory the library is one of the five home education factors, in fact the rapidly growing practice is wisely making home education a part of the library. This is because the country is being rapidly dotted with library buildings supported by taxation and endowments and receiving private gifts and public appropriations and support to a degree never equaled in educational history. The public library is already one of the most popular of American institutions and is rapidly gaining ground in all civilized countries. With buildings, endowments, trustees and public sympathy and support, it is the most economical, natural and best centre for the other elements of home education. In New York the official title now used is "New York State Library and Home Education," but it is frankly stated that the words "home education" will be dropped when the public learns that library means not a mere collection of books, but the home of all this closely allied work.

At the national meeting of American librarians in 1898 the entire program was given to impressing as strongly as possible the fact that small as well as large public libraries had the privilege and duty of giving stimulus and aid not alone to readers of books, but to all citizens, young or old, who were seeking intellectual advancement. Libraries are rapidly introducing the museum element in collecting and lending pictures as they do books. Many have started collections in art, science, or history. Laboratories are sure to follow, where persons without such facilities at home may pursue investigations and supplement their reading with experimental work. Even small towns now consider a library building inadequate which does not provide rooms for literary, scientific and similar societies for mutual improvement, and lecture halls, large and small, for the various phases of extension teaching. In the last few years this development has become less a matter of discussion than the rapidity with which individual libraries may take on their new and broader functions.

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Home Rule, the domestic control of local affairs in a province, colony, or dependency of an empire. The term has been employed in recent history most especially with regard to Ireland, which has been a dependency of England ever since Pope Hadrian, as is averred, handed it over to Henry II. of England in 1155, on condition that a certain portion of its revenue should flow into the treasury of the Holy See. Since that time Ireland has been more or less subject to the government of England. English viceroys have ruled at Dublin, and English troops kept the peace. The Irish are a high-spirited and proud nation, and the history of their subjugation has been a bloody one. For many years, however, they had their own parliament, and managed their own domestic affairs. Then came what was called the Union. The Irish parliament was abolished, and Irish boroughs elected representatives to seats at Westminster. This was in 1801, when it is said that the Irish parliament which passed the bill for its own destruction was bribed or cajoled into what Irishmen of to-day consider a fatal and suicidal act. The first Irishman of note to attempt a remedy for Irish grievances was Daniel O'Connell. Catholic emancipation had been won largely through his agitation, seconded by the strong and clear-headed statesmanship of Wellington. In 1834 O'Connell brought forward in the House of Commons his motion for a repeal of the Union. By recent act of Parliament the municipal councils of Ireland had been thrown open to Roman Catholics. O'Connell was elected lord mayor of Dublin, and while his motion for appeal was supported with but 40 votes in parliament, he carried it by 45 to 15 votes in the municipal chamber at Dublin. This was undoubtedly the earliest step in the movement toward home rule, which from that time to the present moment has convulsed Ireland. In the town council at Dublin one of the 15 who had voted against O'Connell's motion for the repeal of the union was a brilliant young lawyer named Isaac Butt. In 1871 he was elected member of Parliament for Limerick and with him the Home Rule party in the English Parliament was born. The party struggled along for many years striving by obstruction and agitation in several quarters to maintain the rights of Ireland, and obtain for her better terms in her relations with the mother country. Mr. Butt, who was a true home ruler, though a conservative, was at length incensed by the obstructionist tactics of Parnell and Biggar, which he thought beneath "the dignity of Parliament," and practically surrendered the leadership of his party, in which he was succeeded by Parnell. In 1877 Parnell was elected president of the Home Rule Confederation of Great Britain. Parnell very quickly showed that he not only had very definite views, but possessed also the courage of his convictions. He became an advocate of peasant proprietorship. For the realization of this idea the Land League was constituted. At a meeting held in London 21 Oct. 1879 it was declared that the objects of the league were, first to bring about a reduction of rack-rents; second to facilitate the obtaining of the ownership of the soil by the occupiers. It was very remarkable to see how English opinion was gradually molded by the great Land League and Home Rule Party. In the elections of 1885 many Conservative candidates almost echoed the words of Parnell in declaring for a "liberal measure of home rule for Ireland." In the elections of 1885 the Liberals came in for a majority and Mr. Gladstone was premier for the third time. He was not long in bringing in a bill providing for "the constitution of an Irish parliament sitting in Dublin with the Queen as its head." He urged the passing of the bill with one of the most powerful, the most effective, and most touching speeches which he ever delivered. But his eloquence was in vain, the measure was defeated by a majority of 30. This was not the last time that Gladstone was to attempt the liberation of Ireland. But bold as had been his change of opinion in putting forth a measure he had in earlier life condemned, his conception of Home Rule for Ireland was quite inadequate compared with what O'Connell contemplated in his agitation for repeal. Such as it was, Gladstone again staked the existence of his ministry on its realization in 1893. The bill passed the House of Commons, but was rejected in the House of Lords, and since that time Home Rule for Ireland has been a dead issue in English politics.

Home Rule, Municipal. See MUNICIPAL GOVERNMENT.

Homer, hō'mėr, a poet to whom was attributed in ancient Greece the authorship of the two epic poems, the 'Iliad' and the 'Odyssey,' which form the foundation of Greek, and consequently of European literature. Of Homer's personality, birth, place, and time, we have no certain knowledge. His very existence has been brought into doubt, and in accordance with the etymology of his name Homer, which means the same as Vyasa, to whom the Mahabharata has been attributed, he is sometimes taken merely for the "arranger" or "compiler" of the works that go by his name. Seven cities, however, contended for the honor of being his birthplace; their names form the hexameter line

Symrna, Rhodos, Colophon, Salamis, Chios, Argos, Athenæ.

These names cover almost the whole geographical area of Greece and at least point to the extent of the poet's fame and influence. Although the dates of his birth and death are equally doubtful, critics have placed him anywhere in the 9th and 10th centuries before Christ, though some have thought these dates 500 years too early. He is traditionally said to have been blind, like Demodocus, the minstrel of the Odyssey. Some in ancient times attributed to him also the Batrachyomachia, and the so-called Homeric hymns, but it is at least doubtful whether these were written by the author of the 'Iliad,' as the Batrachyomachia seems a century later than the epics, and the hymns to Apollo, Demeter, Hermes, Aphrodite, and minor divinities were probably preludes or introductions which the rhapsodes or minstrels sang or chanted before beginning the serious business of the epic recitation.

The 'Iliad' and 'Odyssey' deal with the war waged by European Greece against Asiatic Troy.

The Iliad.— This 'Poem of Ilium' or Troy describes some phases of the war waged by Agamemnon and his brother Menelaus against Priam, whose son Paris had carried off Helen, the beautiful wife of Menelaus. The subject of this epic is called the wrath of Achilles, the representative Greek hero, a romantic and dazzling figure. He remains in his tent without helping in the war because Agamemnon has taken from him the captive slave girl Briseis. At length Hector, the champion of the Trojans, slays in fight Patroclus, the bosom friend of Achilles, who is roused by this from his sullen inactivity, and rushes forth to the battlefield, where he meets and slays Hector, whose funeral rites form the closing incidents of the poem.

The Odyssey.— The 'Odyssey' describes the return of Odysseus from the siege of Troy to his island kingdom, Ithaca, where he is restored to his faithful wife, Penelope, and takes vengeance on the suitors who have sought her hand and wasted her husband's substance in revelry and debauchery during his absence. The first four books describe Odysseus detained in the magic isle of Calypso, and the despatch of his son Telemachus to bring him home. The following eight are taken up with the hero's homeward voyage with his various adventures. In books 13-19, Odysseus in the attire of a beggar is found unrecognized at the door of his home; books 20-24 describe his vengeance on the suitors.

There were some critics of Greece, notably Xenon and Hellanicus, who held that the so-called Homeric epics were written by different men. This school of grammarians were called chorizontes, or separators. There is much indeed to give color to such a view. As has been said, the 'Iliad' was written for men, the 'Odyssey' for women. But what principally distinguishes the 'Odyssey' from the 'Iliad' is the fuller and more complete individualization of the Greek divinities, the higher tone of religious and social life. The knowledge of foreign lands and their products and the means of travel by sea seem also to have reached a more advanced stage.

It remained for F. A. Wolf in his famous 'Prolegomena ad Homerum' (1795) to make the keenest and most searching analysis of these epics, as regards their unity of composition and identity of origin. He relies upon the statement in Greek history that Pisistratus in 540 collected and arranged the Homeric poems in something like their present form. The epics are thus made up of separate ballads, sung by rhapsodes, probably written by different poets, and Wolf has shown much acuteness in pointing out that long epic poems could not have been transmitted from such early antiquity without handwriting, which did not then exist, and in indicating what portion of each epic originally formed individual and distinct songs or lays. Consult: Jebb, 'Introduction to Homer' (1887); Monro, 'Homeric Grammar' (1891); Ebeling, 'Lexicon Homericum' (1885); Leaf, 'The Iliad' (1888); Hayman, 'The Odyssey' (1882).

Homer, Winslow, American painter: b. Boston 24 Feb. 1836. He studied in the National Academy of Design and was also a pupil of Frederic Rondel. He was sent to the front during the Civil War as special artist to 'Harper's Weekly' and on his return to New York exhibited his first important work, 'Prisoners from the Front' (1864), which won him recognition. In 1865 he was elected Academician. Taking up his residence in Scarboro, Maine, he painted for many years a series of pictures which indicated a marked development in style, sentiment, and power. There was a trace of conventionality at least in the subjects of such pictures as 'Home, Sweet Home,' which he painted between 1864 and 1884. From the latter date he began his portrayal of the fisher population of New England. Dramatic and realistic in the highest degree is the series of seven canvases from the 'Life Line' (1884) to the 'Lookout' (1897). But this artist has reached his finest vein in his pure marines, of which by far the greatest is 'The Maine Coast.'

Homestead, hōm'stĕd, **Pa.,** borough, in Allegheny County, on the Monongahela River and on the Pittsburg & L. E. and the Pennsylvania R.R.'s; about seven miles south of Pittsburg. It was settled in 1871 and incorporated and chartered in 1880. The chief manufactures are foundry-products, glass, machinery, and steel products. It is noted for its large steel plants, which employ over 6,000 men. The borough owns and operates the waterworks. At one time Andrew Carnegie (q.v.) was the principal owner of the Homestead steel works. Pop. (1890) 7,911; (1900) 12,554.

There occurred in Homestead a serious strike which began 6 July 1892. Reductions in wages, change in time of signing the schedule, and refusal to recognize the Amalgamated Iron and Steel Association, or to hold any conferences with the men, had brought on a general strike to date from a certain time, and enraged the men into burning H. C. Frick, the manager, in effigy; whereupon the works were at once shut down, 1 July, two days ahead of the agreed time, and the men armed themselves and prepared to resist by violence any attempt to supply their places with non-union men. The advisory committee of the union took charge of the town with regular armed companies, and allowed no one to enter the mills without their permission. On 5 July the company announced an intention to make repairs, and appealed to the sheriff for protection; he sent a small squad, who were at once driven from town by the strikers, the latter denying that any damage was intended and offering to be sworn in as deputies themselves. The company then hired a body of 300 Pinkerton detectives, who came up the river in barges; but the strikers broke through the fence surrounding the mill, intrenched themselves behind a barricade of steel rails and billets, and whenever the Pinkerton men attempted to climb the steep bank (which they began at 4 A.M. of 6 July), shot them down. Next day they procured a 10-pounder brass cannon and bombarded the boat, splintering her wooden sides, but failing to pierce the steel plates within. They then sprayed the boats with oil from a hose, and emptied barrels of it on the river, setting it on fire to float down and fire the boats. The detectives repeatedly ran up flags of truce, which were at once shot down. At length the advisory committee sent delegates to offer a safe-conduct to the detectives, if they would leave their arms and ammunition and quit the town under guard; they were forced to submit, but when leaving under escort, the mob stoned, shot, and clubbed them shockingly, one having an eye struck out by a woman in the mob. Seven were killed first and last, and 20 to 30 wounded; and 11 strikers and spectators were killed by their return fire from the boats. The governor (Pattison) refused to use the State power to quell the riot till the 10th, insisting that the local authorities must do their utmost first, and the sheriff must summon the citizens; and the troops did not arrive till the 12th, when the town was put under martial law. A committee of Congress was appointed to investigate the case; and later, a Senate committee in the interest of the strikers was appointed to inquire into the hiring of private armed parties to maintain public order. On 21 July Mr. Frick was shot and stabbed in his office, but recovered. On the 18th a number of the strikers were arrested for murder: and retorted by indicting the Carnegie Company, the Pinkerton brothers, and five of their men, for murder. The advisory committee was also charged with treason and usurpation, in taking military possession of the town. The mills were soon supplied with new men, but the strike was not officially declared "off" till 20 Nov. 1892.

Homestead and Land Laws. Under the United States laws any citizen or person who declares intentions to become a citizen, male or female, 21 years old, or head of a family, may become the possessor of a homestead of 80 or 160 acres, by occupation and cultivation, to be taken from unreserved public lands, surveyed or unsurveyed. A fee of $5 or $10 is required to be paid for filing affidavit of settlement, citizenship, age or family status. Total fee is from $26 to $34, according to the land district. Five years' residence and cultivation are required, but only three are demanded where 5 or 10 acres of forest trees have been cultivated. Ex-Union veterans or their heirs obtain patent one year after residence. Benefits are limited to one claim, except that veterans who have made one land settlement may also take a homestead claim. Under timber-culture provisions homestead locators may secure another 160 acres, including timber area, by cultivating 40 acres of trees. A homestead is free from debt liability before patent issues. Locator may, on proof of settlement six months after occupancy, buy said land at pre-emption price.

Homestead discussion began in 1852 by the Free-Soil party demanding reservation for settlers. It was presented first in Congress by Galusha Grow, 1854. A bill was first offered in 1859, and passed the House; an act passed in 1860, granting homestead on payment of 25 cents an acre, was vetoed by President Buchanan. The present law was signed by President Lincoln, 20 May 1862. Homestead law initiated the national land policy. It marks the third step in definite change from purchase to settlement. Pre-emption policy, granting preference to occupancy over speculating purchases, was the second step. First was sale or grants *en bloc*. It began in 1801 when an act was passed granting pre-emption to Miami Valley settlers on Ohio-Symmes tract. Sixteen acts were passed before that of 1832, which fixed the price at $1.25 and $2.50, and divisions at 40, 80, 120, and 160 acres. Under Pre-emption Laws, a locator having civic rights and also able to testify that he or she does not possess 320 acres of land in the United States, or has not abandoned any to settle on public lands, can hold for cultivation and residence up to 160 acres. After a limited period a locator may on satisfactorily proving settlement, purchase and obtain patent at minimum or maximum rate, the latter, $2.50, being paid for government land within railway grant. No restriction is placed on pre-emptor's acquirement of private lands. Under timber-culture acts entry additional to pre-emption or homestead may be made of legal subdivision, one fourth of which must be devoted for eight years to timber culture. On proof, a patent will issue for tracts; the total fee is $18.

Timber acts are in the nature of a land bounty for forest culture in sub-humid areas. Desert land acts are designed to encourage reclamation by irrigation of arid lands. Entry is of 640 acres permitted on "dry lands" within California, Nevada, Oregon, Arizona, New Mexico, North and South Dakota, Wyoming, Utah, Idaho, Montana, and Washington. Three years are allowed to bring water thereon. On proof of this, same may be purchased at 25 cents an acre. Under present laws mineral lands are held for industrial development, miners' customs being recognized by Congress and upheld by the federal judiciary. Locators form district, lode, or placer, adopt regulations, and elect recorder. Quartz or lode claims permitted of 1,500 lineal by 600 lateral feet, 300 on each side of lode. Boundaries must be marked plainly, entry recorded, and work to the value of $100 or more be performed each 12 months in order to hold claim. Qualifications as to persons or associations are the same as in other land entries. No alien is permitted to hold, occupy, work, or possess public lands. Placer claims of 20 acres to the individual, or not over 160 to associations, are similarly permitted. Patents issue on proving up and payment of fees.

The mineral land policy of the United States fluctuated till the act of 1866 was passed. Lands were sold or leased at different periods, and the procedure was wasteful both to miners and people. Mill sites and right of way for ditches are provided for. Coal lands are pre-emptible on civic and occupancy requirements by payment of from $10 to $20 per acre. First priced land is not within 15 miles of a railway; the other is within such distance. The individual limit is 160 acres; association 320 acres. An association on proof of $5,000 expenditure may enter one section. Only one entry is permitted. Saline lands being exempt from settlement, are offered for sale at $1.25 an acre, and then become subject to private entry. Public land for town site purposes is arranged for (1) by Interior Department setting aside suitable area and selling lots of definite size; (2) by town associations, filing plats of 640 acres or less therein. Town associations failing to file plats, lots may be sold publicly after 12 months at increase of 50 per cent. on minimum price. The actual occupant of a town lot may prove up and preempt by time of sale, paying minimum price for same. Stone and timber lands designated as unfit for cultivation, within California, Oregon, Nevada, and Washington, may be purchased by persons having required civic qualifications as follows: Affidavit and proof of non-mineral character and non-speculative purpose required, and they must be sworn to as for personal use and benefit. Notice of application to be published for 60 days in land-office and nearest newspaper. Penalties are provided for perjury or for trespass on timber lands.

The domain is also subject to various land-grant and bounty laws. These include State grants for internal improvements, institutions, common schools, seminaries, and agricultural colleges; land bounties, naval and military; canal, wagon, and railway grants; military and Indian reservations. Under graduation act, land unentered privately can be sold at public sale at minimum figures. The public domain area was acquired by cessions from original States, 259,171,787 acres; by purchase from Spain, France, Mexico, Texas, and Russia 1,580,900,-800 acres; total, 1,840,072,587 acres.

Public lands are surveyed into "hundreds," 10 miles square: then into "sections," of 1 mile square, again subdivided into quarters, and down to eighths. This is known as the rectangular system. A general land-office, forming a bureau of the Interior Department, is in charge of land administration. Each State and Territory has a surveyor-general, and each congressional district a land-office. In the Territories these are provided as required. A large portion of the domain acquired from Mexico still remains subject to private grants. The land laws of Hawaii were drawn up to protect small holders. See PUBLIC DOMAIN. GORHAM D. GILMAN,

Ex-U. S. Consul to Hawaii.

Homicide, hŏm'ĭ-sīd, is either justifiable, excusable, or felonious. Of the first sort are such cases as arise from unavoidable necessity or accident, without any imputation of blame or negligence in the party killing. So where a crime is punishable capitally according to the laws, the judge is bound to condemn the criminal to death, and the sheriff or other executive officer to carry the sentence into effect in the manner prescribed by the sentence of condemnation. But the judge must have jurisdiction of the offense, and be duly commissioned; and the executive officer must be empowered to carry the sentence into effect, and must perform the execution in the manner prescribed by law, otherwise the execution of the criminal will make the judge or the officer, as the case may be, guilty of criminal homicide. So, too, where an officer of justice is resisted in the execution of his office, in his attempt to arrest a person in a criminal, or, as is maintained, even in a civil case, he is not obliged to give back, but may repel force with force; and if the person resisting is unavoidably killed, the homicide is justifiable, for few men would quietly submit to arrest if, in case of resistance, the officer was obliged to give back. It is, however, laid down as law that if a felony be committed, and the felon attempts to flee from justice, it is the duty of every private citizen to use his best endeavors to prevent an escape, and if in the fresh pursuit the party be killed where he cannot be taken alive, it will be deemed a justifiable homicide. The same rule applies to cases of an attempt on the part of a felon to break away and escape after he has been arrested, and is on the way to jail. So if a party has been indicted for felony, and will not permit himself to be arrested, the officer having a warrant for his arrest may lawfully kill him if he cannot be taken alive. But this is to be understood only of officers, and not of private persons. Magistrates and officers authorized to suppress and disperse mobs are justified by the common law in taking the requisite measures and using the requisite force for this purpose, though it extend to the killing of some of the rioters. The law arms every private citizen in the community with the power of life and death for the prevention of atrocious felonies accompanied with violence and personal danger to others, as in case of an attempt to murder or rob, or commit burglary or arson, the person making the attempt may, by the common law, if he cannot be otherwise prevented, be killed on the spot, and the law will not recognize the act as a crime. In cases of this sort, in order to justify the homicide, it must appear that there were good grounds for a suspicion that the person killed had a felonious intent. A woman is justifiable in killing one who attempts to ravish her, and the husband or father may be justified in killing a man who attempts a rape on his wife or daughter.

The cases already mentioned of justifiable homicide are those in which the public authority and laws are directly concerned. The laws of society, however, leave every individual a portion of that right of personal defense with which he is invested by those of nature. If one may interpose to prevent an atrocious crime against society, where he is not himself in any personal danger, the laws will, *a fortiori*, permit him to defend himself against attacks upon his own person. Murder is the killing of a person who is under the protection of the laws, with malice prepense, either express or implied. Malice is the distinguishing characteristic of murder, and may be either aforethought, or expressed, or implied. It is not necessary in order to constitute the crime of murder that the slayer should have the direct intention of killing. If the act be done with a wicked, depraved, malignant spirit, a heart regardless of social duty, and deliberately bent upon mischief, it is characterized by what the law denominates malice, though it may not result from any enmity or grudge against the particular victim. So if a man wantonly discharges a gun among a multitude of people, whereby any one is killed, the act will be done with that depravity of disposition which the law considers malice. Murder can be committed only by a free agent, for the crime presupposes a will, motive, or disposition on the part of the perpetrator. An idiot or insane person cannot commit this crime. But drunkenness is in general no excuse for homicide, though the act be done under its immediate influence.

The manner of killing is not material. Whether it be by sword, poison, beating, imprisonment, starvation, or exposure to the inclemency of the atmosphere, it will be equally murder. This crime may be committed by mere advice and encouragement. An infant unborn is within the protection of the law, and it is laid down that if, in consequence of poison given or wounds inflicted before the birth of a child which is afterward born alive, it dies soon after its birth, the act is murder. The act of suicide is considered by the law to be murder, and the person making away with himself is accordingly styled a "self-felon."

The lines of distinction between felonious and excusable or justifiable homicide, and between manslaughter and murder, are in many cases difficult to define with precision. But in general the accused has the advantage of any uncertainty or obscurity that may hang over his case, since the presumptions of law are usually in his favor. The characteristic distinction laid down in the books between murder and manslaughter is the absence of malice in the latter. Sudden provocation may be an excuse for striking another without the intention to give a deadly blow; and though death ensue, the party may not be guilty of murder. One circumstance, showing the degree of malice, or rather showing its presence or absence, is the kind of weapon used in giving a wound on a sudden provocation; and another circumstance of importance is the fact of the weapon's being already in the hand or not, for going to seek a weapon gives time for deliberation. The ground of excuse of homicide, in case of provocation merely, is the supposed sudden passion, some influence of which the law concedes to the frailty of human nature. But the excuse of self-defense goes still further; and where a man is attacked, so that his own life is endangered, or in such way that he may reasonably suppose it to be so, he may repel the attack with mortal weapons. One of the most frequent cases of manslaughter was that occasioned by single combat, and on account of the firm hold which the point of honor had taken of European nations, was long among the most difficult subjects of legislation. (See DUEL.) The crime of murder in its most aggravated degree is punished with death in most parts of the civilized world.

Hom'ily (Greek, *homilia*, intercourse), as an ecclesiastical term, a discourse addressed to an audience on some subject of religion. The homily was so called to distinguish it from the speeches of profane orators. The ancient homily was sometimes simply a conversation, the prelate talking to the people and interrogating them, and they in turn talking to and interrogating him. The difference between the homily and the sermon was the entire absence of oratorical display from the former, and the elucidation of the Scriptural text in natural order, without throwing the exposition into the form of an essay.

The earliest existing examples of the homily proper are those of Origen in the 3d century. In the schools of Alexandria and Antioch this form of discourse was sedulously cultivated, and Clement of Alexandria, Dionysius, and Gregory Thaumaturgus are among the names most eminent in this department. Augustine and Gregory the Great were among the western composers of homilies. Later still Bede, several of the popes, and foreign ecclesiastics still adhered to the homiletic form of exposition as the most suitable to impress the truths of Scripture with efficacy on the popular mind.

In the Church of England there were two books of homilies that were long authoritative, and are still sometimes appealed to to settle disputes as to what the Anglican doctrine is in points on which they bear.

Homing-pigeon, a variety of the common pigeon in which the love of home and power of flight have been developed to make the bird useful and reliable as a bearer of messages; also a fancy variety characterized by the possession of certain definite points, but not necessarily useful as a homer. The show carrier-pigeon is a large, long-necked variety, with abnormally developed wattles about the base of the beak and round the eyes, but the true homer is of smaller size, and lacks the enormous tuberculated growth.

The training and breeding of homing-pigeons were long almost confined to Belgium, and two main types of the Belgian homer have been distinguished as the Antwerp and the Liège varieties, the former being larger but less graceful in form than the latter. American pigeon fanciers breed mainly from the Antwerp type, and the birds are commonly designated Antwerps.

The training of a homing-pigeon begins when it is about three months old. It may then be taken to a distance of about a mile from its loft in a suitable direction and liberated in order that it may fly back. After an interval of a day or two it should be carried three miles from home in the same direction and set free, and on the third occasion, a few days later still, the distance is usually increased to six miles. This mode of training is continued steadily during the season, the successive distances above those already mentioned being 12, 25, 50, 75, 96, 125, 155, and 200 miles. The intervals of rest must be carefully preserved, especially in times when the weather is unfavorable. During the bird's second season it is made to repeat something of its first year's performances and to extend its flight to 250 miles or possibly to a greater distance. During the following three seasons good birds will be at their best, and even for some few years later they may do good work. During the training period and also at other times the housing and feeding of the birds must be carefully attended to.

Velocities of over 30 yards per second have been recorded for various pigeons, but the average velocity is rather less than half that amount. One bird, in 1896, actually covered the distance from Thurso to London, just over 500 miles, within one day, its average velocity being about 24 yards per second. In unfavorable weather the height attained varies from about 320 to rather over 400 feet, but in good weather some birds will reach a height of about 1,000 feet. The distance from Algiers to Paris, fully 1,100 miles, is one of the longest on record as having been traveled by a pigeon.

There has been much discussion regarding the means by which pigeons return to their homes over such long distances. Untrained birds often fail to return, and during training young birds are often lost.

Many instances are recorded of the employment of pigeon messengers by ancient peoples. During the first half of the 19th century pigeons were widely used in Great Britain for the rapid communication of intelligence, and in particular many stockbrokers obtained early information of the state of the markets by this means. The introduction of the electric telegraph, however, soon led to the complete disuse of the pigeon post. The siege of Paris during the Franco-German war of 1870–1 first brought the carrier-pigeon into prominent notice as a valuable means of communication in time of war. During that siege more than 350 birds were sent out of the city in balloons, and of these some 300 were liberated with messages. Only some 70 returns were made, and these were effected by 57 birds. By the adoption of microphotography the space occupied by a message was so reduced that a single pigeon could carry a very large number of messages without having its movements hampered in the least. One of the pigeons that succeeded in returning to Paris carried no less than 40,000 messages on eighteen collodion films which were enclosed in a goose-quill attached to the tail. Since that time the leading Continental powers have established elaborate pigeon systems for use in time of war. During the war with Spain, in 1898, the fleet of vessels that patrolled the Atlantic coast was supplied with a number of carrier-pigeons' cotes, but happily there was no occasion for testing their effectiveness, though in times of peace messages are frequently successfully carried from war vessels to points on the shore. Consult books mentioned under PIGEONS.

Hominidæ, hō-mĭn'ĭ-dē, the family to which man was assigned in the earlier systems of animal classification; but many modern zoologists refuse him so great a distinction, making man, zoologically considered, only a species (*Homo sapiens*) of a genus of the family *Simiidæ*, which also includes the genera of the anthropoid apes. See MAN.

Homœopathy (Greek ὅμοιος, like, and παθος, suffering or disease). The term signifies similar affection, passion, suffering or disease. As employed in Medicine, and as understood by Hahnemann and physicians of the homœopathic school, it is properly defined as follows: (1) The treatment of disease by means of its similimum; (2) treatment of disease by a medicine capable of causing, in a healthy person, symptoms similar to those manifested by the patient. This definition can refer only to the symptoms producible by the drug, and the symptoms exhibited by the patient. It makes no direct reference to the name or type of the disease, nor to the type or class of the drug administered, nor to the size or strength of the dose. Nevertheless, homœopathy does hold important incidental relationship to the classification of drugs, to the facts and principles of dosage, and to diagnosis and all other departments of pathology. Under this definition, the experimental application of homœopathy requires that the drug shall cover the *tout ensemble* — or, as Hahnemann expresses it, the "totality" of the symptoms as exhibited by the patient; and not merely one, or a few, of the dominant or diagnostic symptoms or conditions. Neither does it imply that the homœopathic remedy can overcome any and all the adverse conditions and circumstances under which it may be administered.

As a system of medical practice, Homœopathy recognizes this principle of similarity as between the symptoms of the curative drug and the symptoms appearing in the patient. In this form of practice, the symptoms exhibited by the patient are carefully ascertained and studied with reference to their significance and relations, and these furnish the indications upon which the selection of the "similar remedy" is then made with equal care. Whether the object of the prescriber be immediate and complete restoration to health in a curable case, or mere alleviation of suffering in a case not curable, the same course is pursued; since, in the experience of the profession, the similimum possesses peculiar efficacy in either class of cases.

In homœopathic practice, the finding of the curative remedy is of *first* importance, as a matter of course. But, the diagnosis of the case is a most urgent consideration, because it materially aids the physician in his quest for the "totality" of the symptoms, suggests his general management of the case, prompts the sanitary precautions to be taken, guides him in his prognosis, etc. Moreover, it sometimes calls to his mind a group of medicines among which the curative similimum will probably be discovered, and in this indirect way may assist in the medical treatment. Yet is must be distinctly understood that in homœopathic prescribing, the final choice of the remedy is always made, not by the name of the disease, nor even by the symptoms usually present in the disease, but only by those occurring in the individual patient. Pathology, both structural and functional, is also a subject of careful research in connection with homœopathic practice, as under other systems; but never for the purpose of formulating "theories" of the nature of the disease, on which to base treatment.

In common with all other modern "schools" of physicians, homœopathists hold that whenever the originating or "exciting" cause of the disease can be discovered, it should be removed if possible; and they claim that when this is done the disease will often disappear spontaneously. When the disease does not so disappear after removal of the cause which had apparently produced it, homœopathic physicians are convinced that some other ("maintaining") cause has been developed. In most cases this perpetuating cause is occult and its nature altogether undiscoverable. They also hold the view that if this latter cause be removed, the continuance of the malady is inconceivable. Equally incredible is it that the disease can be actually "cured" so long as the cause remains operative; if it could be, it would be immediately reproduced; unless meantime the bodily susceptibility to the disease were also removed. Hence, the homœopathic profession does not concede a "cure" in any case in which the operative cause remains active, and therefore, in the view of these practitioners, the word "cure" has a much narrower meaning, and actual cures are accomplished much less frequently than is generally supposed; the majority of such so-called cures being merely recoveries — recoveries facilitated, or perhaps made possible, by the skilful efforts of the medical practitioner — but recoveries nevertheless.

Under this view, that the disease has a central morbific cause, it is impossible that homœopathists can accept the opinion that the malady can be cured by the mere lopping off of one or a few of its principal symptoms, or of its prominent pathological processes or conditions. How, then, do homœopathists explain their ability to reach with their remedies the perpetuating or "maintaining" cause of disease, conceding, as they do, their inability to determine its nature, or even its location?

Starting out with the accepted principle that "like causes operating under like conditions produce like effects," the homœopathist assumes the converse of the proposition to be likewise true; namely, that like results appearing under like conditions and circumstances, indicate the operation of like causes. When two patients in similar conditions of health manifest similar morbid symptoms, the phenomenon is, by all pathologists, considered as indicating the operation of causes in corresponding portions of the two organisms, and acting in a similar manner. This view is not peculiar to any medical school, but is held by all physicians alike. To this doctrine, the homœopathist adds the belief that it also applies to the effects of drugs, as well as to those of natural (?) diseases; and that when similar morbid manifestations result, in one case from disease and in the other from the effects of a drug, the phenomenon still indicates a physiological or (pathological) cause operating in a similar part or parts of the organisms involved, and operating in a similar manner in both. So much as to the *locality* of the cause — the "seat of the disease," upon which the "similar" drug acts. What of the *manner* in which it acts?

It was long ago shown by Hahnemann and others that the effects of almost any drug upon the human body are of two kinds, primary and secondary, direct action and reaction; and that these two actions are, in a measure, the opposite, one of the other. This view has been advocated by numerous physicians, not always of the homœopathic school. Of late years the phenomenon has attracted more attention from medical writers than formerly, and is generally spoken of as "the dual action of drugs." To illustrate: a drug may first stimulate, and afterward depress, a certain organ of function. Another may first depress and then stimulate; and the symptoms will, of course, take their character from the action or reaction of the drug. Some homœopathists are of opinion that this dual quality of drug action is the proper explanation of the curative potency of the similimum. Others, Hahnemann included, explain it on other grounds. Others consider it likely that the different effects of large and small doses — a fact observed by many practitioners — may account for the cures made by the similar remedy. All homœopathists agree, however, that the question turns upon the curative *fact*, and not upon its explanation; and hold that one and all of these explanations may yet prove to be erroneous; yet firmly convinced that the main fact will remain unaffected through all changes in theory and doctrine.

Homœopathy, like any other principle or art, has its own particular field of application and operation. Thus it does not cure *directly*, a mechanical injury to the tissues, or any impairment wrought by chemical means; though it does cure the functional diseases and disorders caused by the irritation of such injuries. The homœopathic remedy acts *directly* only upon function. It never alters a structure except by first modifying a function. Nor does a drug ever act homœopathically upon a function unless that function be disordered. When a drug acts on a healthy function, or when it causes disorder in a function, such action is never homœopathic, whatever may be the mode of its selection and whatever the form or quantity in which it is administered. *The homœopathic medicine is a specific-restorative-stimulant, only and always.* Such, in brief, is an exposition of homœopathic belief and practice, and of its underlying principles and doctrines as taught by Hahnemann and held by the profession as a body. The small dose used by homœopathic prescribers is considered in another part of this article.

Homœopathy as a mode of medical practice is usually said to have originated in 1796, when Dr. Christian Friedrich Samuel Hahnemann published in 'Hufeland's Journal,' at Jena, an 'Essay on a New Principle for Ascertaining the Curative Powers of Drugs.' In this essay he criticizes the state of the medical art, and especially urges that the chemical properties and powers of drugs are not adapted to the work of curing disease, but that cures must be accomplished by an entirely different property resident in medicinal substances. Having read of cures in medical literature and observed, in his own patients, recoveries occurring under the evident influence of the "similar" remedy, he offers the following theory of the phenomenon: "Every powerful medicinal substance produces in the human body a kind of peculiar disease; the more powerful the medicine, the more peculiar, marked, and violent the disease. We should imitate nature, which sometimes cures a chronic disease by superadding another, and employ, in the (especially chronic) disease we wish to cure, that medicine which is able to produce another very similar artificial disease, and the former will be cured; *similia similibus*." Hahnemann further explains his conception of a homœopathic cure in his 'Organon,' section 26, in the following language: "A weaker dynamic affection is permanently extinguished in the living organism by a stronger one, if the latter (while differing in kind) is very similar to the former in its manifestations." This language he designates the "homœopathic law of nature." The term "homœopathy" or "similar disease," as representing the new medical practice, may have been suggested not alone by the fact of cures produced by the similar drug, but also by Hahnemann's theoretical explanation of the phenomenon.

A correct and adequate conception of homœopathy, of the difficulties necessarily encountered in its propagation and establishment, and of the place it holds and the influence it exerts in the development of therapeutics can be obtained only through knowledge of the conditions of general medicine down to the close of the 18th century. It is essential, therefore, that reference be made to certain points in the progress of medical history from its beginnings to and including the period of the investigations that resulted in the discovery of homœopathy as a general therapeutic principle. This reference does not need to embrace all the departments of medical science — anatomy, physiology, pathology, etc.— but the department relating to treatment, or therapeutics only. It is requisite for us to know and appreciate the mental conception — the basis of reason — upon which the "art of healing" was established prior to the advent of homœopathy as a system of medical practice.

The earliest efforts of men to alleviate the sufferings caused by illness and mechanical injury were chiefly instinctive. Water, moist earth, the fleshy portions of plants, and other cooling substances, were employed by men, as well as by the lower animals, to mitigate the pain, heat, and discomfort of local inflammation; and other simple expedients were instinctively resorted to for various disordered conditions. In time the number and variety of known remedial agents, as well as of the diseases for which they were used, must have been rapidly extended by experience. And thus began the "empirical method" of treatment — the natural second step in the progress of medicine.

Inefficient as were these modes of treatment, they were far more rational than most of those that occupy the pages of medical history for many succeeding centuries. These later methods were based, not on observation and experience, but upon pure assumptions having, as John Stuart Mill expresses it, "no limitations other than those of the imagination." (The construction of medical theories, or philosophical explanations of observed facts, was a still later development.)

Among the large number of these hypotheses are the following: (1) That disease is a punishment sent by some malevolent deity; (2) that it is due to the influence of a comet, a planetary conjunction, an earthquake, or some other celestial or terrestrial phenomenon; (3) that it is caused by abnormal preponderance of some one of the four elements (fire, air, earth, and water) of which the human body was said to be composed; (4) that it originates in a disturbance of the bodily states of heat, coldness, moisture, and dryness; (5) that it arises from disproportion in the four humors which supply the organism — blood, mucus, black bile, and yellow bile; (6) that it is produced by a *materia peccans,* or offending matter, which must needs be expelled; (7) that the body contains multitudes of "invisible pores" through which circulate infinitesimally minute atoms or corpuscles, and that disease has its cause in obstruction or relaxation of these pores; (8) that disease is based upon three possible states of the organism — "strictum," "laxum," or "mixtum" — which must be treated with laxatives, astringents, or a combination of both, as might be needed; etc., etc. All these hypotheses, and many others, arose prior to the close of the 2d century A.D. Their absurdity is not more grotesque than that other hypothesis which underlies each and all of them; namely, that a knowledge of the cause or nature of disease can indicate the means and method of its cure; a view not held at present by any homœopathic or other scientific physician.

The period between the 2d century and the 15th presents little record of therapeutic art; but with the invention of the printing-press came a stronger impetus to all forms of research, medical included. Since that time increasing knowledge of anatomy, chemistry, and physiology has led to the elaboration of therapeutic theories based upon certain facts relating to these natural sciences. The advances in anatomy had suggested a mechanical basis for therapeutics; pneumatics, friction of fluids in vessels, the diameters, curvatures, and angles of blood-vessels were brought forward to explain the phenomena of disease and to suggest measures for its cure. Physiology and chemistry brought out a renewal of the ancient doctrine of "four elements" and the substitution of the three "alchymistic symbols" represented by mercury, salt and sulphur, whose union is health, and their separation disease. The author of this doctrine, Paracelsus, also ascribed to the "vital force" not only the power, but also the intelligence, to resist disease and to provide for its cure. About the middle of the 18th century, or near the time at which the discovery of the general principle of similars was made, physiological hypotheses became largely identified with therapeutics; and the same might be said of chemical theories. Health and disease were the results of a contention between the acids and the alkalies. Haller held to the view that disease was due to change in the "irritability" of the tissues. Cullen revived an old doctrine that disease was caused by "spasm" and "atony," and required to be treated in accordance with that view. Brown, the rival of Cullen, concluded that diseases were either "sthenic" or "asthenic," and required asthenic, or sthenic medication, as the case might be.

Before the close of the 18th century the medical profession had acquired knowledge of a number of drugs possessed of "specific" properties for the cure of particular diseased conditions; among them Peruvian bark for intermittent and other malarial fevers, mercury for syphilitic diseases, sulphur for itch, etc. These specifics exerted their curative effects by virtue of properties not at all understood at that time, and but imperfectly known a century later. These specific cures were limited to comparatively few diseases. For the treatment of the conditions with which the medical practitioner is contending daily, which constitutes almost his entire duty, he had nothing but fallacious assumptions and hypotheses to depend on. Such was the condition of the medical art at the time when Hahnemann began his independent researches in therapeutics.

Hahnemann possessed unusual linguistic attainments, which gave him access to the publications not only of Germany, but of England, France, Spain, Italy, Austria, Greece, and Arabia. He was not only a literary scholar. He was also a practical expert in the fields of chemistry, pharmacy, and industrial technology. He made many discoveries in industrial chemistry, and introduced scores of improvements in the details of manufacturing chemical products. At the period of his earliest responsible connection with medicine, "there was," says Rapou, "complete anarchy in the domain of therapeutics." Hahnemann, unwilling to trust the lives of his patients to the tender mercies of this conglomeration of assumptions, adopted the use of the class of remedies known as specifics, whose effects were easily ascertainable, though their *modus operandi* was altogether unknown.

Homœopathy was not an invention, like some of the "systems" of medicine that preceded it; neither was it a sudden discovery. It was an evolution extending from 1790 to 1835, a period of 45 years. The earlier portion of the process is described by Bradford, who in speaking of its beginning says: "We now come to the translation of a very important book (Cullen's 'Materia Medica'), from which must be dated the discovery of the Law of Similars. It has been asked why Hahnemann at this time happened to translate this particular book, and it has been asserted that he used it as a blind to foist on the world his peculiar theories. It is not probable that when he commenced upon Cullen Hahnemann had any particular medical theories, but only a growing disgust for the medical fallacies of the day. This is clearly evidenced by his writings at that time. It is not to be wondered at that he should translate the work at that particular time. He was translating for money, for the booksellers and publishers of Leipsic, and it is not likely that he selected the books which he was to translate. Dr. Cullen was an authority on the subject of the materia medica of his day, an experienced lecturer, a talented chemist, and a brilliant and popular teacher in Edinburgh. Naturally the Germans wished to learn of his new and peculiar theories regarding disease, as well as to obtain the use of his 'Materia Medica,' which at this time was a standard work.

"Hahnemann was the most accomplished translator of medical works of the time, and what more natural than that the task should be given to him. Cullen published the first edition of this book, in London, in 1773. Another edition was issued in 1789, in two volumes, and it was this edition that Hahnemann used in his translation. In this book, Volume II., Cullen devotes about 20 pages to *Cortex Peruvianis* (Peruvian Bark), gives its therapeutical uses in the treatment of intermittent and remittent fevers, advises its use to prevent the chill, and gives minute directions for the safest period of the disease in which to use it. Hahnemann was impressed with the use of this drug, with which he as a physician had before been familiar. Something in the manner in which Cullen wrote decided Hahnemann to experiment with it upon himself and to see what effect it would have upon a person in perfect health. The result of this experiment will be given in Hahnemann's own words. In the translation of William Cullen's 'Materia Medica,' Leipsic, Schweikert, 1790, page 108 of Volume II., appears the following foot-note by Hahnemann: 'By combining the strongest bitters and the strongest astringents, one can obtain a compound which, in small doses, possesses much more of both these properties than the bark, and yet no specific for fever will ever come of such a compound. This the author (Cullen) ought to have accounted for. This perhaps will not be so easily discovered for explaining to us their action in the absence of the Cinchona principle.

" 'I took, by way of experiment, twice a day, four drachms of good *China*. My feet, finger ends, etc., at first became cold: I grew languid and drowsy; then my heart began to palpitate and my pulse grew hard and small; intolerable anxiety; trembling (but without cold rigor); prostration throughout all my limbs; then pulsation in my head, redness of my cheeks, thirst, and, in short, all those symptoms which are characteristic of intermittent fever, made their appearance, one after the other, yet without the peculiar, chilly, shivering rigor.

" 'Briefly, even those symptoms which are of regular occurrence and especially characteristic — the stupidity of mind, the kind of rigidity in all the limbs, but above all, the numb, disagreeable sensation which seems to have its seat in the periosteum, over every bone in the body — all these made their appearance. This paroxysm lasted two or three hours each time, and recurred *if I repeated this dose, not otherwise;* I discontinued it, and was in health.'

"The next note in the German translation is as follows: 'Had he (Cullen) found in bark traces of a power to excite an artificial antagonistic fever, he certainly would not have persisted so obstinately in his mode of explanation.' " ('Life and Letters of Dr. Samuel Hahnemann,' by T. L. Bradford, M.D., pp. 35–7.)

These experiments seemed to show that Peruvian bark is capable of producing in the healthy human organism a series of symptoms quite closely resembling those of that peculiar form of fever which it is known to cure. Instead, however, of solving any questions in the mind of Hahnemann, it only served to suggest several others. Does Peruvian bark then produce the same symptoms that it specifically cures? Is its specific curing property dependent on its power to cause the symptoms which it cures? If so, is this power peculiar to *Peruvian bark*, or is it to be discovered in other drugs? And do all drugs possess the power to cause symptoms similar to those they cure?

To obtain light upon these questions occupied his efforts during the six years between the translation of Cullen's 'Materia Medica' and the publication of the 'Essay' above mentioned. To quote from a writer in the British 'Homœopathic World,' 1875, p. 234: "Drug after drug, specific after specific, was tested on himself and on healthy friends with one unvarying result — each remedy of recognized specific power excited a spurious disease resembling that for which it was considered specific. But many more symptoms than those diagnostic of any one disease resulted from almost every medicine, and aroused a hope in the experimenter's mind of specifically treating a greater number of diseases than had ever been so treated before. Besides discovering many valuable phenomena undreamt of, he verified his discoveries and observations by ransacking the volumes of recorded experiments in materia medica and the whole history of poisoning." The members of his family and his personal and professional friends aided in the work of experimentation, and tests of each medicine were made with different doses, and on many different persons, all the work being conducted under his own supervision.

Dr. Bradford tells us that at the time of Hahnemann's translation of Cullen's 'Materia Medica,' that is, at the beginning of his independent investigations in 1790, he had no preconceived theories or opinions to sustain. This view of his biographer is corroborated by the absence from Hahnemann's writings of even remote reference to any *a priori* conception or suspicion of a general curative relation between drugs and diseases. Nor does it appear that he then possessed the faintest conception of the magnitude, or of the quality, of the task he was gradually assuming. His original object evidently was to ascertain why Peruvian bark cures intermittent fever, and to learn if the view held by Cullen — that its curative property resides in a combination of bitter (tonic) and astringent qualities — was indeed true. There is no historic evidence that before 1790 the general therapeutic principle of similars had even dawned upon his mind. But we may be quite sure that the logical and philosophical principles that must necessarily govern his researches had been well thought out before the work had very far advanced.

Hahnemann and his disciples claim that in the discovery of homœopathy as a general principle of organic science, and in its conception and development as a system of medicine, assumption, speculation and hypothesis have had no place; but that observation, experimentation, and inductive classification constitute the scientific and solid foundation of fact upon which it rests. They assert that all its essential doctrines are susceptible of demonstration, that they have been verified and reverified times without number, and that for the first time in the history of intellectual development the establishment of the homœopathic principle showed that the Baconian method of research is as applicable in the realm of therapeutics as in any other department of scientific investigation. If we look over the records of the processes leading to its discovery, it appears that these processes were under the guidance of the following principles of scientific philosophy, all of which are distinctly set forth by Hahnemann in his 'Organon':

1. That in the study of disease with a view to its cure, the only safe dependence is upon the manifestations (symptoms) perceptible to the senses, and that no safe conclusions can be drawn from mere theories erected upon these signs and symptoms. The signs and symptoms constitute the only side of the disease that is turned toward the physician, and the totality of these signs furnishes the only true expression or portrait of the disease.

2. That the specifically curative power of a drug resides not in its physical, nor yet in its chemical properties, but in its capacity to produce changes in the functions of the organism.

3. That the dynamic properties of a drug — in other words, its power to specifically cure disease — can be ascertained only by observing the signs and symptoms which it can produce in the organism, and that these specifically curative properties cannot be inferred from the physical or chemical properties of the drug substance.

4. That experiments for the purpose of ascertaining the pathogenetic properties (signs and symptoms) of drugs must be conducted under the precautions necessary in other researches; and the tests must be repeated and varied with a view to eliminate every influence and agency that can vitiate the experiment. The drug experimented with, and the person experimented upon, must both be "standard." That is, the drug must be pure and unmixed with any other substance capable of disguising, modifying, or otherwise affecting its own specific activity, and the person experimented upon (prover) must be possessed of good health, and free from any unhealthful occupation or habit, and from any mental, moral, or other influence or agent that can modify the pure effects of the drug upon his organism. Also, that the experimentation with the drug must be continued until its whole pathogenetic effect has been elicited.

5. That the observations made from such experiments as those here indicated constitute the only source of a pure and "standard" materia medica, and supply the only material from which general therapeutic principles can be discovered or deduced.

6. That effects observed from the action of a drug upon diseased persons (clinical effects) or those obtained from a combination of drugs (polypharmacy) are not "standard" effects and cannot serve as reliable guides in a search for therapeutic principles.

In the opening sections of the 'Organon,' Hahnemann mentions as among the physician's essential acquirements:

(1) Knowledge of diseases; (2) knowledge of the dynamic properties of drugs; (3) knowledge of the curative relations between the two. This knowledge he holds essential both to the development of therapeutic science and to enable the physician to prescribe the curative remedy.

In order to qualify the physician for his work his knowledge of disease must be composed of facts perceptible to the senses. Our physiological and pathological deductions in reference to a case of disease are more or less uncertain and theoretical. Absolute knowledge of disease is limited to its signs and symptoms, besides which there can be no certain and assured foundation for a science of therapeutics.

The knowledge of drug-properties must be equally certain and substantial. All drugs possess three classes of properties — physical, chemical, and specific or "dynamic." The physical and chemical properties can be ascertained by physical and chemical methods. The specific or dynamic properties, that is, the properties which alone impart the power to accomplish specific cures of disease, can be learned only by observing their power to cause changes in the health of the organism as shown by their capacity to produce signs and symptoms. Here again the signs and symptoms constitute the only sure basis of classification and induction in the construction of a science of therapeutics.

Having possessed himself of so much of such knowledge as was within his reach, Hahnemann then began the investigation of the great and dominating question: Given a knowledge of diseases as expressed by signs and symptoms, and a knowledge of drug properties as expressed by signs and symptoms, can we discover between them any general relation that will guide the physician in his search for the curative drug? In this work of "interrogating nature" he had already been led to infer what her reply might be. His experiment with Peruvian bark had given him a somewhat emphatic hint. Then followed the six years of experimentation upon himself, his family, and friends; with what result we have already seen. Accompanying and following these experiments came the "ransacking of the libraries"— a work for which few men were so well fitted. This literary search resulted in two important discoveries. First, that when two diseases manifesting quite similar symptoms appear in the same organism, they antagonize or annihilate each other. This subject is carefully outlined in the 'Organon,' sec. 42–45, and in sec. 46 the writer cites a score of illustrative instances obtained from the pages of contemporaneous literature, the authority being carefully mentioned in every citation.

The second result of this literary search is that it corroborates the view with which Hahenemann set out; namely, that even under the modes of treatment in vogue before his day, undoubted cures frequently resulted from the action of drugs possessed of the power to cause symptoms similar to those of the cases cured. Some of these cases are well worthy of study by those interested in medical subjects. In the earlier editions of the 'Organon' and in the 'Essay on a New Principle for Ascertaining the Curative Powers of Drugs,' these published cures are reported *in extenso*, the literary source being given, together with the name of the physician in each case. In the Dudgeon translation of the 5th German edition the same list occupies 31 pages of the appendix. In practically all of the cases reported, the mere name of the disease is sufficient to suggest the fact of similarity between the symptoms of the malady cured and the symptoms of the drug prescribed. In other cases the symptoms themselves are given with more attention to detail than was customary at that period of medical history. If we sum up the remedies named in the 'Essay,' together with those mentioned in the 'Organon,' we have a total of 63 drugs to which Hahnemann was able to ascribe homœopathic cures occurring in the practice of physicians who had no knowledge of the homœopathic principle.

In presenting this list of cases successfully treated with the similar remedy, Hahnemann has made nearly 500 citations of writers who had no suspicion that any general law of therapeutics was involved in the operation of their prescriptions. The degree of similarity shown between the pathogenetic properties of the drugs administered and the symptoms manifested by the patients seemed, in most cases, to be positive and emphatic, and in some instances striking. In what he has to say regarding the curative effects of opium this fact is graphically shown. He says:

"A condition of convulsions without consciousness, resembling the death-agony, alternating with attacks of spasmodic and jerky, sometimes also sobbing and stertorous, respiration, with icy coldness of the face and body, lividity of the feet and hands and feebleness of the pulse (precisely resembling the symptoms of opium observed by Schweikert and others), was at first treated unsuccessfully by Stütz with potash, but afterward cured in a speedy, perfect, and permanent manner by opium. According to Vicat, J. C. Grimm, and others, opium produces an extreme and almost irresistible tendency to sleep, accompanied by profuse perspiration and delirium. This is the reason why Osthoff was afraid to administer it in an epidemic fever which exhibited similar symptoms, for the system he pursued prohibited the use of it under such circumstances. It was only after having employed in vain all the known remedies and seeing that death was imminent that he resolved to try it at all hazards, and behold, it was always efficacious. J. Lind also avowed that opium removes the head troubles, and the burning sensation in the skin and the difficulty of perspiring during the pyrexia; under opium the head becomes free, the burning febrile heat disappears, the skin becomes soft, and its surface is bathed in a profuse perspiration. But Lind was not aware of the circumstance that opium produces very similar morbid symptoms in the healthy. Alston says that opium is a remedy that excites heat, notwithstanding which it certainly diminishes heat where it already exists. De la Guérène administered opium in a case of fever attended with violent headache, tension and hardness of the pulse, dryness of the skin, burning heat, and hence difficult and debilitating perspirations, constantly interrupted by the extreme restlessness of the patient. He was successful with this case because opium possesses the faculty of creating an exactly similar feverish condition in healthy persons, of which he knew nothing, though it is stated by many observers. In a fever where the patients were speechless, eyes open, limbs stiff, pulse small and intermittent, respiration labored, snoring, and stertorous, and deep somnolence (all of which are symptoms perfectly similar to those which opium excites), this was the only substance which C. L. Hoffmann saw produce any good effects. Wirthenson, Sydenham, and Marcus have in like manner cured lethargic fevers with opium. C. C. Mathai, in an obstinate case of nervous disease, where the principal symptoms were insensibility and numbness of the arms and legs, after having for a long time treated it with inappropriate remedies, at length effected a cure by opium, which, according to Stütz, Young, and others, causes similar states in an intense degree. Hufeland performed, by the use of opium, the cure of a case of lethargy of several days' duration. How is it that opium, which, as everyone knows, of all vegetable substances is the one which in its primary action (in small doses) produces the most severe and obstinate constipation, should be one of the most efficient remedies in constipation of the most dangerous character, if not by virtue of the homœopathic therapeutic law, so long unrecognized? The honest Bohn was convinced by experience that opiates were the only remedies in the colic called 'miserere': and the celebrated F. Hoffmann, in the most dangerous cases of this nature, placed his sole reliance on opium combined in the anodyne liquor called after his name. Can all the 'theories' contained in the 200,000 medical books which cumber the earth furnish us with a rational explanation of this and so many other similar facts?"

The great German physician and philosopher was careful to credit other medical men with having obtained foregleams of his great discovery. "How near," he says, "was the great truth sometimes of being apprehended!" And again: "There have been physicians here and there across whose minds this truth passed like a flash of lightning without ever giving birth to a suspicion of the homœopathic law of nature."

From Hahnemann's literary and experimental investigations alone, both he and his disciples have unhesitatingly justified their belief in a general curative relation between drugs, as represented by their symptoms, and diseases as represented by their symptoms, and their belief that this curative relation is properly set forth by the word "similarity." The proofs herein presented are considered conclusive, although similar evidence has been constantly accumulating in the writings of medical men of all schools, and in the practice of hundreds and thousands of homœopathic physicians for more than a century.

In Hahnemann's foot-note (see Dudgeon's Appendix to the 'Organon,' p. 207) it is shown that he early became aware of the "danger which is to be anticipated from large doses of homœopathic remedies." He says, however, that "it often happens, from various causes which cannot always be discovered, that even very large doses of homœopathic medicines effect a cure, without doing any particular harm." In most instances homœopathic physicians came to regard the small dose as a necessity to homœopathic practice. Thus, a full dose of belladonna, or of opium, administered to a patient already suffering with symptoms like those producible by one of these drugs, might be perilous. Experience also taught them that the curative action of the homœopathic drug could be secured as well or even better through the small dose. The results claimed for these small or minute doses naturally aroused the skepticism of physicians and laymen alike, and became a serious hindrance to the spread of the homœopathic system. The very nature of the homœopathic principle, however, carries with it the necessity for the use of the diminished dose.

Homœopathic physicians, when prescribing minute doses of their remedies, are under the necessity of employing great care in securing absolute purity and simplicity in the preparation of their medicines; and this has led to the need of a special pharmacy for homœopathic prescribers. Another corollary of the homœopathic law of cure is the "single remedy," without which no prescription can be strictly homœopathic. Still another principle follows from the application of this law: namely, that a homœopathic prescription can never be made from the *name* of the disease. The similarity must be traced between the symptoms of the drug and those of the individual patient. This fact is fortunate in that it at once brands the advertised "homœopathic" proprietary medicine as a fraud and a pretense, no matter in what form it may be put upon the market.

The spread of homœopathy in the country of its birth, and in other countries of Europe, has been slow. The delay in securing its establishment has been due partly to the cause already mentioned — an unwillingness on the part of both physicians and laymen to accredit the little dose with curative potency. But the chief obstacle to its advancement is to be sought in inimical legislation and the lack of facilities and authority to educate young men and women for homœopathic professional life, and the consequent inability to supply the public need of homœopathic physicians.

Homœopathy was introduced into the United States in 1825 by a physician named Hans B. Gram, who at that time settled in New York. In this country, with its free institutions and its asserted freedom of opinion, the new medical thought found less antagonism to overcome, although there were many obstacles to be encountered, chiefly of a social and legislative character. The physicians of America, less conservative, perhaps, than those of Europe, were more disposed to inquire into the scientific and practical aspects of homœopathy, with the result that in less than 20 years more than 300 of them were engaged in its practice. These physicians speedily conceived the necessity for having their own students educated under teachers of their own faith and practice, and in 1848 organized and equipped a medical college for this purpose. This school was almost immediately succeeded by others; and these institutions have very largely contributed to the rapid spread of homœopathic practice in all parts of the United States.

When Dr. H. B. Gram arrived in New York in 1825, the only homœopathic literature in the English language was Hahnemann's 'Geist der homöopathischen Heilkunst,' a pamphlet of 24 pages, translated by himself and published by J. & J. Harper, of New York. The remaining homœopathic literature was all in the German language, and it is recorded that such was the interest felt in the subject that numerous converts to Hahnemann's system, some of them past middle life, pursued the study of German in order to facilitate their investigations in homœopathy. At the close of the first quarter-century of the new practice, more than 25,000 pages in the English language had been published by the homœopathic press, and at the end of 50 years the aggregate reached more than 150,000 pages. (See 'Transactions of the World's Homœopathic Convention of 1876, Vol. II., pp. 1020–65.)

The progress that homœopathy has made in the United States can be best shown by the records of its organizations and institutions. The American Institute of Homœopathy, the national society of homœopathic physicians, organized in 1844, now has a membership of over 2,000. There are six other national organizations, formed to promote various departments of medical and surgical interest. State societies are organized in 36 of the commonwealths, and at the present rate of increase these bodies will in a few years exist in every State. To these may be added 150 local societies of various kinds. In the United States homœopathic physicians are in charge of 220 hospitals, general and special, 66 other institutions — asylums, homes, etc., and 65 dispensaries, 20 medical colleges, and 32 medical journals.

The exact number of physicians practising homœopathy in this country cannot be ascertained with accuracy, but it is known to be not less than 12,000, and has been estimated as high as 18,000. The number of people employing these physicians, regularly or irregularly, cannot be less than 15,000,000. Thus has the influence of homœopathy extended during its American career of 75 years.

The influence of homœopathy upon public and professional sentiment has been beneficent and pronounced. Laymen and physicians have alike learned from the practice, that large quantities of potent and dangerous drugs are not often necessary to determine recovery from disease, and physicians have reached the wise conclusion that cures sometimes occur under the influence of small doses, as well as quantities with larger.

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Homol'ogy, a principle first enunciated by E. Geoffrey St. Hilaire. It is the anatomical or morphological identity of parts or organs, which may have entirely different functions. Thus the wing of a bird is homologous with the fore limb of a dog or the arm of man. On the other hand analogy involves the idea of physiological identity, or use. Thus the wing of a bird is analogous to the wing of an insect. Homologous organs are also present in groups of animals which have had a common origin; thus the swimming-bladder of a fish has given origin to the lungs of the higher vertebrates, the physiological differences arising from change of function. See ANATOMY, COMPARATIVE; ANALOGY.

Homoousian, hō-mō-oo'sĭ-an (Greek *homos*, "the same," and *ousia*, "substance") and **Homoiousian** (Greek *homoios*, "like," and *ousia*, "substance"). The Council of Nice adopted the word homoousian to express that the Son was of the same substance with the Father, while the followers of Arius adopted the term homoiousian, as a sort of middle and reconciling theory, to express that the Son, though not of the same, was yet of a similar substance with the Father. The doctrine of Arianism was not only that the Son was subordinate to the Father, but that he was totally unlike him, being a mere created being.

Homoplasy, hō'mō-plăs-ĭ, the effect of the influences of convergence (q.v.), upon homologous structures. The term was proposed by E. Ray Lankester and used at first with a rather broader meaning subsequently restricted and defined by Osborn. See ANALOGY.

Homop'tera. See HEMIPTERA.

Homs, hōms. See HEMS.

Hondo, hōn'dō (signifying "chief island"), the largest island of Japan (q.v.), for a long time erroneously known as Nippon or Niphon, the Japanese name for the whole empire.

Honduras, British, or **Belize,** a colony in Central America, bounded on the north and northwest by Yucatan (Mexico), on the east by the Caribbean Sea and Gulf of Honduras, and on the south and west by Guatemala. Its chief town, Belize, has 9,113 inhabitants. The Cockscomb Mountains in the southern district rise to the height of 3,700 feet. Principal rivers are the Old, the New, and the Sibun. The northern part of the colony contains many lagoons, and a chain of cays stretches along the coast. The forests yield mahogany and logwood in large quantities; cattle raising and the cultivation of coffee and fruits receive some attention. The value of exports since 1897 has been decidedly greater than that of imports. During the year ending 31 March 1902 exports reached $1,427,500 in value; imports for the same period, $1,262,500. In 1901 exports of mahogany amounted to 6,485,952 superficial feet; logwood, 19,682 tons. Registered shipping: 6 steamers and 204 sailing vessels. Vessels entering and clearing in 1901, 414,795 tons. The total number of letters, books, postal cards, parcels, and newspapers transmitted by the post-office in 1901 was 245,694. That is to say, proportionately to the population, from 100 to 350 per cent more than in the neighboring Guatemala and Honduras. The standard of currency since 15 Oct. 1894 has been United States gold. In common use are silver coins and government notes. British Honduras is governed as a crown colony, by a governor, assisted by executive and legislative councils, the former composed of five members and the latter of eight. Expenditures since the close of 1899 have been less than the revenue, the latter being derived from customs duties, excise, land-tax, licenses, and the sale or leasing of lands. Total expenditure in the year ending 31 March 1902, about $256,050; revenue, $300,750; public debt, $173,680. There are [illegible] primary schools, with 3,423 pupils, receiving aid from the government; also a few denominational secondary schools. Population, according to the latest census, 37,479, an increase of about 17 per cent since the previous census. For origin and early history of the settlement, see BELIZE; also CENTRAL AMERICA.

Consult: 'Consolidated Laws of the Colony of British Honduras' (London 1887); Gibbs, 'History of British Honduras'; and Henderson, 'An Account of the British Settlement of Honduras.'

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Honduras, Gulf of, a spacious inlet of the Caribbean Sea, having on the west British Honduras, and on the south Guatemala and Honduras. In it several smaller bays of which the Gulf of Amatique, with its inner recess, the bay of St. Tomas, are spacious and deep. Several large rivers, the Belize, Chamelicon, Dulce, Motagua and Ulua, flow into the gulf. Along the shores are the islands of Turneffe, Manabique, the Bay Islands including Ruatan, Utila, and Bonacca, and numerous islets and reefs called cays.

Honduras, Republic of, a country of Central America, bounded on the north and northeast by the Gulf of Honduras and the Caribbean Sea; on the southeast and south by Nicaragua; and on the southwest and west by Fonseca Bay, Salvador, and Guatemala. Estimated area, 46,250 to 46,400 square miles. The departments of the republic, with the population of each as shown by official statistics of 1901, are as follows: Tegucigalpa, 81,800; Copán, 62,398; Gracias, 48,242; Choluteca, 45,340; Olancho, 44,496; El Paraiso, 39,918; Santa Bárbara, 36,228; Valle, 33,450; Comayagua, 29,023; La Paz, 27,384; Intibucá, 26,348; Cortéz, 21,801; Yoro, 19,988; Colón, 13,791; Atlántida, 8,797; Bay Islands, 4,737. The capital, Tegucigalpa, has 12,000 inhabitants. Mountain ranges, which rise to heights of 5,000 or even 10,000 feet, are massed in the western half of the republic; the Juticalpa, Camasca, and Tompocente ranges, however, are near the frontier of Nicaragua in the east. Rivers emptying into the Caribbean Sea or Gulf of Honduras are the Coco or Wanks, and Patuca, in the east, and the Ulua, Chamelicon, etc., in the west. The Choluteca flows southward from the Misoco Mountains near Tegucigalpa, and empties into Fonseca Bay, on the Pacific coast. Large lakes are the Caratasca, on the Mosquito coast, and Yojoa, among the western mountains. The chief port on the Pacific is Amapala; other ports of entry are Puerto Cortez (on the Gulf of Honduras), La Ceiba, Truxillo, Roatan, and Iriona.

Minerals, Woods, and Agricultural Products. — Gold is found between the south and centre; silver in almost all sections. Lead, copper, saltpeter, iron, coal, platinum, zinc, and antimony are also widely distributed. The value of ores produced in 1902 was approximately $1,000,000 (that is, 23,234 ounces of gold, 1,010,204 ounces of silver, and a considerable quantity of copper). Only about 5 per cent of the mines of the country are being worked. The forests from sea-level to an altitude of 1,000 feet, contain mahogany, ebony, dyewoods, sarsaparilla and other medicinal plants, and cabinet woods, cedar, etc. At an elevation of 1,800 feet are dense and very extensive forests of pine and similar woods. Agriculture receives more attention than formerly, and the leading product is the native maize, of which 500,049 bushels were raised in 1902, chiefly in the departments of Copán, Gracias, and Santa Barbara. Bananas and plan-


CENTRAL AMERICA
SCALE OF MILES.
0 10 25 50 75 100 125 150
Importance of places is indicated
by different lettering, thus:
25,000 or over..........GUATEMALA
10,000 to 25,000..........Santa Fe
1,000 to 10,000..........Limon
Smaller Places..........San Rosa
Steamship Routes
Railroads
Submarine Telegraph Cables
MEXICO
GUATEMALA
BRITISH
HONDURAS
GULF OF
HONDURAS
HONDURAS
SALVADOR
NICARAGUA
COSTA RICA
PANAMA
CARIBBEAN SEA
PACIFIC OCEAN
MOSQUITO GULF
MOSQUITO
RESERVATION
LAKE
NICARAGUA
Bay Islands
SAN JUAN DEL NORTE
BAY
BAY OF
PANAMA
Belize
TEGUCIGALPA
Comayagua
Leon
Granada
Greytown
Limon
TO NEW ORLEANS
TO TAMPA
TO NEW ORLEANS
TO NEW YORK
TO SANTIAGO DE CUBA
TO PUERTO CABELLO
TO SABANILLA
TO PANAMA
TO ACAPULCO
TO SALINA CRUZ
Longitude West from Greenwich
Copyright, 1903, by The Americana Company
Panama
Bay of Panama
Colon
PACIFIC OCEAN
NICARAGUA CANAL
CARIBBEAN SEA
CARIBBEAN SEA

tains are grown on 42,840 acres of territory in the departments of Cortéz, Atlántida, the Bay Islands, etc. The wheat crop in 1902 was 15,813 bushels; rice, 3,914,219 pounds. Nearly 20,000 acres are devoted to the cultivation of plantains. Cocoanuts, lemons, and oranges are produced for export on a large scale. The coffee crop in 1902 amounted to 4,494,826 pounds, and tobacco to 1,378,573 pounds. Sugar-cane is cultivated on 13,263 acres; indigo on about 9,000 acres. The total value of agricultural products in 1902 was about $2,482,449.10. The number of cattle is estimated at 571,120; horses, 43,549; mules, about 14,000, etc.

Commerce and Manufactures.— The total value of imports in 1902 was 4,377,161.42 *pesos*, or about $1,750,684.68 in United States currency; of exports, 6,170,353.27 *pesos*. Imports came chiefly from: the United States (60 per cent), Germany, Great Britain, Belize, Central America, and France. Exports were sent to: the United States (two thirds of total), Great Britain, Central America, Cuba, and Germany, with comparatively small amounts to other countries. The articles exported, together with their values (in *pesos*), follow: Metals, 2,319,070.49; fruits, 1,943,168.06; cattle, 560,411; coffee, 275,826.68; hides and skins, 257,598.10; woods, 217,459.70; tobacco and cigars, 200,851; indigo, 105,425; sarsaparilla, 80,602.50; rubber, 77,552.50; wheat and flour, 66,992; salt, 22,716.20; hats, 14,150; miscellaneous, 28,529.04. Exports to the United States were valued at 1,235,624.79 *pesos* more than imports from that country. Native industries include the manufacture of cigars, flour, hats, and candles.

Railways, etc.— A contract for the completion of an interoceanic railway was entered into by an American syndicate in 1897; in 1902 the government's concession to the syndicate lapsed, but a prorogue was requested. The line from Puerto Cortéz runs southward to San Pedro and La Pimienta. Tegucigalpa is to be connected with the Pacific coast, at San Lorenzo, by a line which is now being constructed. Roads in the country, with a few exceptions, are mere mule-paths. A cart-road from the capital to San Lorenzo is completed as far as La Venta. There are 245 post-offices, and the number of letters (both internal and foreign correspondence) is not more than 1,250,000 in a year. The republic has 3,249 miles of telegraph wire; the capital and some other towns telephone services.

Money, Weights, Measures, and Banking.— The standard dollar, or silver *peso*, is worth about 40 cent, United States currency. Gold coins of the value of 20, 10, and 5 dollars, and silver pieces, fractions of one dollar, are also in circulation. While the metric system is authorized by law, the chief measures and weights in commercial use, as in the other countries of Central America, are: Centaro = 4.2631 gallons; fanega (dry) = 1.5745 bushels; libra = 1.043 pounds; and vara = 33.874 inches. Note also, manzana = 1 5-6 acres, and arroba = 2¾-3½ gallons. The capital of the Bank of Honduras, 30 June 1902, was 600,000 *pesos*; bank-bills in circulation, 60,242 *pesos*.

Government, Finances, Army and Navy.— The president and vice-president of the republic, nominated and elected by vote of the people, serve for four years; the former is assisted by the ministers (chiefs of departments) of finance, interior, foreign relations, public works, war, public instruction, and justice. The legislative body is composed of deputies elected by the people, there being one deputy for each 10,000 inhabitants. The budget for the fiscal year 1903-4 gives, as the total of receipts from all sources, 2,637,724.20 *pesos*, the largest items being, customs duties, 1,100,000 *pesos*; tax on aguardiente, 805,000 *pesos*; and lottery and wharfage, 223,500 *pesos*. The estimate of expenditures in the same budget is 2,625,985.45 *pesos*, the largest item being for the war department — 941,853.85 *pesos*. The foreign debt of the republic (that is, the loans of 1867-70, with arrears of interest amounting nearly to two and a half times the principal sum) was determined by calculation to be about $96,124,940 in United States currency; and the internal debt was put at 1,332,400 *pesos* in 1900. But in the annual message of the retiring president, Sr. Sierra, sent to Congress 1 Jan. 1903, the assertion was made that the total "recognized" debt had been only $1,704,124.67 silver in 1899, and that this amount was reduced to $1,221,298.09 silver by 31 Oct. 1901. President Sierra completely ignored the large foreign loans, speaking of the 1,704,124 *pesos* as "the entire amount of the debt existing at the beginning of my term of office," "the public debt," etc. The army on 31 July 1902 comprised, according to a statement in the same message, 480 *jefes*, 2,608 officers, and 47,841 men. The permanent force consisted of 87 *jefes*, 226 officers and 2,481 men. Two small steamers belong to the government, and are used as revenue vessels.

Population, Education, and Religion.— The total number of inhabitants, as shown (by departments) in the first paragraph of this article, is 543,741, exclusive of forest tribes. Very few of this number are of Spanish descent, the great mass of the people being Indians or Mestizos. Between 1899 and 1903, new schools to the number of 136 were founded, making a total of 851; and 30,025 pupils received instruction in 1902. There are 13 national "colleges" and one private school for higher education; professional schools with faculties of jurisprudence and political science, and medicine and surgery, at Tegucigalpa; the Escuela de Derecho at Comayagua; a national library with 6,854 volumes; and an art school. Primary instruction is compulsory, gratuitous, and secular. Freedom of worship is secured by constitutional guaranty; the government does not contribute to the support of any church; the prevailing religion is Roman Catholicism.

History.— The first place of debarkation of Christopher Columbus on the American mainland was near the present Cape Honduras, where he landed on Sunday, 14 Aug. 1502. On the following Wednesday Bartholomew Columbus landed at the mouth of Rio Tinto. They sailed thence along the coast to Cape Gracias á Dios (see Central America). The conquest of the country was effected by Hernan Cortés, who found the natives manageable, but their land "covered with awfully miry swamps," as he wrote to the Spanish emperor 3 Sept. 1526. "I can assure your majesty," he adds, "that even on the tops of the hills our horses, led as they were by hand, and without their riders, sank to their girths in the mire." The most important fact in the history of Honduras — the fact that the Indians remained in possession of so large a portion of the country that their descendants constitute the bulk of the population to-day — is a consequence of the policy observed by Cortés and his successors. The natives were tractable; without their assistance it would have been impossible to move about among the dense forests, swamps, and mountains; therefore the Spaniards realized that more was to be accomplished by diplomacy than by force. Massacres occurred, but extermination was not attempted; on the contrary, Honduras became in time a nation of Spanish-speaking Indians, those of pure or nearly pure blood being more numerous now than before the conquest. For the era of independence, confederation with the neighboring states, etc., see CENTRAL AMERICA.

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Hone, hōn, **Philip**, American merchant: b. New York 1781; d. there 4 May 1851. He was a successful auctioneer in New York, established there the first savings bank (1816), was mayor in 1826, and one of the founders of the Mercantile Library Association. Prominent in national political affairs, he aided in the formation of the Whig party. His diary, a portion of which, edited by Tuckerman, appeared in 1889, contains important side-lights on the early history of the Whigs. Hone was also at one time naval officer of New York port.

Hone, a strop or stone for sharpening knives and razors. See WHETSTONE.

Honesdale, hōnz'dāl, Pa., borough, county-seat of Wayne County; on the Lackawaxen River; the Erie, and the Delaware & H. R.R.'s; about 15 miles northeast of Carbondale and 30 miles northeast of Scranton. The first locomotive used in America, the "Stourbridge Lion," made its trial trip from this city. It is situated in a coal-mining region, with good farming land in the valleys. Its manufactures are silk and woolen goods, boots, and shoes, machine-shop and foundry products, axes, electric elevators, green, cut, engraved, and decorated glassware, men's clothing, and wheels for polishing glass. Large quantities of coal are shipped annually from Honesdale. Pop. (1900) 2,864.

Honesty. A flowering herb. See SATIN-FLOWER.

Honey, a sweet sticky liquid obtained by bees and other insects from flowers (see HONEY-BEE; and FLOWERS AND INSECTS) as food, or taken home to be stored as food for the young. The care with which the honey-bee (q.v.) collects and stores this substance in its hive has led to bee-culture (q.v.). Honey is highly nutritive, especially as a fuel for the energies of the body, as four fifths of its components are carbohydrates, the remainder being water with a trifle of protein. The saccharine elements are mainly grape-sugar and some fruit-sugar, which are so readily affected by yeast that various fermented drinks are made with honey as their basis, of which the best known are the mead and metheglin in great demand among all Teutonic peoples a thousand years ago, and the equivalents of which are still made in Russia, Abyssinia and elsewhere. Before the general manufacture and use of cane-sugar, honey was largely depended upon for purposes of sweetening, and was put into a great number of cakes and confections now rare or only locally manufactured. Of the place which it took among the ancients in the household, in ceremonials, worship, and folk-lore a large amount of curious information may be gathered from such books as Beckman's 'History of Invention' (1846); Dutt's 'Materia Medica of the Hindoos' (1877), and similar works, of which lists may be found in Warring's 'Bibliography of Therapeutics' (1868), and in the 'Catalogue of the United States Army Medical Museum.' The importance of honey was, indeed, much greater to the ancients than to us; as might be inferred from its frequent mention in the Bible as a sign of abundance or the resource of the destitute. It has well-recognized medicinal properties, especially as a demulcent against hoarseness, catarrh, etc., in promoting expectoration in disorders of the breast, and as an ingredient in cooling and detergent gargles. Its effect is usually laxative also. It is used to sweeten certain medicines; and is sometimes mixed with vinegar in the proportion of two pounds of clarified honey to one pint of the acetic acid, boiled down to a proper consistence over a slow fire, and thus forms the oxymel simple of the shops. It enters into the composition of various sweetmeats, especially in the East, such as the genuine Oriental nougat. These properties and the flavor and color of honey vary with the qualities of the flowers from which it is made. Thus in Europe the white Narbonne honey of France, is said to owe its peculiar and delicious flavor to the rosemary and other labiate flowers on which the bees feed. The Grecian honey also stands in high estimation. Mt. Hymettus in Attica has been famous since classic times for this product; but that yielded by the bees who range the thyme-covered hills of Corinth is said to excel it. Another famous ancient source of supply was Sicily, especially about Mt. Hybla; and Corsica is yet celebrated for its honey and wax, which in ancient times were the chief exports of that island. In the eastern United States the early light-colored honey obtained from the blossoms of the white clover, is especially esteemed; also that derived from raspberry plantations, bass-wood flowers and the like; while that made later in the summer from buckwheat is in favor among darker varieties. California is an extensive producer of honey from various flowers.

As the aromatic agreeable flavors and healthful qualities of special flowers (fortunately in the majority) are kept and apparent in ordinary good honey, so certain bad qualities are retained and spoil some honey, which thereby becomes deleterious to the human system, acting as a nauseant, a purgative, affecting the nerve-centres or even seriously poisoning those who eat it. This is the case in the United States with honey made from the flowers of the mountain laurel (*Kalmia*) and some other toxic plants. Some persons are unable to eat any kind of honey, without disarrangement of the digestion or nerves, or both; and all should use it in moderation.

The industry of bee-keeping is for the purpose of supplying the market demand for honey. Modern hives are so constructed that the bees build separate combs each filling a box with glass sides, which are taken out and sent to market as the bees finish them. Another method of marketing is in the form of "strained" honey, the liquid pressed from the comb after warming, through sieves of linen cloth, or by other means. There is no reason why this should not be as good as that left in the comb, if properly prepared and preserved, and it permits of saving the material of the combs for wax (q.v.); but it makes possible adulteration, which is freely taken advantage of. The chief adulterant is commercial glucose, which occasionally is substituted to the extent of three fourths of the volume, leaving only enough real honey to flavor the mass. As glucose (grape-sugar) is a large constituent of this substance in nature no great harm results (when the glucose is good), beyond the deception; and wholly artificial honey has been largely sold in the past as the product of bees.

The United States is probably the greatest honey-producing region of the globe, and exports a vast quantity to Europe annually. The census of 1900 reported 4,149,426 swarms of bees, valued at $10,186,513; and the annual production of honey at 61,196,160 pounds, which, together with 1,765,315 pounds of wax was worth $6,664,904.

Honey Ant, a true ant of the family *Formicidæ*, fifth sub-family *Camponotinæ*, and allied to the typical ants (*Formica*). The honey ant (*Myrmecocystus melliger*), is so called from certain of the wingless individuals being so many honey-pots, their abdomens being distended with honey fed to them by the normal workers, including both dwarfs and majors. It occurs from central Colorado (Garden of the Gods) to New Mexico and as far south as the city of Mexico. It erects mounds six or seven inches across and two or three inches in height, of the shape of a truncated cone. In the interior is the "honey chamber" or a rough dome-roofed vault or fissure, the honey-bearers (600 in a large colony) clinging by their feet to the roof. Their yellow bodies are stretched along the ceiling, their swollen, round, amber-colored abdomens of the size of currants hanging down. The "honey" is obtained in the night time by the workers which go in long processions to some distant scrub-oak bearing nectar-producing galls. The workers return with distended abdomens, and feed the honey-bearers with the nectar. C. McCook thinks the honey-bearers are not a distinct caste, but simply workers "with an overgrown abdomen." The honey is thus stored, as bees store their honey, for food in winter or times of famine. Consult McCook, 'The Honey Ants of the Garden of the Gods,' etc. (Philadelphia 1882).

Honey-badger, a small mustiline burrowing animal (*Mellivora indica*) of India, which eats insects, frogs, birds' eggs, and small animals generally, and is fond of honey. The natives believe it robs graves, but destruction of poultry is its worst sin. It is nearly related to the South African ratel.

Honey-ball, or **Globe-flower**, the flower of an American shrub (*Cephalanthus occidentalis*) of the madder family, which grows in wet places, where it is called button or river bush, and bears extremely fragrant flowers whose small florets are folded or packed into balls, while "the long styles and capitate stigmas remind us of pins stuck in a cushion."

Honey Bear, the sun-bear (q.v.).

Honey-bee. Bees in general are *Hymenoptera*, of the family *Apidæ*. Bees are distinguished from wasps and other hymenoptera in the first place by the long, broad, flattened basal joint of the hind tarsus, which is adapted for carrying pollen to the nest. Bees are also more hairy than others of their order, and some of the hairs are plumose or feathery. The mouth-appendages are long and highly specialized, especially the long flexible proboscis or tongue (hypopharynx). There are no wingless adult forms. While the more primitive genera are solitary, in the more specialized or social kinds, besides the males and females, there are workers, which are, as a rule, sterile females in which the ovaries are undeveloped. Of the bee family there are now known to be about 150 genera and 1,500 species.

Original Home of the Honey-bee.— Although the honey-bee (*Apis mellifica*) has followed the white man in his migrations from the Old World to the New, and to Australia, New Zealand, etc., its original birthplace is in southern Asia, probably including the eastern shores of the Mediterranean Sea. Besides *A. mellifica* there are seven or eight other species, all except one southern and eastern Asiatic, including the islands of Timor and Celebes; the exceptional one (*A. adamsoni*) inhabiting tropical Africa and Madagascar. We know little of the honey-bees of China and Japan.

Like other domestic animals (and the honey-bee is the only domestic insect we possess), this bee is divided into races of which the Ligurian bee (variety *ligustica*), originally inhabiting Italy and adjoining regions, is a well-marked one, and another is the Egyptian honey-bee (variety *fasciata*). There are several sub-varieties of the northern form of *A. mellifica* in Germany. The English naturalist Ray, who published before Linné gave the name *A. domestica* to the northern dark form, our common honey-bee. This dark, northern form is the one which has been carried by the European race to various parts of the world, in some of which it is now wild. It occurs in the West Indies, in North America, including Mexico, in central and southern Africa, and in Australia and New Zealand. The variety *ligustica* has also been found at the Cape of Good Hope.

Besides the honey-bee there are other social forms in Central and South America, as well as other tropical countries, including Australia, which store up honey; these are small bees, exceedingly numerous in individuals, which belong to the genera *Melipona* and *Trigona*, and are stingless, though the sting exists in a rudimentary state. *Trigona mosquito* is known to send off swarms and to have but a single queen in a colony. The nests are built in hollow trunks of trees, in banks of clay or earth, and they gather pollen, nectar, and resin. On the whose, the honey-bee stands at the head of the hymenopterous series, and, in fact, at the head of the class of insects, though the house-fly is in some respects more extremely specialized.

Structure of the Honey-bee.— Besides the males or drones, and the female or queen, the colony consists of workers; these carry on the work of the society, gathering nectar, pollen, building the cells and feeding the young. The colony is permanent, differing in this respect from that of bumblebees, which come to an end each autumn. We will first describe the chief points in the external anatomy of the insect. The body is divided into three regions, the head, thorax, and abdomen. The eyes are of two kinds, simple and compound, the male differing from the queen and the workers in the large compound eye meeting in the middle of the top of the head. The mouth-appendages consist of three pairs,— first the jaws or mandibles: these in the queen and drone are notched, but in the worker the edge is entire and serves for biting, and in comb-building for thinning out wax shreds, also for scooping and molding the wax, while the next pair of appendages, or accessory jaws, are called maxillæ, and are used as a trowel. In the bumblebee the maxillæ are also used for piercing the corolla of flowers like the wistaria and honeysuckle, but those of the honey-bee appear to be too weak for this purpose. They also ensheathe the proboscis. The so-called tongue (ligula, lingua or hypopharynx) is the long, slender, hairy appendage adapted for gathering the nectar of flowers. It is an outgrowth of the under lips (labium or fused second maxillæ), is situated in a tube formed by the maxillæ and labial palpi, and can be partially withdrawn into the memtum, or base of the under lip. It can move up and down in the tube thus formed. It is covered by a hairy sheath, and is very elastic, this being due to a rod extending through its centre, enabling it to be used as a lapping tongue. Cheshire states that the rod on the under side has a gutter or trough-like hollow, which forms a false tube by the intercrossing of black hairs. There are also two side-ducts, which extend along to the end of the tongue, where the "spoon" or "bouton" is situated. This is provided with very delicate split hairs, "capable of brushing up the most minute quantity of nectar, which by capillarity is at once transferred by the gathering hairs to two side groove-like furrows at the back of the bouton." The central duct, because of its smaller size and consequent greater capillary attraction, receives the nectar, if it sufficient in quantity to fill the side ducts. "But," says Cheshire, "good honey-yielding plants would bring both centre and side into requisition. The nectar is sucked up until it reaches the paraglossæ, which are plate-like in front, but membranous extensions, like small aprons, behind; and by these the nectar reaches the front of the tongue, to be swallowed as before described. The process of gathering the nectar is not exactly either a sucking or a licking process; but, as Cheshire shows, the action is primarily due to capillary attraction.

Organs of Smell and Taste.— Bees are guided to flowers chiefly by smell, rather than by the color of the flowers they visit. (See FLOWERS AND INSECTS.) The olfactory organs are multitudes of microscopic pits in the antennæ — the organs of smell. The sense of taste is lodged in a minute soft baggy fold on the under side of the upper lip, which is rich in taste-cups; and, besides, there are a few taste-papillæ or cups found by Packard at the base of the paraglossæ and on the base of the labial palpi. These sites of the gustatory organs are situated where the food or nectar will come in contact in passing down the throat into the stomach.

Formation of Honey and the Honey-Stomach.— In insects there is the fore stomach (proventriculus) and the true or chyle-stomach. The former is called by apiarians the "honey-sac" or "honey-stomach." "If," says Cheshire, "it be carefully removed from a freshly killed bee, its calyx-like 'stomach-mouth' may be seen to gape open and shut with a rapid snapping movement." The entrance to the stomach is guarded by four valves, which open to allow the passage of food from the honey-sac to the chyle-stomach. It is closed at will by circular muscles. Thus the bee can carry food for a week's necessities, either using it rapidly in the production of wax, or eking it out if the weather is unfavorable for the gathering of a new store. By means of a complicated mechanism a bee in sucking up from composite and other flowers nectar together with much pollen (1) can either eat or drink from the mixed diet she carries, gulping down the pollen in pellets, or swallowing the nectar as her necessities demand; (2) when the collected pollen is driven into the chyle-stomach, the tube-extension prevents the pellets forming into plug-like masses just below, for by its action these pellets are delivered into the midst of the fluids of the stomach to be at once broken up and digested; (3) "while the little gatherer," says Cheshire, "is flying from flower to flower, her stomach-mouth is busy in separating pollen from nectar, so that the latter may be less liable to fermentation and better suited to winter consumption. She, in fact, carries with her, and at once puts into operation, the most ancient, and yet the most perfect and beautiful, of all honey-strainers.' "

How the Honey is Made.— Honey is made of nectar, and is due to a chemical change in the honey-sac. The bee gathers the nectar with its "tongue," swallows it; it then passes into the honey-sac, and is regurgitated as honey. The nectar when gathered is almost entirely pure saccharose, and, according to Bertrand, when regurgitated it is found to consist of dextrose and levulose; this change appears to be practically the conversion of cane-sugar into grape-sugar. A little salivary fluid is poured out into the mouth as the bee sucks the nectar, and this effects the chemical change. Cheshire thinks that the salivary fluid is added while the nectar is being sucked, and is passing over the middle parts of the under lip, so that the nectar may be honey when swallowed by the bee.

Many and probably all bees eat the pollen while gathering it. The plumose hairs of bees are of use in collecting the pollen grains which adhere to them, but the exact method of accumulation of the pollen and the mechanism of its conveyance from hair to hair till it reaches the part of the body it must attain in order to be removed for packing in the cells, is not fully understood, but the head and front legs scratch up the pollen-grains, and the honey-bee has a pollen-basket on each hind leg, the basal joint of the tarsus being broad and slightly hollow, with nine rows of short hairs to which the pollen-grains adhere.

Life History and Social Life.— In founding a new colony the young swarms consist of a queen-bee and a number of workers, a surplus population of the old colony. The swarming is not a nuptial flight, but an act of emigration. After the new swarm has been housed, the workers begin their labors by secreting wax. This is formed in glands on the inside of the ventral plates of the abdominal segments, appearing outside as thin projecting plates, which are removed by the wax-pincers on the hind legs; after being molded by the jaws they form the hexagonal cells in which the young or larvæ live and the food is stored, and thus the comb is gradually built up. The queen then lays an egg in each cell, and the larvæ (grubs) on hatching are fed by the workers. This they do by eating honey and pollen, which is formed in the digestive organs, into a kind of pap. This pap looks like arrowroot made with water, and the very young grubs partly float in it, besides absorbing it by the mouth. The young grubs, as they increase in size, are weaned from this glandular secretion or pap, pollen, honey and water being added, while the pap or glandular secretion is gradually withdrawn. The queen larvæ, according to Cheshire, is not weaned, but the secretion or pap (the so-called "royal jelly"), which is a rich, highly nitrogenous food, is added unstintingly to the end, and owing to this the queen becomes larger and fertile. When the colony is progressing well and young bees emerge, these act as nurses, the old ones going out of the hive to forage. When the grub is full-sized the worker bees seal up the cell with a cover made of pollen and wax, but pervious to the air. In this cell the grub spins a cocoon in which it pupates, finally biting its way out; the bee developing in three weeks from the time the egg is laid.

The new queen arises from an egg laid in the royal cell, which is large and slipper-shaped. She develops in 16 days. Only one queen is allowed in the hive at one time. The males (drones) arise from unfertilized eggs. The drone cells are a little larger than the ordinary worker cells. A drone is developed in about 24 days. When a swarm leaves the hive the old queen quits with it, but when a second swarm goes off from a hive it is accompanied by a young queen, who is frequently and perhaps usually, unfertilized.

The young queens will usually mate when five to seven days old, flying from the hive for this purpose. In a day or two after mating the queen generally begins to deposit eggs, and is then ready for use in the hive or to be sent away as an "untested queen."

Bee-Culture.— Spring is the best season to start a hive or apiary. In April a good colony situated in the Central States ought to have brood in five or six combs. The Langstroth hive with its modern improvements is the best, and the novice should select those holding 10 to 12 frames in each story.

Swarming is the result of an abundant secretion of honey, and combs crowded with bees and brood, that is, overpopulation. Just before swarming there is a partial cessation of field-work, the workers clustering or loitering about the entrance to the hives. Suddenly those which happen to be in the hive at this time rush forth, accompanied by the old queen, and cluster on some tree or shrub near by. Hiving the new swarm can be done after a little experience and the use of smoke. Swarming may be prevented by giving abundant room for the storage of honey early in the season, before, as Benton says, the bees get fairly into the swarming notion. The honey also should be frequently removed. Also the hives should be well ventilated and shaded in hot weather. To successfully winter bees the colony must have a good queen, and young workers, also good and abundant food. Those colonies having the most honey compactly stored in the brood department and close about the very centre when the last brood of young bees should emerge, are the ones which will winter best. A good substitute for honey is a syrup made of granulated sugar, to be fed early in autumn. The bees should be kept dry and warm, and there should be no manipulation out of season. (Benton.)

Diseases and Enemies.— Diarrhœa is due to sour or fermented honey, dampness, and chilling of the bees. Foul-brood is a germ-disease, occasioned by *Bacillus alvei;* it affects both the brood and the adult bees. Of insect enemies the caterpillar of the wax or bee-moth is the most destructive, but with care it can be kept out of well-regulated hives.

Agency of Bees in Cross-Fertilization of Plants.— A hive is an essential thing in an orchard, and were it not for the visits of bees the fruit in many cases would not set. Also in hothouses where cucumbers are raised, a small hive of bees is indispensable for fertilizing the flowers. See BEE-KEEPING; FLOWERS AND INSECTS.

Consult: Cheshire, 'Bees and Bee-Keeping' (2 vols., London 1886); Benton, 'The Honey Bee'; Bulletin No. 1, new series, U. S. Department of Agriculture, Division of Entomology, Washington, 1896, contains a list of the best books on bee-keeping.

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Honey-bird, or Honey-guide. See GUIDE-BIRDS.

Honey Bloom, one of the American species (*Apocynum androsæmifolium*), the "spreading dogbane" of the family *Apocyanaceæ* (q.v.). It grows in fields and thickets all over temperate North America, and has the medicinal qualities characteristic of the family.

Honey-buzzards, a genus (*Pernis*) of Old World hawks, formerly called "perns," which subsist mainly on insects, especially burrowing wasps, and bees, with their young and food-stores, which they dig out of the ground.

Honey-creepers, a group of small warbler-like birds (the family *Cœrebidæ*) of gay plumage, numerous in the West Indies and neighboring lands, where they are known about gardens and plantations and admired for their agility in searching flowers for small insects, and their cheery notes. Among them are the "banana-birds" (q.v.).

Honey-dew, the sweet secretion of certain plants and insects. (1) Some trees in warm climates yield from their leaves in very warm moist weather a saccharine liquid which may fall in drops, or may form a sticky film over each leaf. This exudation, dried, is one form of manna. (2) Certain minute insects, chiefly plant-lice, leaf-hoppers, and related bugs, yield a sweetish secretion, sometimes so copiously as to bedew a whole tree, and even fall in drops, giving the phenomena called weeping trees. The usual cause in this case is the presence of a tree-hopper (*Proconia undata*). Honey-dew in both cases attracts insects in large numbers, who feed upon it or upon the lesser insects gathered to the feast: and these, in turn, attract larger predatory animals, as birds, lizards, etc. Moreover dust sticks to it, closing the pores of the leaves to the injury of the tree; and, still worse, the honey-dew forms a highly favorable culture-ground for the spores of smuts and other pernicious fungi.

Honey-eater, or **Honey-sucker,** any of various small and somewhat thrush-like long-billed birds of the family *Meliphagidæ,* which inhabit the Australian regions, and seem to feed upon the nectar of flowers. They do so to some extent, but mainly are in search of insects within the corolla, collecting them easily by means of a peculiar tongue, which is divided near the end into a sort of fringe. They also eat soft fruit, and spend much of their time hunting insects on the ground. Well-known examples are the soldier-bird, parson-bird, pimlico, friar-bird (qq.v.) and others familiar in Australia and New Zealand.

Honey-guides. See GUIDE-BIRDS.

Honey Hill, Battle of. On the night of 28 Nov. 1864 Gen. Foster, commanding the Federal troops in the Department of the South, left Hilton Head, S. C., with 5,000 infantry, cavalry, and artillery, and about 500 sailors and marines, for Boyd's Neck on the south side of Broad River, the object of the movement being to cut the railroad connecting Savannah and Charleston, and otherwise co-operate with Sherman, who was marching to the coast. Owing to a thick fog many of the boats lost their way, and it was late in the afternoon of the 29th before the troops got ashore. Gen. Hatch was put in command, with orders to push forward and cut the railroad. Hatch marched immediately; the guides and maps proved worthless, and, after marching and countermarching the greater part of the night, he went into bivouac about 2 o'clock on the morning of the 30th. Information of Foster's appearance at Boyd's Neck was carried to Gen. Hardee at Savannah on the evening of the 29th, and next morning at 2 o'clock, the advance of G. W. Smith's Georgia militia arriving at Savannah, Hardee directed Smith to hasten it to Grahamsville Station on the Charleston & S. railroad. The station was reached at 8 A.M., and the men marched out on the road leading to Broad River landing, about three miles where, on the crest of the north bank of a small stream, a work for light guns had been thrown up and trenches for infantry prepared. These works were about 100 yards from the little stream, and upon Honey Hill, 10 or 12 feet above the water level. On the right of the battery of five guns was a dense forest, on the left an open pine wood. The ground in front was open. Preparations were completed by 10 o'clock, at which hour about 1,000 militia filled the trenches on the right and left of the battery. Early in his march Hatch encountered the Confederate outposts, drove them in, and, soon after 10 o'clock, came under fire of the guns. Hatch attempted a flanking movement, but failed, and made several direct assaults during the day, all of which were repulsed, and at dusk he began his retreat to Boyd's Neck. His loss was 711 killed and wounded, and 43 missing. During the action Smith was reinforced by the 47th Georgia, but at no time did he have more than 1,400 men. He lost 8 killed and 42 wounded. Consult 'Official Records,' Vol. XLIV.

E. A. CARMAN.

Honey-locust, or **Honey-shucks.** See LOCUST TREE.

Honeysuckle, a genus of plants, *Lonicera,* belonging to the natural order *Caprifoliaceæ.* Upward of 100 species are native to the northern hemisphere. The honeysuckle family is represented in the North American flora by different species, among which are *L. sempervirens,* the trumpet honeysuckle; *L. grata,* American woodbine; *L. flava,* yellow honeysuckle, etc. "Coral honeysuckle" is another name in the United States for *L. sempervirens.* It is much valued in the South, where it is native, for its flowers of beautiful color and grateful perfume. In the eastern United States the Japanese honeysuckle has escaped from cultivation. The common honeysuckle, *L. periclymenum,* with distinct leaves and red berries, is indigenous in Great Britain: but two others have been naturalized, *L. caprifolium,* distinguished by its upper leaves being united (connate) and perfoliate, and by its smooth orange-colored berries: and *L. xylosteum,* an erect shrub, with small, yellowish, scentless flowers and scarlet berries. There are many other species in America, Europe, and Asia, and the name honeysuckle is often given to shrubs with sweet flowers of quite different genera.

Honey-sweet. See MEADOW-SWEET.

Hongkong, hŏng'-kŏng', or **Hian-Kiang,** hē'än-kē'äng (signifying "the place of sweet streams"), an island off the southeast coast of China, forming with Kau-lung on the mainland, a British crown colony and naval station. The island is on the east side of the estuary of the Chu-Kiang or Canton River, 90 miles south of Canton, and is separated from the mainland by the narrow Lyemun strait. About 10 miles long and about 7½ miles broad, the island is of rocky formation, attaining in Victoria Peak a maximum altitude of 1,809 feet. While almost treeless it is noted for its profuse flora. Good water is abundant. Hongkong is a great entrepôt for the foreign commerce of China, and Victoria (q.v.) the chief town and centre of its commerce is a free port. The foreign commerce is carried on mainly with Great Britain and Germany, whence considerable quantities of goods are imported, cottons being the principal item,— and to which tea, silks, hemp, etc., are exported.

In 1902 Hongkong exported, in vessels of European construction, goods to the value of $3,963,463, besides $2,372,397 worth of goods in transit, making a total of $6,335,860, and showing an increase of $720,288 over the previous year.

Comparing 1902 with 1901 the number of steamships which entered the port of Hongkong and their classification by the flags they carried, is as follows:

Courtesy of the Philadelphia Commercial Museums.

QUEEN STREET, HONGKONG.

Flag	Ships 1901	Ships 1902	Total Tonnage 1901	Total Tonnage 1902
British	321	324	2,894,519	2,965,030
German	122	123	1,242,499	1,360,524
Japanese	65	56	692,981	865,400
Norwegian	3	3	78,004	263,379
French	22	27	209,094	219,111
Chinese	4	17	3,349	163,396
Austrian	20	20	128,483	125,929
American	19	23	130,476	121,939
Others	33	37	119,498	131,518
Totals.........	609	630	5,498,903	6,216,226

In 1901 the vessels entered the port 3,510 times, and in 1902 4,000 times.

The currency is chiefly in silver dollars. The revenue of the government is derived from land rents, licenses to sell opium, spirits, etc., taxes, postage, office fees, fines, etc. The colony's prosperity is due chiefly to the presence of large numbers of Chinese engaged in trade or in working building stone, one of the island's principal products. Exclusive of the naval and military establishments which numbered 5,597 and 7,640 respectively, the population in 1901 was 283,905 of which 274,543 were Chinese and one third of these by birth, British subjects. Hongkong was ceded to Great Britain in 1842; some 376 square miles on the mainland, with 100,000 Chinese inhabitants, were leased in 1898.

Honolulu, Hawaii, capital and principal city of the Hawaiian Islands (now a United States Territory), and commercial metropolis of Polynesia; the business heart of the central Pacific. It is 2,089 miles southwest of San Francisco, in lat. 21° 17′ 56″ N., lon. 157° 51′ 48″ W. It lies on the southwest side of Oahu (the third island of the group in size, and northwest of Hawaii, with a safe harbor formed by a natural breakwater of coral reef, pierced by a broad opening. A fine lighthouse here throws a light visible for 25 miles. With its natural advantages, and the absence of rivals, the city occupies a unique position. From its central location it is a common point of touch for the three great trans-Pacific steamship routes — from the United States and British Columbia to New Zealand and Australia, from the same to Japan, China, and the Philippines, and from South America to Japan and China. Several independent steamship routes also run from it. It has regular communication with San Francisco, Vancouver, and Seattle, Peru, Auckland, and Sydney, New York and Boston, Yokohama and Hongkong, Liverpool, Glasgow, and Bremen, besides other places. The steamship line to Sydney touches at the Fijis; the line to Auckland, at Apia, Samoa. From Honolulu it is 3,850 miles to Auckland, about 4,000 to Sydney, and 3,445 to Yokohama. It is the port of foreign trade for the archipelago; hundreds of vessels and some $20,000,000 worth of products pass in and out of it annually. There are numerous wharves and warehouses here and a government custom-house. (For the items of the trade, see Hawaii: the great items are sugar and molasses, rice, coffee, hides, and wool.)

Honolulu lies at the mouth of the valley of Nuuanu, which runs back between two high ridges to a pass between two peaks about 3,000 feet high in the great eastern range of mountains; the view from the brink of the *pali* or precipice at this pass, is one of the notable sights of the neighborhood. The climate is mild and equable, and many sufferers from lung troubles in the United States seek it for a sanatorium. The extreme range of temperatures is 52° to 88°, average 70°. The rainfall is very irregular, but never slight; from 40 to 60 inches annually. The island is volcanic, the bordering reefs coral; hence the city streets are macadamized with coral and lava, porous rock making good surface drainage. The city is well laid out in American fashion, being indeed a modern American place; the old one-story wooden huts, mingled with grass huts among the trees, have mostly given place to cottages, unpretentious indeed, but neat and comfortable, and making parts of a beautiful and picturesque whole of luxuriant gardens and surroundings of tropical trees, with which also some of the streets are abundantly shaded — the great Norfolk pine, papaya, bread-fruit, mango, and monkey-pod, umbrella-tree, tamarind tree, algaroba, bamboo and koa, date and cocoa palms, candle-nut, royal-palm and poinciana regia, alligator-pear, china-rose bush, blooming all the year round, etc., many with rich and fantastic blossoms, others with great parasitic ferns, besides peach, oleander, banana, guava, orange, citron, and others. The flowers are also of great beauty and luxuriance.

The city has nearly 200 acres of public parks. There are all modern appliances and services for civilized work and comfort; several first-class hotels, physicians, lawyers, daily and weekly newspapers, four banks and two theatres, insurance offices, several hospitals, a public library, etc. There are 22 public schools, including a high school and normal school, with a total attendance of over 4,000 pupils, besides 37 private schools, with an attendance of 2,700 pupils. There are a number of churches, Protestant and Catholic; the city is the seat of a Roman Catholic and an Anglican bishop. It is also the residence of the government officials, and the consular agents of many European powers. It has waterworks owned and operated by the Territorial government, and furnishing excellent water, pumped from artesian wells, supplemented by water from the adjoining valleys. Ice is made by machinery. There is an electric street lighting system operated by the government, and an electric street railway system, built and conducted by a chartered company; a telephone system; and there is a submarine cable to San Francisco and wireless telegraph to the neighboring islands. Of manufactures the number of different lines is upward of 30, of course chiefly for local needs; the largest branch is foundry and machine-shop manufacture, which is carried on in large works, and turns out some $650,000 a year of product. Next to this is rice-milling, with some $150,000 a year. Minor industries are ice, harness, leather, jewelry, soap, and shipbuilding. The total number of all employees in 1900 was 1,854, and the total annual wages paid $1,201,648.

The chief building is the former royal palace, now the executive building, in the Italian style, finished in 1882. The judiciary and other government buildings are near it. The most interesting place is the museum, with many curious relics of early Hawaiian history, corals, and shells and other native curiosities, land and marine. The chief in interest and value is the great feather war-cloak of Kamehameha I., the founder of the monarchy, valued at $150.000. This was the chief treasure of the former sovereignty, and was used as a mantle of state by the sovereigns. It was made of yellow feathers from the *mamo* bird, found only in the mountains, each bird furnishing only two small tufts of feathers for it, one from under each wing. It is four feet long, and has a spread at the bottom of 11½ feet. Nine generations were employed in making it.

Honolulu harbor was discovered by Capt. Brown in November 1794. The city as a modern foundation dates only from 1816, when John Young, an Englishman, and a faithful counsellor of the king, Kamehameha, advised its fortification. Previously it had been only a native village of huts, of little commercial importance. In 1820 it was made the capital of the archipelago, and afterward became the seat of government. Population (1870) 14.852; (1890) 22.907; (1900) 39.306. Since the annexation of Hawaii to the United States, it is rapidly increasing. Of the population in 1900, 24.746 were males and 14.560 females: the total being divided as follows: 11.090 Hawaiians, 9.061 Chinese, 7.229 whites, 6.179 Japanese, 5.000 Portuguese, and 147 negro. Of these, 21.871 were born in Hawaii and 17.435 born in foreign countries. (This classification is based upon a census taken by the plague inspectors during the spring of 1900, and is believed to be approximately correct. Of the 7.229 whites about 2.000 are classed as foreigners.)

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Honor, Knights of, a secret, beneficiary order founded in 1873. In 1902, there were in the United States 36 grand lodges, 1.960 sub-lodges and 54.029 members. Since its organization the order has disbursed over $79.000.000 in benefits, and in 1902 the amount was $3.074.649. The order is incorporated under the laws of Missouri, with headquarters in St. Louis.

Honor, Knights and Ladies of, a fraternal, benevolent society founded in 1877 at Louisville, Ky. In 1902 there were 16 grand lodges, 1.100 sub-lodges, and 63.000 members. Since its organization over $10.000.000 has been disbursed in benefits, and during 1902, the amount was $1.173.000.

Honorius I., hō-nō'rĭ-ŭs, Pope: d. 12 Oct. 638. He was elected pope in 625. In the hope of allaying a controversy he temporized with the leaders of the Monothelite heresy, which, while recognizing the twofold nature of Christ, declared he had but one will, a doctrine condemned by the sixth council of Constantinople. He was anathematized by the council that condemned the heresy. Pope Leo II., in confirming the acts of this council, says that Honorius was condemned for "not extinguishing the flames of incipient heresy." For a full account of the case of Honorius, consult Parson, 'Studies in Church History,' Vol I.

Honorius II., Pope: d. 14 Feb. 1130. He was elected pope in 1124, and was at the time of his election bishop of Velletri. A part of the bishops and cardinals had previously invested Cardinal Thibaut with the papal dignity; but both candidates having resigned Honorius was re-elected.

Honorius III., Pope: d. 18 March 1227. He became pope in 1216, on the death of Innocent III. He at once wrote to the King of Jerusalem to assure him of his support; to the bishops of France, to encourage pilgrims, and to the Emperor of Constantinople to promise him assistance. John, king of England, had left to his successor, Henry III., the burden of a war with the French Prince Louis, who laid claim to the English throne, and had been encouraged in his pretensions by Innocent. Honorius reconciled the barons with Henry, and obliged Louis to renounce his pretensions. He then turned his attention to the crusades, and crowned Frederick II. emperor of Germany, on condition that he would go to Palestine within two years. In France he instigated Philip Augustus and Louis VIII. to support the war against the Albigenses. He was succeeded by Gregory IX.

Honorius IV., Pope: d. 3 April 1287. He was elected pope in 1285, and supported the French king, Philip the Bold, in the war against Peter of Aragon.

Honorius, Flavius, Roman emperor, son of Theodosius the Great, b. Constantinople 9 Sept. 384 A.D.: d. Ravenna, Italy, 26 Aug. 423 A.D. On the death of his father in 395 the empire was divided into two parts, Honorius receiving the western half, with Rome as his capital. The principal events of his reign are the adoption of rigorous measures against paganism in 399; the devastation of Northern Italy by Alaric in 400–403; another irruption of barbarians under Rhadagasius 405–6. Both invasions were repelled by his able minister Stilicho, who, however fell under the displeasure of his weak and indolent master, and was assassinated at Ravenna in 408. Taking advantage of the death of the defender of Rome, Alaric marched upon the city and plundered it in 410.

Hooch, or Hoogh, Pieter de, pē'tėr dė hooн, or hōg, Dutch painter: b. Utrecht 1630; d. Amsterdam soon after 1677. His early art training was much influenced by Rembrandt. In 1655, he was enrolled in the Painters' Guild of Delft, where he resided, but later removed to Amsterdam. He was the chief representative of Dutch genre painting, and his specialty was the delineation of Dutch interiors, with their semi-darkness, suffused by the witchery of sunlight. Sometimes he set out two or more rooms in perspective, the vista of which was drawn and lit up with extraordinary skill.

Hood, John Bell, American soldier: b Owingsville, Ky., 29 June 1831; d. New Orleans, La., 30 Aug. 1879. He was graduated at West Point in 1853, and bore a commission in the United States Army till 1861 when he joined the army of secession. The part he took in the Virginia campaign gained for him the rank of major-general, and at Gettysburg his division made a gallant record in its position at the extreme right of the Confederate line. He took part in the battle of Chickamauga on 19–20 Sept. 1863, having come to Tennessee to the support of General Bragg. When General Johnston was endeavoring in the spring of 1864 to impede Sherman's advance on Atlanta, Hood was a lieutenant-general in his army and his corps on

Courtesy of the Philadelphia Commercial Museums.

THE HARBOR OF HONOLULU.

25 May 1864, was attacked by Hooker at New Hope Church. He succeeded Johnston the following July in the command of the Army of Tennessee, fought the battle of Peach Creek with Sherman 20 July 1864, but was compelled to retire behind the fortifications of Atlanta. After the battle of Jonesboro he retired from Atlanta, which was entered by Sherman. His attack on the forces under Schofield at Franklin being repulsed, he proceeded to Nashville, where he met General Thomas. Thomas advanced from his entrenchments on 15 December, and a two-days' battle ensued. Federal preparation had been carefully and deliberately made. A general attack on the afternoon of 16 December caused the entire Confederate line to give way. Soon Hood's army was in full retreat toward Franklin, the larger part of it "in great confusion," according to Hood's official report. After a nine-days' pursuit by the Federals, the remnant of the Confederates, now largely disintegrated, crossed the Tennessee. Hood, at his request, was relieved of his command. Subsequent to the war he was a commission merchant at New Orleans. He wrote 'Advance and Retreat: Personal Experiences in the United States and Confederate States Armies' (1880), and articles for 'Battles and Leaders of the Civil War' (1887). Consult these works; see also NASHVILLE, CAMPAIGN AND BATTLE OF.

Hood, Robin, English outlaw: said to have been b. 1160 and d. 1247. According to the popular account, with his followers, he inhabited Sherwood Forest, in Nottinghamshire, and also the woodlands of Barnsdale in the adjoining West Riding. They supported themselves by levying toll on the wealthy, and more especially on ecclesiastics, and by hunting the deer. The principal members of his band were his lieutenant Little John, his chaplain Friar Tuck, William Scadlock, George-a-Greene, Much the miller's son, and Maid Marian. His skill with the long-bow and quarter-staff was celebrated in tradition. What basis of fact there is for the story of Robin Hood is doubtful. Grimm maintained that he was one with the Teutonic god Woden. Other theories suppose him to have been a rebel yeoman in Lancaster's rebellion under Edward II.: a Saxon chief who defied the Normans; and a fugitive follower of Sir Simon de Montfort after the battle of Evesham. He figures prominently in Scott's novel 'Ivanhoe,' and in 'The Foresters,' a drama by Tennyson. The earliest known mention of him is in 'The Vision of Piers Plowman,' version B. (about 1377), in which Sloth says he knows "rymes of Robin Hood." 'The Gest of Robin Hood' (assigned to 1400), almost epic in length, consisting of 456 four-line stanzas, is the oldest extant ballad on this theme. Others of the more important ballads are 'Robin Hood and the Monk,' 'Robin Hood and Guy of Gisborne,' and 'Robin Hood's Death.' The remaining ballads are, in general, of inferior merit. It seems probable that there were what may be called a Sherwood cycle and a Barnsdale cycle, respectively. Many proverbs and sayings exist in connection with Robin Hood. Consult: Child, 'English and Scottish Ballads' (1883); Fricke, 'Die Robin Hood Balladen' (1883); and Ritson, 'Robin Hood' (new ed. 1885).

Hood, Samuel, VISCOUNT, British naval officer: b. Thorncombe, Devonshire, 12 Dec. 1724; d. Bath, Somersetshire, 27 Jan. 1816. He entered the navy in 1740, was promoted lieutenant in 1746, commander in 1754, and post-captain in 1756. While commanding the Vestal in 1759 he took the French Bellona after a three-hours' fight. From 1767 to 1771 he was commander-in-chief in North America. Having served as commissioner of the Portsmouth dockyard in 1778–80, he was made admiral of the blue in 1780, and almost immediately was sent in command of a squadron to reinforce Rodney on the North American and West Indian stations. He remained on that duty until the signing of the peace, and distinguished himself in several battles. Despatched in 1781 to blockade Martinique, he was intercepted by De Grasse and the French fleet, against which he fought in April and in July (under Admiral Graves). Again in the West Indies in 1782, after an absence along the North American coast, he outmaneuvered De Grasse in several minor contests, and later, on 12 April, took an important part in the victory of Dominica, when he led the rear of the British line. In 1784 he was elected to Parliament for Westminster, and in 1788 made a lord of the admiralty. He took command of the British fleet in the Mediterranean in 1793, and occupied Toulon. Hood had a great reputation as a tactician, and a high tribute was paid him by Nelson, who had been one of his subordinate officers. Consult James, 'The Naval History of Great Britain' (1822–4; new ed. 1837).

Hood, Thomas, English poet and humorist: b. London 23 May 1799; d. there 3 May 1845. In 1821 he became sub-editor of the 'London Magazine,' and from that time appears to have resolved on devoting himself entirely to a literary life. In 1826 he published 'Whims and Oddities.' This was followed by 'National Tales' in prose, and a volume of serious poetry, which, though favorably received, did not obtain much popularity. In 1830 he started the 'Comic Annual,' which, during the eight years of its existence, was made the vehicle of many of his most remarkable productions. At the same time his pen was diligently employed on other subjects, and he published the powerful poem called 'Eugene Aram's Dream,' 'Tylney Hall,' a novel, which, though defective in its plan and structure, abounds in fine strokes of wit and humor. His health had begun to fail, and in consequence he lived on the Continent 1835–40. He continued his 'Comic Annual' during his residence at Coblentz and Ostend, and in 1838 published 'Hood's Own.' His continental experiences also furnished materials for his 'Up the Rhine' (1839), a series of imaginary letters after the manner of Smollett's 'Humphrey Clinker.' The whimsical cuts inserted in the work, as well as its combination of good sense and humor, made it very popular. Shortly after his return, he undertook the editorship of the 'New Monthly Magazine,' and continued it until 1843. His principal contribution to it was the famous tragi-comic story in verse of 'Miss Kilmansegg.' His last periodical, entitled 'Hood's Magazine,' was commenced in 1844. It contains some of his best productions, though several of them were written after his health had completely given way, and while he was propped up by pillows in bed. Hood is unrivaled as a punster, and seems to have been almost equal master of the comic and the pathetic. In the latter style his 'Song of the Shirt' is universally known, and as a burst of poetry and indignation is not surpassed by anything in the English language.

Hood, Thomas, generally known as TOM HOOD, English miscellaneous writer: son of the preceding: b. at Wanstead, Essex, 19 Jan. 1835; d. Peckham Rye, Surrey, 20 Nov. 1874. He was educated at Oxford in 1853, with a view to a clerical career, but edited the 'Liskeard Gazette' in 1858–9, and from 1860 till 1865 was a clerk in the accountant-general's department at the War Office. In 1865 he became editor of the comic paper called 'Fun.' His first separate publication was 'Pen and Pencil Pictures' (1857), and among his subsequent works are: 'The Daughters of King Daher, and other Poems' (1861); 'Jingles and Jokes for the Little Folks' (1865); 'Captain Masters's Children' (1865), his best novel; 'A Golden Heart' (1867); 'The Rules of Rhyme: A Practical Guide to English Versification (1869), a work which has gone through two later editions; 'From Nowhere to the North Pole' (1874). From 1867 he produced 'Tom Hood's Comic Annual.' A volume of his 'Favourite Poems,' with a memoir by his sister, Mrs. Broderip, was published in the United States in 1877.

Hood of Avalon, Arthur William Acland Hood, BARON, English naval officer: b. Somersetshire 14 July 1824; d. Glastonbury 15 Nov. 1901. After service on the coasts of Spain and of Syria, he was made lieutenant in 1846, and in 1854 commander in recognition of his services with the naval brigade before Sebastopol. Assigned to the China station, he participated in the capture of Canton (December 1857), and in 1858 received the commission of post-captain. In 1862–6 he was in command of the Pylades of the North American station, in 1866–9 of the Excellent and the Royal Naval College at Portsmouth, and in 1869–74 director of naval ordnance. He was promoted rear-admiral in 1876, was first sea lord of the admiralty in 1885–9, and became admiral in 1886. His attitude in connection with the development of the British navy was strongly conservative.

Hood, Mount, a peak of the Cascade Range, in the northern part of Wasco County, in Oregon. The height is usually given as over 11,225 feet, but the latest explorers claim it is nearly 12,000 feet. Mount Hood was at one time an active volcano; the lava is found on the slopes and some distance from its base.

Hood River, a name applied to a valley, town, and river in Wasco County, Oregon. The town is situated on the Columbia River and on the line of the Oregon Railway & Navigation Company, 66 miles east of Portland and 22 miles below The Dalles, the county-seat. The Hood River strawberry has acquired a reputation almost phenomenal, and is distributed over an immense area of country extending from Denver and Omaha on the south to Winnipeg in the province of Manitoba to the north and east. The output in 1903 was 150 carloads. The apple industry is also rapidly assuming large proportions, grades of superior excellence are produced, and the highest priced Spitzenburgs and Yellow Newtown Pippins found in the markets of New York and London were grown in Hood River. The valley proper extends south from the Columbia River to Mount Hood, some 20 miles, and is protected and cradled by the Cascade range of mountains on the west and a high divide putting out from Mount Hood on the east. The amount of land adapted for fruit culture in this unique valley exceeds 50,000 acres. The river itself drains all of the north side of Mount Hood, has a large and constant flow of water, and for the last 10 miles of its course before entering the Columbia has an average fall of over 60 feet per mile, affording 10,000 measured horse-power per mile. There are immense forests of fir and cedar about the head-waters of this stream, and one of the largest saw-mills in the State is conveniently situated near its confluence with the Columbia. The climate is a happy mean between the moist section of western Oregon and the semi-arid plains of the Columbia. The scenery is grand in the extreme and yearly attracts the attention of many visitors. The town is pleasantly situated, overlooking the Columbia River, is supplied with electric lights, while the telephone is universally present in both town and country. It is, however, the superlative excellence of its fruits that has given Hood River a reputation almost world-wide. The population of town and valley (1904) is about 6,000.

E. L. SMITH.

Hooded Crow, a crow native in northern Europe (*Corvus cornix*), so termed in allusion to markings on the head. Head, wings, and fore parts are jet black, the rest of the bird ash-gray; bill and feet are black. It retires to the southward from its more northerly haunts at the time of the crow migration. In England it is known as the gray, dun, or Royston crow. The hooded crow found in India is similar in general appearance, but is a smaller species.

Hooded Seal, a large dark-gray spotted seal of the North Atlantic, closely related to the common harbor seal, and named *Cystophora cristata*. It reaches a length of about 10 feet, and is especially distinguished by a large inflatable sac upon the face, the expansion of which is thought to be a defensive device, calculated to terrify enemies. It is occasionally seen on ice-floes along the Labrador coast.

Hooded Warbler, a fly-catching warbler (*Sylvania mitrata*), common in the southern United States in summer and making its nest in low bushes. It is bright yellow except a solidly black crown, neck and breast, comparable to a hood, leaving the face golden yellow.

Hoodoo. See MASCOT.

Hoof, a toe-nail which is large, envelops the terminal phalange, and is of material assistance in walking, as in the case of horses, cattle and other ruminants, and in the elephant, rhinoceros, etc. It is most highly developed in the horse, where the whole terminal part of the foot is reduced to a single, well-booted toe. In split-hoofed or cloven-hoofed animals there are two toes approximately equal, and booted with hoofs flat on their inner sides and closely appressed. The small non-functional toes hanging behind the hock-joint in most split-hoofed animals are often called "false hoofs." Accidents and diseases affect the hoofs of domestic animals (see FOOT-ROT, etc.), and require careful attention, especially in the case of horses. The soundness of a horse's foot is mainly preserved by permitting it to grow uninjured by the rasp and knife, and kept clean by being washed with cold water; all other aplications are injurious and destroy the toughness of the "horn surface." Softness and brittleness of the hoof, which are fruitful sources of cracks and corns, may be remedied by placing the feet for several hours daily in thick woolen swabs, kept cool and moist by frequent applications of cold water, and by encouraging a more healthy growth of horn by occasional mild blisters round the coronary band. Cracks (or sand-cracks) mostly occur among horses much upon the road, cause lameness, and constitute unsoundness. When serious and recent, poulticing, thinning away of the crust about the crack, and perfect rest are essential. After the earlier heat and tenderness are removed a hot iron should be drawn at right angles to the crack, both above and below, so as to separate the diseased from the sound horn. Waxed thread or fine wire should be wound round the hoof, and a sound growth of horn stimulated by a blister round the coronet.

Hooft, Pieter Corneliszoon, pē-tĕr kor-nā'-lēs-zōn hōft, Dutch poet and historian: b. Amsterdam 26 March 1581; d. The Hague 21 May 1647. He was son of that Cornelius Hooft who did much to procure Elizabeth's recall of the incompetent and tyrannical Leicester in 1587. He traveled through France, Italy, and Germany in 1601, and on his return began with patriotic ardor to improve and purge the speech of his mother country. With this aim in view he translated Tacitus into Dutch, and made that Latin writer the model of his style, as a historian. His historical writings are vivid and comprehensive. His poems are chiefly in the erotic vein. He also produced dramas in the form of pastoral, tragedy, and comedy. In his comedies the domestic life of the Netherlands is admirably portrayed. In the castle of Moritz, Prince of Orange, at Muiden, where he lived as high bailiff, he used to gather round him a coterie of brilliant men and women, and this intellectual circle famous as the "Muiderkring" included the poets Huygens, Vondel, and Baerle. His principal works are 'Hendrik (IV.) de Grote zijn leven en bedrijf' (1671); 'Nederlandsche Historien' (1656); the poems 'Minneliederen'; 'Afbeeldinglien van Minne'; the pastoral drama 'Granida' (1605); the tragedies 'Geraerdt van Velzen' (1813); and 'Baeto' (1616); and the comedy 'Warenar.'

Hook, Theodore Edward, English novelist and journalist: b. London 22 Sept. 1788; d. 24 Aug. 1841. For some years Hook led a life of gaiety in London, and became notorious for practical jokes and similar escapades. In 1812 he was appointed accountant-general and treasurer of the island of Mauritius; but, owing to his gross carelessness, a large deficiency in the military chest was discovered, and in 1818 he was sent home under arrest, but no proceedings were taken against him. From 1820 to 1841 he was editor of the 'John Bull,' and at intervals from 1824 to 1828 published his 'Sayings and Doings,' while in 1836 he became editor of the 'New Monthly Magazine.' His other principal works are a series of novels, among which may be mentioned 'Love and Pride'; 'Jack Brag'; 'Gilbert Gurney'; 'Gurney Married.'

Hooker, hŭk'ĕr, **Edward**, American sailor: b. Farmington, Conn., 1822; d. Brooklyn, N. Y., 1 May 1903. He followed the sea in the merchant service until the outbreak of the Civil War when he joined the United States navy as acting master, and served with distinguished bravery. He was commissioned as lieutenant-commander in the regular naval service in 1884 and full commander two years later, when he retired.

Hooker, Isabella Beecher, American philanthropist: b. Litchfield, Conn., 22 Feb. 1822; d. 25 Jan. 1907. She was a daughter of Dr. Lyman Beecher (q.v.) and in 1841 married Joseph Hooker, a lawyer. She made a special study of the right of women of the United States to vote; was active in various reform movements, and is known as a public speaker. She wrote 'Womanhood, Its Sanctities and Fidelities.'

Hooker, Joseph, American soldier: b. Hadley, Mass., 13 Nov. 1814; d. Garden City, N. Y., 31 Oct. 1879. He was graduated at West Point in 1837 and received a commission in the 1st artillery. He served in Florida and on the northeast frontier 1837–40 and during the Mexican War was aide to Generals Smith, Harmer, Butler and Pillow. He saw much service in both the northern and southern campaigns, and resigned from the army in 1853. From that date to the breaking out of the Civil War he was successively farmer, engineer and militia colonel. In 1861 he went to the front as a brigadier-general of volunteers. In 1862 he was commissioned major-general of volunteers and was present at the battle of Williamsburg, Va., and was subsequently conspicuous in the Peninsular campaign and in the battles of Bristoe Station and Chantilly. He also took part in the Maryland campaign, and in September of 1862 was appointed brigadier-general in the regular army. Two months later he was placed in command of the Fifth corps, and at the battle of Fredericksburg commanded the Third and Fifth corps. In 1863 he was put in command of the Army of the Potomac, but although very successful in refitting and reorganizing his troops, failed to show, as head of an army, those qualities which had characterized him in the field as corps and division commander. At Chancellorsville the defeat of the Federal troops by General Jackson was largely due to Hooker's vacillation and his want of power to cope with the sudden surprise of his right flank by the Confederate general.

In 1863 he was despatched in command of the Army of the Cumberland to reinforce Rosecrans at Chattanooga and distinguished himself on 24 November in the so-called "Battle among the Clouds" on Lookout Mountain. He was brevetted major-general in the regular army in 1865, and a paralytic stroke forced him to retire from active service with that rank in 1868.

An equestrian statue of General Joseph Hooker by the sculptor French, was unveiled on Beacon Hill, Boston, 25 June 1903, with imposing ceremonies. The day was made a State holiday.

Hooker, Sir Joseph Dalton, English botanist; son of Sir William Jackson Hooker (q.v.)

b. Halesworth, Suffolk, 30 June 1817. He was educated at the University of Glasgow, accompanied Sir James Clark Ross's Antarctic expedition of 1839–43 as assistant-surgeon and naturalist, and in 1847 published an account of its botanical results in two volumes, entitled 'The Botany of the Antarctic Voyage of H.M. Discovery Ships Erebus and Terror in the years 1839–43.' He went to India in 1847, in order to investigate the botany of part of the Himalayan region, and in 1854, three years after his return issued his 'Himalayan Journals, or Notes of a Naturalist in Bengal, the Sikkim and Nepal Himalayas, the Khasia Mountains,' etc. In his work on the 'Rhododendrons of the Sikkim Himalaya' (1849), he first introduced to the notice of European gardeners many splendid and now familiar species of these favorite shrubs. In 1871 he set sail for Morocco, and in May of that year he and his companions reached the summits of the Great Atlas, which till then had never been trodden by any European foot. A record of this journey is contained in the work written with John Ball, 'Journal of a Tour in Morocco and the Great Atlas' (1879). He traveled in the Rocky Mountains and California in 1877. In 1855 was appointed assistant to his father in the directorship of Kew Gardens, and on his father's death in 1865, succeeded him as director. He retired in 1885. He was president of the Royal Society during the five years 1873–8. Among his other works are: 'Introductory Essay to the Flora of New Zealand' (1853); 'Introductory Essay to the Flora of Indica' (1855); 'Flora Novæ Zealandæ' (1853–5); 'Flora of Tasmania' (1856–60); 'The Flora of Australia: its Origin, Affinities, Distribution, etc.' (1859); 'Genera Plantarum' (1862–83), with George Bentham, an epoch-making revision of the natural system of classification; 'The Student's Flora of the British Islands' (1870; new ed. 1883), an excellent and popular work; 'The Distribution of the North American Flora' (1878); and the great 'Flora of British India' (1875–97).

Hooker, Richard, English theologian: b. Heavitree, near Exeter, March 1554; d. Bishopsbourne, 2 Nov. 1600. He was educated at Oxford. In 1581 he took orders, and was shortly after made preacher at St. Paul's Cross, in London. In 1584 he became rector of Drayton Beauchamp, Buckinghamshire. The following year he was appointed by Archbishop Whitgift Master of the Temple for life. Here he became engaged in a controversy with his colleague Walter Travers, whose sympathies were strongly puritanical, and to this controversy we owe his celebrated work 'Of the Laws of Ecclesiastical Polity.' The first four books were printed in 1594. The fifth book of his great work appeared in 1597; the last three in 1600. 'The Ecclesiastical Polity' written in defense of the Church of England, is no less remarkable for learning and extent of research than for the richness and purity of its style, which entitles its author to be regarded as one of the classics of the Elizabethan age. See Lives by Walton, and Keble.

Hooker, Thomas, American colonial clergyman: b. Markfield, Leicestershire, England, probably 7 July 1586; d. Hartford, Conn., 7 July 1647. After being graduated at Cambridge he took orders, preached in London, and was chosen lecturer at Chelmsford in 1626. Having been silenced by Laud for nonconformity, he established a grammar school, and about 1630 went to Holland, where he preached at Delft and Rotterdam. In 1633 he came to New England with Cotton and Stone, and was settled with the latter at Newtown, now Cambridge, being ordained by the brethren of the church. In 1636 he removed with about 100 others to what is now Hartford, Conn., where he and Stone were the first ministers of the church. He was a remarkably animated and able preacher, of commanding presence and earnest zeal, and he has been called the Luther of New England. It was his custom to preach without notes. Some 200 of his sermons were sent to England, where about half of them were published. His most celebrated work, 'A Survey of the Summe of Church Discipline,' written with John Cotton, was published in England (1648). Many of his works have gone through repeated editions. See Walker, 'Life of Hooker' (1891).

Hooker, Sir William Jackson, English botanist: b. Norwich 1785; d. 12 Aug. 1865. He applied himself to the study of botany at an early age, and in search of botanical specimens visited Scotland and the Scottish islands, France, Switzerland, and Iceland. His investigations on the British 'Jungermanniæ and Mosses' drew attention to his attainments, and he was elected to the chair of botany in the University of Glasgow, a position he filled for 20 years. In 1836 he was knighted, and in 1841 was appointed director of the Royal Gardens at Kew, a post which he held up to the time of his death. Under his management these gardens increased their area from 11 acres to 270. They are well laid out, and contain hot-houses and conservatories far superior to anything of the kind on the Continent, and include museums filled with objects derived from the vegetable kingdom, botanical libraries, and a most extensive and excellently arranged herbarium. Among his works may be mentioned 'Tour in Iceland' (1811); 'The British Flora'; 'Flora Boreali-Americana'; 'Illustrations of the Genera of Ferns, Icones Plantarum'; 'British Ferns'; etc.

Hooker, Mount, Canada, a peak in the Rocky Mountains; 15,690 feet high; near the eastern boundary of British Columbia.

Hoonoomaun, hoo'noo-män. See Entellus Monkey.

Hoop Ash. The black or water ash (*Fraxinus nigra*). See Ash.

Hooper, hûp'ėr, **John,** English reformer and martyr: b. Somersetshire, about 1495; d. Gloucester 9 Feb. 1555. He embraced the principles of the Reformation and in 1539, to avoid the persecution consequent on refusing to sign the new articles of faith put forth by Henry VIII., withdrew to the Continent. On the accession of Edward VI., in 1547, he went to London, and contributed greatly to the progress of the Reformation. In 1550 he was nominated bishop of Gloucester. On the accession of Mary, in 1553, he was one of the first victims fixed upon, and being imprisoned in the Fleet, was treated with great severity. In 1555 he was required formally to recant his opinions. This he refused to do and was burned at the stake near his own cathedral. His works consist chiefly of a 'Godly Confession and Protestation of the Christian Faith'; 'Lectures on the Creed'; 'Sermons on the Book of Jonah'; 'Annotations on the Thirteenth Chapter of the Romans.'

Hooper, William, American patriot: one of the signers of the Declaration of Independence: b. Boston, Mass., 17 June 1742; d. Hillsboro, N. C., October 1790. He was graduated at Harvard College in 1760, studied law with James Otis in Boston, and removed permanently to Wilmington, N. C., in 1767, where he soon rose to professional eminence and was noted for his social qualities and hospitality. He was delegated to the Continental Congress in 1775, and was till his death a leader in the councils of North Carolina.

Hoopeston, hoops'tŏn, Ill., city in Vermilion County; on the Lake Erie & W. and the Chicago & E. I. R.R's.; about 85 miles south ot Chicago and 48 miles south by east of Kankakee. It is situated in an agricultural region, and its chief industries are connected with agricultural products. It has large sweet-corn canning establishments, and factories for making the cans and the canning machinery. There are manufactured other canned goods, also horsehoe nails and agricultural implements. Grain and hay are shipped to the larger markets. The government, in accordance with the charter of 1877, is vested in a mayor who serves for two years and in a city council. The city owns and operates the waterworks. Pop. (1890) 1,911; (1900) 3,823.

Hooping-cough, a series of coughs ending in a long-drawn breath, during which a shrill whistling sound, the hoop, is produced. Several fits of coughing succeed one another, until some phlegm or mucus is expelled. Vomiting not infrequently follows a fit of coughing. It has recently been discovered that the cause of the complaint is a poison acting as an irritant on the pneumogastric nerve. Hooping-cough is contagious, and most commonly attacks children, generally but once in their lives. The first symptoms are a difficulty of breathing, and other slight febrile affections, which are succeeded by hoarseness, cough, and difficulty of expectoration. After a fortnight or more the cough becomes convulsive, and is attended by the hoop. In four or five weeks the expectoration becomes loose, and the fits of coughing gradually diminish in frequency and duration. Hooping-cough is seldom fatal to adults, but is most fatal in the first year of childhood. Bronchitis and pneumonia are the most serious complications.

Hoopoe, hoo'pō, a peculiar bird of the Old World, which takes both its vernacular and scientific name (*Upupa*) from its whooping cry. It is of the group *Coccygomorphæ* (q.v.) and represents a family (*Upupidæ*), many species of which inhabit southern Asia and Africa, while one (*U. epops*) is a well known migrant in Europe. It is about 12 inches long, is brown above and white beneath, with black, white-barred wings, and a very large cinnamon-red black-tipped crest and a long, sharp, curved bill. It seeks its food on the ground, nests in holes in trees, crannies in walls, etc., and has many curious traits and habits which have caused the bird to take a prominent place in the folk-lore of all countries. The African hoopoes belong to the genus *Irrisor*, and are called wood-hoopoes. They have brilliant plumage, but no crest. They go about in noisy flocks, and have much the appearance and habits of woodpeckers.

Hoorn, hōrn, or **Hoorne,** hōr'nė, or **Horn,** or **Hornes,** ŏrn, Count of (Philip II., De Montmorency-Nivelle): Flemish soldier and statesman: b. about 1520; d. Brussels 5 June 1568. His father was a descendant of the French family of Montmorency, and on the mother's side he was related to Lamoral Egmont, with whose fate his own was linked. His mother becoming a widow when he was about eight, was married again to John, Count van Horn, one of the wealthiest nobles of the Netherlands, who, left his estates to his wife's children on condition that they should assume his name. Philip was thus at the outset of his career one of the most influential of his order, and received from Charles V. and Philip II. important trusts and distinctions. He accompanied Philip II. to Spain, where he is supposed to have received information of the designs of the Spanish court against the Netherlands, and to have communicated them to the Prince of Orange. Returning to the Netherlands he joined Orange and Egmont in resisting the aggressive policy of Philip; yet continued loyal to the crown. He was, however, suspected by the Spanish court, and upon the arrival of Alva in Brussels was enticed with Egmont to that city, and arrested in September 1567, on a charge of high treason. Ceaseless but vain efforts were made to obtain for him a fair trial, and appeals for clemency on his behalf were made by potentates in all parts of the Continent. He was executed with Egmont in June 1568.

Hoosac (hoo'sak) **Mountain,** the name given to a spur of the Green Mountains (q.v.) which is in the northwestern part of Massachusetts, on the east side of the valley of the Hoosac River. The whole length is about 16 miles. The mountain is noted for its beautiful scenery.

Hoosac Tunnel, in the towns of Adams and Florida, in Berkshire County, in Massachusetts, and piercing the Hoosac Mountain. It is on what is now known as the Boston and Maine railroad, the route from Boston to Troy, N. Y., by way of Greenfield. From the west entrance of the tunnel to Troy is 54 miles; from the east entrance to Boston, 137 miles. The tunnel is nearly five miles in length, the longest tunnel in the United States. Before the general introduction of railroads, and, as early as 1825, the project was broached of making a canal across Massachusetts from Boston to the Hudson River. This plan was abandoned when railroads were built across the State. In 1851 the tunnel question had advanced so far that surveys of various routes were made and some experiments were begun. The work of tunneling began in 1856 and was completed in 1873. For so long a tunnel the ventilation is good owing to the shaft, 1028 feet, sunk near the centre. The width is sufficient for two tracks. The total cost, including 39 miles of adjoining railroad, was about $13,000,000.

Hoo'sic Falls, N. Y., village in Rensselaer County; on the Hoosac River and on the Boston & M. railroad; about 28 miles northeast of Albany. The first permanent settlement was made in 1688, and the first charter was received in 1827. The charter has been revised and the last revision was in 1890. The village has excellent water-power. The chief manufactures are agricultural implements, paper and paper-making machinery, shirts, cotton and woolen goods, and flour. The government of the village is vested in a president who holds office three years, and a board of trustees. Pop. (1890) 7,014; (1900) 5,071.

Hoosier (hoo'zhėr) **Schoolmaster, The,** a story by Edward Eggleston (q.v.) published in 1875, and the most popular of its author's works. It is descriptive of the life of the Middle West in the pioneer days of the early 19th century.

Hoosier State, a popular name for Indiana. The word is said to be a corruption of "husher," formerly a colloquial name for a fighter or a bully.

Hop-hornbeam. See IRON-WOOD.

Hopatcong, hō-păt'kŏng, **Lake,** in Sussex County, New Jersey; about 33 miles northwest of Jersey City and 25 miles west of Paterson. The lake is 725 feet above the sea, and eight and one-half miles long and three and one-half miles wide. Its outlet is the Musconetcong River which flows into the Delaware. Lake Hopatcong is a favorite summer resort, its beautiful scenery is one attraction. It is surrounded by hills and low mountains, all well wooded, and many of the trees are evergreens.

Hope, Anthony. See HAWKINS, ANTHONY HOPE.

Hope, Ascott R. See MONCRIEFF.

Hope College, in Holland, Mich., a coeducational institution, founded in 1866, by Dutch settlers, and under the auspices of the Reformed Church in America. At the close of 1902 there were connected with the school 14 instructors and 200 students.

Hope Diamond, a famous blue diamond weighing 44¼ carats, in possession of the family of H. T. Hope, of England, until 1903, when it was sold to an American.

Hope'dale, the name of a community founded by Rev. Adin Ballou, in 1841, at Milford, in Worcester County, Mass. At the beginning there were 28 persons who wished to lead lives in accordance with high ideals of Christianity. They formed themselves into a joint-stock company, purchased a farm of 238 acres, established a settlement, and proceeded to cultivate the soil, and to manufacture their own breadstuffs and clothing. At first a board of trustees were the chief governing power and had entire control of the industries. Later more responsibilities were given to the members, and the industries were, in different ways, apportioned among them. In 1854 there were 200 members; but the community had become a financial failure and dissensions had crept in. In 1856 they were in debt, and as a joint-stock company they disbanded; but continued as a semi-communistic community until about 1862, when they gave up the industries they had established to private individuals, and formed themselves into Hopedale Parish with their founder as pastor. Consult: Adin Ballou, 'Hopedale Community.'

Hop'kins, Alphonso Alvah, American author and lecturer: b. Burlington Flats, N. Y., 27 March 1843. He was for three years professor in the American Temperance University; from 1867–86 was editor of three agricultural papers successively. Since 1868 he has lectured on temperance and other social and political subjects; in 1882 he was the prohibition candidate for governor of New York. He has written 'Geraldine, a Romance in Verse,' a popular poem in the style of Owen Meredith's 'Lucille' (1881); 'His Prison Bars' (1878); 'Sinner and Saint' (1880); 'Wealth and Waste' (1896); 'Ballads of Brotherhood' (1900).

Hopkins, Edward, American colonial governor: b. England 1600; d. London March 1657. He was a prominent merchant of London, and came to Boston in 1637, but soon after removed to Hartford, where he was chosen a magistrate in 1639, and governor of the colony of Connecticut every other year from 1640 to 1654, alternating with Haynes. He afterward went back to England, where he was chosen warden of the English fleet, commissioner of the admiralty and navy, and member of Parliament. But he never lost his interest in the colonies, and at his death bequeathed much of his estate to New England, giving £1,000 for the support of grammar schools in Hartford and New Haven, which are still flourishing, and £500 which went to Harvard College and the grammar school at Cambridge.

Hopkins, Edward Washburn, American philologist: b. Northampton, Mass., 8 Sept. 1857. He was graduated from Columbia in 1878, and going to Germany to study took the degree of Ph.D. at the University of Leipsic. In 1895 he became professor of comparative philology and Sanskrit at Yale. He has written 'Caste in Ancient India' (1881); 'Manu's Lawbook' (1884); 'Religions of India' (1895); 'The Great Epic of India' (1901); and 'India Old and New' (1901).

Hopkins, Esek, first commodore of the American navy: b. Scituate, R. I., 1718; d. North Providence, R. I., 26 Feb. 1802. In November 1775 he received a commission from the Continental Congress as commodore and "commander-in-chief" of the navy, soon after which he put to sea with the first squadron sent out by the colonies. The fleet sailed for the Bahama islands, and captured the forts at New Providence, and with them 80 cannon, and a large quantity of ordnance, stores, and ammunition. On his return, when off Block Island, the commodore took the British schooner Hawke and the bomb brig Bolton. For this act the president of congress complimented Hopkins officially. Commodore, or Admiral Hopkins, as he was generally called (even by Washington, who so addressed him in his official letters), performed other remarkable exploits, though he had great difficulties to contend with. His name became a synonym for heroism, and for American patriotism. In June 1776, Hopkins was ordered by Congress to appear before the naval committee in Philadelphia to reply to charges which had been preferred against him for not annoying the enemy's ships on the southern coast. He was defended by John Adams, and was acquitted. The unavoidable delays at a later period in getting his ships ready for sea gave another chance for his enemies to complain; and neglecting a citation to appear at Philadelphia, because no specific charges were made against him, and on account of his general disgust at the conduct of his opponents, he was dismissed the service, 2 Jan. 1777. He resided near Providence, and exerted during a long life a great political influence in Rhode Island, being often elected to the general assembly of that State. Consult Field, 'Esek Hopkins' (1898).

Hopkins, John Henry, American Protestant Episcopal bishop: b. Dublin, Ireland, 30 Jan. 1792; d. Rock Point near Burlington, Vt., 9 Jan. 1868. At the age of eight, he was brought to America, his father settling in Philadelphia. He became a successful member of the bar in Pittsburg, where his interest in church work was so earnest that the vestry of Trinity Church unanimously elected him rector of the parish though he was not even a candidate for orders. He accepted the call, was ordained in 1823, and remained in Pittsburg until 1831, when he went to Trinity Church, Boston, as assistant, and became at the same time professor of systematic divinity in a theological school. He was consecrated bishop of Vermont in 1832 and combined with the episcopate the rectorship of St. Paul's Church, Burlington. Though at the head of a small diocese, he exerted a widespread influence as a learned theologian and a controversialist of uncompromising bravery and great versatility. He is said to have been the first to suggest the idea out of which grew the important Lambeth Conferences of the entire Anglican Communion, and it is unquestionably to his prudent and charitable efforts that the happy reunion of the northern and southern dioceses after the Civil War was largely due. Besides controversial works, which at the time had great effect, he published 'The Primitive Creed' (1834); 'The Primitive Church' (1835); 'The American Citizen' (1857); and 'The Law of Ritualism' (1866). See 'Life of Bishop Hopkins by One of his Sons' (1873).

Hopkins, Johns, American financier and philanthropist: b. Anne Arundel County, Md., 19 May 1795; d. Baltimore 24 Dec. 1873. His parents, Quakers, gave him a fair education and the training of a farmer. At 17 he went to Baltimore, there became a grocer, and in 1822 founded the house of Hopkins & Brothers. He built up a trade in Maryland, Virginia, and North Carolina, having practically a monopoly in his line. His credit and counsel were highly valued in financial and mercantile affairs. He retired in 1847 with a large fortune, which he employed in banking and railway operations. In 1873 he gave property worth $4,500,000 to found a free hospital; he presented Baltimore with a public park, and also gave over $3,000,000 to found the Johns Hopkins University in Baltimore.

Hopkins, Lemuel, American physician and political writer: b. Waterbury, Conn., 19 June 1750; d. Hartford, Conn., 14 April 1801. He practised medicine at Litchfield 1776–84, when he removed to Hartford, where he sustained a high reputation, and had an extensive practice till his death. He was singular in his appearance, manners, and opinions; a man of talents and learning, and also a poet. He was associated with Trumbull, Barlow, Alsop, Theodore Dwight, and others (called the "Hartford wits"), in the 'Anarchiad,' the 'Echo,' 'Political Greenhouse,' the 'Guillotine,' and similar satirical compositions; and is said to have written for Barlow the beautiful and well known version of the 137th psalm beginning, "Along the Banks where Babel's Current Flows."

Hopkins, Margaret Sutton Briscoe, American author: b. Baltimore 7 Dec. 1864. She married Prof. A. J. Hopkins of Amherst College, and has been engaged in literary work since 1890. She has written under the pen name of "Margaret Sutton Briscoe" 'Perchance to Dream and Other Stories' (1892); 'Links in a Chain' (1893); 'Jimty and Others' (1898); 'The Sixth Sense and Other Stories' (1899).

Hopkins, Mark, American college president: b. Stockbridge, Mass., 4 Feb. 1802; d. Williamstown, Mass., 17 June 1887. He was graduated at Williams College, Mass., in 1824, and having filled a tutorship in the college two years received in 1828 the degree of M. D., and in the same year commenced the practice of medicine in New York. In 1830 he was recalled to Williams College to fill the chair of moral philosophy and rhetoric, and in 1836 became president of the college, a position which he held till 1872. In addition to his labors as an instructor, he lectured before the Lowell Institute of Boston, the Smithsonian Institution, and various scientific and literary associations. Presiding over a college which has been called the cradle of foreign missions, he took an active part in the deliberations of the American board of commissioners for foreign missions, of which he was president from 1857. He published 'Lectures on the Evidences of Christianity' (1846); 'Miscellaneous Essays and Discourses' (1847); 'Lectures on Moral Science' (1862); 'The Law of Love and Love as Law' (1869); 'Outline Study of Man' (1873); 'Scriptural Idea of Man' (1883); 'Teachings and Counsels' (1884). See Carter, 'Life of Mark Hopkins' (1892).

Hopkins, Pauline Bradford Mackie, American novelist: b. Fairfield, Conn., 1874. In 1899 she married H. M. Hopkins; she has been in literary work since 1896. Her works include 'Mademoiselle de Berny, a Story of Valley Forge' (1897); 'Ye Lyttle Salem Maide, a Story of Witchcraft' (1898); 'A Georgian Actress, an Historical Romance' (1900).

Hopkins, Samuel, American Congregational clergyman: b. Waterbury, Conn., 17 Sept. 1721; d. Newport, R. I., 20 Dec. 1803. He was graduated at Yale College in 1741, studied theology under Jonathan Edwards (q.v.), and in 1743 was ordained at Housatonic, now Great Barrington, Mass., where he continued until 1769, when he removed to Newport, R. I., and was pastor there till his death. He possessed almost incredible powers of application, and is said to have been sometimes engaged during 18 hours of the day in his studies. He published 'Dialogue, Showing it to be the Duty and Interest of the American States to Emancipate all their African Slaves' (1776); 'System of Doctrines Contained in Divine Revelation, Explained and Defended' (1793); etc. His theological opinions gave rise to the famous Hopkinsian Controversy. Hopkins differs from orthodox Calvinism in his opposition to the doctrines of original sin and of the atonement; moreover, he put particular stress on the virtue of altruism and unselfishness, even claiming that selfishness, of whatever nature, was inherently and essentially sinful. Consult: West, 'Life of Hopkins' (1805); Park, 'Memoir' (1852). See also Mrs. Stowe's novel, 'The Minister's Wooing,' in which Hopkins is the central figure.

Hopkins, Stephen, American statesman; a signer of the Declaration of Independence: b. Scituate, R. I., 7 March 1707; d. Providence 13 July 1785. In 1733 at Providence he was elected a member of the general assembly, and in 1739 became chief justice of the court of common pleas. In 1755 he was elected governor of the State, and remained in office, with the exception of four years, until 1768. In 1754 he was appointed a member of the board of commissioners assembled at Albany, N. Y., to concert a plan of union for the colonies. In 1765 he was elected chairman of a committee appointed at a special town meeting held in Providence to draft instructions to the general assembly on the stamp act. In August 1774, he was, with Samuel Ward, elected to represent the State in the general Congress held at Philadelphia, and was also chosen in 1775 and 1776. On the naval committee he was placed next after John Hancock, the chairman, and greatly assisted in the formation of a navy. For 50 years he filled some public station; he was for many years chancellor of Brown University. In 1765 he commenced a 'History of the Planting and Growth of Providence,' published in the 'Providence Gazette.' In the same year he published 'The Rights of the Colonies Examined,' which was reprinted in London.

Hopkins, Tighe, English author: b. 8 Dec. 1856. He is a frequent contributor to English and American periodicals and among his numerous works are ''Twixt Love and Duty' (1886); 'For Freedom' (1888); 'Dungeons of Old Paris' (1898); 'An Idler in Old France' (1889); 'The Man in the Iron Mask' (1901).

Hop'kinson, Francis, American jurist; one of the signers of the Declaration of Independence: b. Philadelphia 21 Sept. 1737; d. there 9 May 1791. He was graduated at the College of Philadelphia (now the University of Pennsylvania), having been the first student who entered that institution at its opening, and afterward studied law. In 1776 he was sent from New Jersey as one of her representatives in Congress. During the Revolution he distinguished himself by satirical and political writings, which attained such popularity that it has been said that few pens effected more than Hopkinson's in educating the American people for political independence. He also ridiculed in prose and verse most of the social follies of his time. In 1779 he was made judge of the admiralty of Pennsylvania, which office he held for ten years, until the organization of the federal government, when it expired. As soon, however, as Washington became President of the United States, he addressed to Hopkinson a letter enclosing a commission as United States district judge for Pennsylvania. He was skilled in painting and music, composing highly popular airs for his own songs. Of his political writings the most prominent were: 'The Pretty Story' (1774); 'The Prophecy' (1776); 'The Political Catechism' (1777). The best known of his poems are: 'The Battle of the Kegs,' a humorous ballad, and 'The New Roof, a Song for Federal Mechanics.' The 'Miscellaneous Essays and Occasional Writings of Francis Hopkinson' were published in 1792.

Hopkinson, Joseph, American jurist and poet: b. Philadelphia 12 Nov. 1770; d. there 15 Jan. 1842. He was a son of Francis Hopkinson (q.v.). He was educated at the University of Pennsylvania, studied law, and began to practise at Easton, Pa., in 1791, whence he returned to Philadelphia. From 1815 to 1819 he was a member of the House of Representatives from Philadelphia. He opposed the recharter of the United States bank, and made a noted speech on the Seminole war. At the close of 1819 he retired from Congress, declining a re-election. Having gone to Bordentown to reside, he was elected to the legislature of New Jersey. In 1828 he was appointed judge of the United States court for the eastern district of Pennsylvania, an office which had been filled by his father under Washington. In 1837 he was chairman of the judiciary committee of the convention to revise the constitution of Pennsylvania. He is, however, best known as the author of the national song 'Hail Columbia,' written in 1798 for the benefit of an actor named Fox.

Hop'kinsville, Ky., city and county-seat of Christian County, on the Louisville and Nashville, and the Ohio Valley R.R.'s. Here are Bethel Female and Southern Kentucky colleges, Western Kentucky insane asylum, and manufactures of tobacco, lime, brick, wagons, and carriages, a national bank and the Hopkinsville high school. The city has an assessed property valuation of over $2,000,000. Pop. (1900) 7,280.

Hop'per, De Wolf, American actor: b. New York 1858. He made his first professional appearance in 'Our Boys' (1878), and later appeared in 'Hazel Kirke' and other plays. He studied vocal music for several years and became a star in comic opera and musical comedy.

Hopper, Isaac Tatem, American philanthropist: b. Deptford, N. J., 3 Dec. 1771; d. New York 7 May 1852. He was a member of the Society of Friends, and in the division which took place in 1827–8, joined the anti-orthodox or "Hicksite" branch. In 1829–41 he was director of a New York shop for the sale of Hicksite books, in 1841–5 was treasurer and book-agent of the Anti-Slavery Society, and from 1845 devoted his efforts to the work of the New York Prison Association. He was widely known for his interest in benevolent objects, especially negro emancipation and the assistance of discharged prisoners. At Philadelphia he was a founder and the secretary of a society for the employment of the poor, teacher in a colored school, and otherwise interested in philanthropic measures. He was an eloquent speaker. Consult the 'Life' by Child (1853).

Hop'pin, James Mason, American scholar and author: b. Providence, R. I., 17 Jan. 1820. He was graduated from Yale in 1840, studied law at the Harvard law school (1841–2), theology at the Union and Andover seminaries (1843–5) and the University of Berlin (1847–9), was ordained to the Congregational ministry in 1850, and was pastor at Salem, Mass., in 1850–9. In 1861–79 he was professor of homiletics at Yale, in 1861–3 also pastor of the College church, and from 1879 until his retirement as professor emeritus in 1899 professor of the history of art. His publications include 'Notes of a Theological Student' (1854); 'Old England: Its Art, Scenery, and People' (1867); 'The Office, and Work of the Christian Ministry' (1869); 'Homiletics' (1881); 'Pastoral Theology' (1889); 'The Early Renaissance' (1892); and 'Greek Art on Greek Soil' (1897).

Hoppner, hŏp'nėr, **John**, English portrait painter: b. London 4 April 1758; d. 23 Jan. 1810. He entered the schools of the Royal Academy in 1775; and became a fashionable portrait painter and the rival of Lawrence. He was a member of the Royal Academy in 1795. His paintings have suffered from his use of bad mediums; but his repute has risen, and in 1896 a portrait by him was sold for 1,800 guineas.

Hopps, John Page, English Unitarian clergyman: b. London 6 Nov. 1834. He was educated at the Baptist College in Leicester, and first entered the Baptist minstry. Becoming a Unitarian, he held pastorates in Unitarian churches in Sheffield, Dukinfield, Glasgow, Leicester, and Croydon. He was a member of the first school board of the city of Glasgow. He was proprietor and editor of 'The Truthseeker,' 1863–87, and became editor of 'The Coming Day' in 1891; he has written 'Pilgrim Songs'; 'A Scientific Basis of Belief in a Future Life'; 'The Alleged Prophecies concerning Jesus Christ in the Old Testament'; 'The Plain Truth about the Bible'; 'First Principles of Religion and Morality.'

Hops (*Humulus lupulus*) are a climbing plant, often met with in the wild state in northern Europe and in North America. The hop belongs to the hemp family (*Cannabinaceæ*) and it is the sole representative of its genus, but is cultivated in many varieties. It is a diœcious plant, that is, the pistillate (female) and staminate (male) infloresence is borne by different plants. In American and English hop-gardens it is customary to grow a sprinkling of male plants, but these are rigorously excluded on the Continent. In the former case the pistillate inflorescence becomes impregnated and forms seeds, in the latter they do not. In good hops the seeds are scarce, small, shrunken and sterile, that is incapable of propagating the plant. Many believe that the formation of seed ought to be prevented, as the seeds are useless to the brewer, the main consumer of hops, and besides they only add weight to the hops. Hop-plants are not raised from seeds, but are propagated by cutting off and transplanting portions of the underground stem or root. Only the pistillate plant is cultivated, because its ripe flower is the part of the hop-plant used in brewing. It has been introduced into Brazil, Australia and the Himalayas.

The hop is a perennial herbaceous plant, which produces each year several long twisting, striated stems, 15 to 20 feet in length, which clamber over hedges, brush, etc., with ease. The leaves are stalked, opposite, three to five lobed, and coarsely serrate. They are, like the stem, rough to the touch. The male inflorescence forms a panicle; the flowers enclose five stamens in a small greenish five-parted perianth. At an early stage the female inflorescence is less conspicuous. The strobile or catkin consists of several small acute bracts or leaves at whose base are situated two sessile ovaries, each subtended by a rounded bractlet. These bracts are attached to the extremity of the stem in such a way as to form a cone, and are shaped similar to roofing tiles, being one half to three quarters of an inch long.

The ovary and the base of the bracts are covered with a yellowish powder, the "hop-meal" or lupulin, which is the active principle of the plant.

Only a very slight amount of hops is used in medicine, being chiefly employed as a stomachic in dyspepsia; a pillow stuffed with hops is said to induce sleep. Nevertheless by far the largest portion of the hops produced is used in the manufacture of various beers, so that here this subject is treated with that idea in view.

The pistillate plant alone is cultivated, because hop growers on the Continent, especially Germany and Austria, find that unfertilized pistillate plants produce strobiles richer in aroma, more plenteous in lupulin, and in general better than where the plants were fertilized through the pollen of the staminate plant. In the United States we always find the strobiles containing much seed, while the choice imported Bohemian and Bavarian hops are seedless. The pistillate plant flowers in August, and its strobiles are ready for harvesting during September.

The continental European growers always strive to have early, medium and late hops, so that there the hop-picking begins late in August and lasts through the early part of October. In the United States the picking is usually over in two weeks. The time at which the strobile is fit to pick is indicated by the change of color from a light golden to a somewhat deeper hue, also by the closing up at the tips and making a rustling sound when touched. The seeds should be firm and dark in appearance before the hops are gathered. Much loss can occur by too early picking, while too late harvesting is also detrimental to the value and quality of the product.

For about 1,000 years hops have been added to beer or wort, in former times to prevent its spoiling and also to give it its pleasant and characteristic flavor and aroma; and its cultivation has progressed as the manufacture of beer became more widespread. Germany and England had hop gardens in the 8th and 9th centuries, but the cultivation was not rationalized until the 16th century, and at the present is a very important agricultural product.

Abroad the finest hops are raised in Bohemia, its "Saazer" hops being known throughout the world. Next to this ranks the Bavarian "Spalter hops," and the product of the so-called "Hallertau." As a rule the Bavarian hop is stronger than the Bohemian, but somewhat inferior in quality. Würtemberg, Saxony, Baden, Prussia and Alsace also raise a good quality of hops; and Belgium, northern France and Burgundy cultivate it on a large scale. England's most famous hops are the "Farnhams," the "Golony" and "Grape" varieties. Owing to the high import taxes, Russia has also begun to raise hops. Of all these only the "Saazer" and the "Spalter" are imported to the United States. The following table gives an idea of the size of the world's production during the years 1900 and 1901:

WORLD'S PRODUCTION OF HOPS IN HUNDREDWEIGHTS.

Countries	1901	1900
United States	451,000	528,000
German Empire	283,580	523,600
Austro-Hungary	308,000	214,500
France	49,500	55,000
Belgium and Holland	93,500	55,000
Russia	88,000	88,000
Great Britain	726,000	385,000
Australia	3,300	13,200
	2,002,880	1,862,300

In the United States, the culture of hops was introduced as early as 1625 in New Netherlands, and 23 years later in Virginia, but although encouraged by special legislation in 1657, never assumed its present important agricultural role until 1800. During the first half of the 19th century Vermont produced seven eighths of the entire United States crop; since then New York has held first place. It has always been the tendency of hop cultivation to concentrate in well-defined districts, but in spite of this accumulative tendency, the centre of cultivation has slowly but surely moved westward. At first Massachusetts, Vermont and Maine were the chief hop States, but as the quality of the New York hops was far superior, and the quantity three times as great, the former States soon abandoned hop culture. The result was that during 1850-65 a small portion of New York, lying south of the New York Central Railroad between Rochester and Albany, monopolized the hop raising of the United States. Small patches were planted in Wisconsin and Michigan in 1860 and in 1866, when the New York crop was completely destroyed by vermin, Wisconsin hop-growers obtained exorbitant prices for their excellent product, which induced many to plant hops, expecting to realize a fortune in a few years, but the prices speedily declined owing to an overproduction. During 1870 and 1880 New York again was at the head, but at that time fresh competition began to develop on the Pacific coast. The «Russian River» hops of California were a marvel; their texture was «fine as silk»; their color «bright golden»; they were «clean picked»; their «contents of lupulin» second only to the best German brands, so that it was no wonder that hop-culture there advanced quickly to 40,000 bales, the yield of 1902. The first of the three following tables shows the yield in pounds of the various States from 1849 to 1899. The next table gives a comparison between the acreage, yield and value of the hop crop for 1899, 1889, and 1879; and in the third table this comparison has been calculated to

State	1899	1889	1879	1869	1859	1849
New York	17,332,340	20,063,029	21,628,931	17,558,681	9,671,931	2,536,299
Washington	6,813,830	8,313,280	703,277	6,162	44	....
California	10,124,660	6,547,338	1,444,079	625,064	80	....
Oregon	14,675,577	3,613,926	244,371	9,745	493	8
Wisconsin	165,346	428,547	1,966,827	4,630,155	135,587	15,930
All other States	97,951	205,350	558,895	2,626,862	1,183,861	944,792
Total U. S.	49,209,704	39,171,270	26,546,378	25,456,669	10,991,996	3,497,029

State	Acres under Cultivation			Yield of Hops in Pounds		
	1899	1889	1879	1899	1889	1879
New York	27,532	36,670	39,072	17,332,240	20,053,029	21,628,931
Washington	5,206	5,113	534	6,813,830	8,313,280	703,277
California	6,890	3,974	1,119	10,124,660	6,547,338	1,444,079
Oregon	15,433	3,130	304	14,675,577	3,613,726	244,371
Wisconsin	342	967	4,439	165,346	428,547	1,066,827
All other States	120	358	1,332	97,951	205,350	558,895
Total	55,613	50,212	46,800	49,209,704	39,171,270	26,546,378

State	Average Yield in Pounds per Acre			Value of Total Yield			Value of Crop per Acre		
	1899	1889	1879	1899	1889	1879	1899	1889	1879
New York	629.33	547.12	553.56	$1,600,305	$2,210,137	$6,488,678	$ 58.30	$ 60.30	$166.08
Washington	1,280.41	1,625.91	1,316.99	589,582	841,206	210,983	111.32	164.52	395.09
California	1,468.02	1,647.54	1,290.50	925,310	605,842	433,223	137.06	152.40	387.13
Oregon	950.92	1,154.52	803.85	937,513	322,700	73,311	60.75	103.09	240.15
Wisconsin	483.47	443.17	443.09	18,020	51,083	500,048	56.19	53.78	130.67
All other States	816.26	537.60	412.09	11,190	27,083	167,668	93.25	78.11	125.12
Total	884.85	780.11	567.23	4,081,929	4,059,697	7,063,913	73.39	80.65	170.17

State	1899			1889			1879		
	Per cent of Acreage	Per cent of Yield	Per cent of Value	Per cent of Acreage	Per cent of Yield	Per cent of Value	Per cent of Acreage	Per cent of Yield	Per cent of Value
New York	49.5	35.2	39.3	73.0	51.2	54.5	83.4	81.4	81.7
Washington	9.5	13.8	14.5	10.1	21.2	20.8	1.3	2.7	2.6
California	12.4	20.5	22.6	7.9	16.7	14.9	2.4	5.4	5.3
Oregon	27.7	29.8	22.8	6.2	9.2	7.9	0.6	0.9	[illegible].9
Wisconsin	0.65	0.45	0.44	1.8	1.0	1.2	9.5	7.5	7.4
All other States	0.25	0.25	0.26	0.7	0.7	0.7	2.8	2.1	2.1

percentages of the total United States crop, in order to give a clearer idea of the hop industry during these years.

New York hops are almost entirely consumed in the United States, while the greater amount of the Pacific coast hops (especially Oregon) is exported. The English production is scarcely ever sufficient for its needs, so that Great Britain must import some and mostly takes Oregon hops, because they are especially adapted to the English ale brewer's requirements.

The hop plant is subject to many diseases, due mostly to parasites, among which are the hop plant-louse (*Phordon humuli*), the hop-grub (*Gortyna immanis*), the hop-vine snout-moth (*Hypena humuli*), the hop-merchants (*Polygonia interrogationis*), the zebra caterpillar (*Mamestra picta*), the common woolly bear caterpillar (*Spilisonma virginica*), the saddle-back caterpillar (*Empretia stimulea*), hop vine leaf-hopper (*Tettigonia confluenta*); various beetles, the "red spider" or spinning mite, and the needle-nosed hop-bug (*Calocoris fulmomaculatus*), which mostly produce red smut, etc., and even destroy entire crops. Fungus pest, blight and mold (black smut), are extremely rare in the United States, although widespread in England and Europe. It is almost impossible to eradicate these pests, except by extreme measures. The best remedies for the destruction of the animal parasites is the use of bisulphide of lime or a heavy spraying of soap and tobacco emulsion. Sulphur in any form is a good remedy, and a spray of kerosene soap emulsion, to which a small quantity of flowers of sulphur is added, is generally effective. In extreme cases the affected plants are cut down and burned to prevent a spread of the disease.

The elements also play havoc with the development of the tender hop-vine. High winds will tear the vine from its support; drouth will tend to change the color of the light yellow strobile to the objectionable "pole redness"; and too much water will produce a lack of lustre, when the hops are said to be "blind." This is due to the fact that the entire energy of the plant is spent in the formation of leaves, the strobile being scarcely developed.

Hops contain hop-oil, hop-resins, acids, hop-tannin, hop-bitter, hop-wax, nitrogenous bodies, carbohydrates and mineral substances. Diastase (an enzyme) has also been found, which is especially valuable in ale brewing. Hop-oil, the principal constituent of the lupulin, present in 0.2 per cent to 0.8 per cent, is obtained by distilling the hops with water. It is colorless and hardly soluble in water. The characteristic agreeable aromatic flavor of the hops depends on this oil. If exposed to air the oil turns to resin, passing to valerianic acid, to which the cheesy odor of old hops can be traced. According to Hayduck, there are three resins in hops, the α, β, and γ, of which the first two are soft and the latter hard. The preserving, antiseptic effect of hops is due to the two soft resins, as they are distinctly prejudicial to the growth of butyric acid and many other bacteria, but do not have much effect on acetic acid bacteria and sarcina. In old hops valerianic acid, malic acid, citric acid and succinic acid are present. Hop-tannin is chiefly stored in the leaves of the strobile and is a pale brown amorphous powder soluble in dilute alcohol, which through oxidation passes into phlobaphen. The hop-bitter is obtained from the two soft resins, and imparts a pleasant bitter taste to the beer, without which it would be flat and insipid. Hop-wax is present in considerable proportions in hops, but, since it is insoluble in water and even in 90 per cent alcohol, it has no value in beer. Nitrogenous constituents of hops are about 2 per cent to 4 per cent, which calculated to albumen are 12 per cent to 24 per cent, of which 0.75 per cent to 1.6 per cent are soluble. Bungerer maintains that 30 per cent of the nitrogenous substances are asparagin. Behrens says that trimethylamin and free ammonia are also present. Griess and Harrow have discovered cholin in hops. Brown and Morris have shown the presence of an enzyme similar to diastase, which will saccharify starch, that is, change it into sugar. This enzyme is chiefly accumulated in the seeds. The carbohydrates contained are cellulose, sugar, dextrin. According to Brown and Morris there is present 1.55 per cent dextrose and 2.10 per cent levulose, together 3.65 per cent of inverted sugar. According to Thausing hops contain 5.3 per cent to 15.3 per cent of ash and an average of 7.54 per cent, of which over one third is potash, one sixth phosphoric acid, one sixth silica, and some sodium, lime, magnesia, iron oxide, sulphuric acid and chlorine. The presence of an alkaloid in the seed has been ascertained by Dr. Ernst Hantke, but research on this point is still progressing.

Although it is possible to estimate with a fair degree of accuracy the several constituents of hops, it has not been so far found possible to establish any definite relation between the value of the hops and the amounts of hop-oil, resins, tannin, etc., which they contain. Consequently up to the present time, chemistry has not afforded much assistance in this direction. Hence the value of hops is still judged according to its general properties. The color, size and appearance and lustre of the strobile, the quantity and color of the lupulin, the amount of seed, the odor, taste and cleanliness, are the essential points in the valuation of hops.

Fine hops possess a silky lustre which is lacking in inferior grades. The color is greenish yellow, varying with the origin. New York hops have a somewhat paler color of a stronger greenish shade, while the Pacific coast hops have a more pronounced yellowish color. A reddish tint may indicate pole-redness, or, what is worse, that the hops have become overheated in the bale, which implies a darker coloration of the lupulin and deterioration of quality. The form and size of the strobile is also characteristic of the origin. Small strobiles are preferable to big ones, as they contain on an average more lupulin; and the fewer the seeds the better. The bracts ought to lap over one another and hold firmly together, whereby the lupulin is kept in better. The odor and aroma should be strong, fine, free from any off-smell such as odors of fruit, garlic, etc. Only very slight amounts of stems, foliage, or stripped cones should be present, as they impart a coarse taste to the beer. The amount of lupulin present in the strobile is an indicator of the value of the hops, because it contains those resins, volatile oils and bitter substances, which are so essentially valuable to the brewer. In fresh hops, slight pressure will force out the contents of the strobile in a transparent droplet, but in old hops the contents of the lupulin granule will not flow, due to resinification, and the expressed juice is more syrupy, wax-like and opaque. In short, the preparation of the strobiles for the market should be as follows: After the crop has been harvested, it is dried. The largest part of the German crop is merely air-dried or sun-dried, and it is claimed that this "natural cure" preserves far more of the essential oils and other active principles than is possible by the artificial hot-air cure used in the United States and England, and that this at least in part accounts for the peculiarities of Spalt hops that command such extraordinary prices. The kiln in which the hops are dried resembles in some respects the drying kiln of the maltster. This process requires great care, as much of the hops may be easily damaged. When the moisture has been completely removed, sulphur is placed on the fire, which has the effect of brightening the color; the evolved sulphurous acid also acts as an antiseptic, destroying to some extent the germs of mould-fungi and other organisms. After drying, the hops are stored three or four days, whereupon they are baled and are then ready for the market. They are easily affected by warmth, moisture, air and light, and for this reason must be protected in storage against these influences. For brewing purposes it is almost impossible to pass off a substitute for hops, although lupulin and hop-extract are now manufactured. The lupulin is separated from the strobile, and inasmuch as it contains the essential constituents for which hops are used in brewing, it can be better utilized, although it is impracticable and impossible to replace the entire quantity of hops with lupulin alone because it contains very little tannin, which also is essential. The same remark is applicable to hop-extract.

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Horace (Quintus Horatius Flaccus). Roman poet of the Augustan Age: b. Venusia, Italy, 8 Dec. 65 B.C.; d. Rome 27 Nov. 8 B.C. Our information about Horace's life is derived in the main from his own writings, which are supplemented in a few details by a brief biography attributed to Suetonius. He was born at Venusia, a small town in Apulia, near the boundaries of Lucania and Samnium. His father was a freedman, and, according to Horace's own statement, followed the trade of a *coactor* or collector. He seems to have prospered, for he was able to purchase a small farm. He was not satisfied to send the boy to the local school of Flavius, which was patronized by the aristocracy of Venusia, but moved to Rome to give his son the best possible educational advantages. It is to his credit that he did this, not that Horace might better his position in life, but for the sake of the education itself. At the capital he supplied his son with the means of making a creditable appearance, and he himself accompanied him to and from his classes, giving him moral instruction in a shrewd and homely way by pointing out men who offered examples to be followed or shunned. To this training Horace owed both his habit of self-examination and his consequent temperance and self-control, and that keen observation of men and things which is one of his marked characteristics. He nowhere makes mention of his mother, who very likely died while he was an infant.

At Rome Horace pursued the usual grammatical studies under the notorious "flogging Orbilius," and doubtless supplemented them by more advanced work in rhetoric and literature. It is, however, in marked contrast to the fulness of our information about the other details of his life, that we know little or nothing about the masters who influenced him or about the particulars of his education, except that he implies that he attended the classes of several teachers. We may, however, infer something from the results. He certainly acquired a taste for reading, both in the literature of Greece and that of his native land, a habit which he continued to follow throughout his life. Somewhere about 46 B.C., in his 19th year, Horace went to Athens to study philosophy but he does not seem to have been especially attracted by any particular school. In his early life he leaned toward the Epicurean doctrine, but as time went on he turned more and more to that of the Stoics, without, however, committing himself to either sect. The assassination of Cæsar and the arrival of Brutus in Athens in September 44 B.C., put an end to his quiet student life. He joined the army of the liberators, and received a commission as tribune, though he was in no way fitted for the post. At Philippi he fled from the field with the rest of the routed forces, and, as he himself says, "left his shield behind." His humble estate was confiscated, but on his return to Rome in 41, when a general amnesty was granted by Octavian, he in some way secured a position as clerk in the quæstor's office, which furnished him the means of livelihood.

Horace freely admits that it was lack of money which first led him to write verse, and it was to his efforts in this line that he owed his advancement. He soon made the acquaintance of Vergil and of Varius, by whom he was introduced to Mæcenas. After a delay of several months, during which the astute statesman doubtless took the young man's measure, his position was established by his admission to the select circle of Mæcenas' literary friends. This honor, as he says with pardonable pride, was due not to high birth, but to his personal character. In 33 he received from his patron a small estate, the famous Sabine farm, situated in the valley of the Digentia, a small stream flowing into the Anio, about 30 miles northeast of Rome. Through Mæcenas he became intimate with the most eminent men of the day, both in literary and in political life, including Augustus. Toward the emperor his attitude was one of dignified independence. He was quick to recognize the advantages of the peaceful and established order of things which Augustus had brought about, and he celebrates it in many of his odes; but he did not hesitate to decline the position of private secretary which the emperor offered him. This he did without giving offense, for Suetonius quotes extracts from letters of Augustus which indicate a cordial and even an intimate friendship. Horace also preserved his independence in his relations with his benefactor Mæcenas, as appears from several passages in his works, although he showed a proper gratitude for his many favors.

In the year 35 Horace issued his first book of satires, to which he himself gave the title of 'Sermones,' or familiar talks. On this branch of literature, which the Romans claimed as their own creation, see SATIRE. He took as his model Lucilius, and at first seems to have followed him closely, but he soon found himself out of sympathy with the earlier poet's severity in invective and disregard of form. In the fourth and tenth Satires he subjects the work of his predecessor to a thorough criticism, and defines his own ideal of what satire should be. This book was complete in itself, and begins with an essay addressed to Mæcenas. That the reception given to his first effort, which did not lack serious defects, was not wholly favorable, and that Horace had not satisfied himself, is evident from the poet's own words in the introductory essay of the second book, which seems to have appeared in the year 30. This book marks a great advance on the first, from which it differs in its externals in having no formal dedication and in being cast almost wholly in dialogue form, whereas in the first book Horace himself had been the chief speaker. In the following year, urged by Mæcenas, Horace published his first collection of lyrics, some of which doubtless represent his earliest attempts at verse. It was a volume of 17 Epodes, or 'Iambi,' as he himself named them. He chose as his model the Greek iambic poet Archilochus, and followed him closely in form. His work, however, has little of the bitter invective for which the Greek poet was notorious, and Horace shows no little originality both in his choice of themes and in his treatment of them. Six years later Horace, now a man of 42, published the first three books of the Odes, which form a work complete in itself, opening with a dedication to Mæcenus and closing with an epilogue in which he predicts his own immortality. In his choice of metres he followed especially Alcæus and Sappho, from whom he also took many of the subjects of his odes. But he shows the influence of many other Greek poets, as well as considerable independence. Although this work did not wholly escape hostile criticism, it at once placed Horace in the front rank of Roman poets. This position was formally recognized in 17 B.C. through his appointment by Augustus to write the ode, the well-known 'Carmen Sæculare,' which was sung at the celebration of the secular games in that year.

His next work was a return to the field of satire, for the 'Epistles' belong with the 'Sermones' to that branch of literature in the Roman sense of the term. They differ from the 'Sermones' in their greater finish and in their external form. Horace regarded the hexameter as the conventional form for satire, and the poetic epistle represents his third and final choice of form for his essays in that measure. The first book was apparently issued in the year 20. Horace was then a mature man, who had made his mark, and his tone is more assured and his self-appreciation is greater, though without any trace of egotism. The practical philosophy of life seemed to him the thing most worthy of serious consideration, and to teaching this he proposed to devote the rest of his literary work. This book, which consists of 20 letters, of which some are genuine and some fictitious, is also dedicated to Mæcenas. The second book is devoted wholly to literary criticism, a subject which lay within the domain of satire and had already been handled in some of the 'Sermones.' The chronology of the book is somewhat difficult. It was probably published in the year 14. Whether the *Ars Poetica* formed the third letter of the second book or not is uncertain. It has been assigned to various years from 20 to 8 B.C., and if it really belongs to the latter date, it must have been published separately, perhaps after Horace's death, and is the latest of his works. The title which Horace gave it seems to have been 'Epistula ad Pisones,' but it received its present designation at an early period. The second book of epistles begins with a letter addressed to Augustus, who is said by Suetonius to have taken Horace to task for dedicating none of his works to him. In his epistles, Horace had formally renounced lyric poetry. Nevertheless, at the express request of the emperor, he published a fourth book of odes in 13 B.C. This collection, though admirable in form and containing some of Horace's best work, is characterized by a certain perfunctoriness and lack of spontaneity. It was not addressed to Mæcenas, but is without a formal dedication. This was, however, not due to any diminution of his regard for his patron, but to the fact that the book was published by the special request of Augustus.

Of the remaining years of the poet's life we know very little. Suetonius says that he died 27 Nov. 8 B.C., and there seems to be no ground for rejecting this testimony. No authentic portrait of Horace has come down to us. From his own allusions to his personal appearance, and from a letter of Augustus, quoted by Suetonius, we learn that he was stout and short, with dark eyes and hair, but prematurely gray. He further tells us that he was quick to anger, but easily appeased. He never married, and of all the loves of which he sings, Canara alone seems to be other than imaginary.

It is probably safe to say that Horace has been the most widely read of all Roman writers, not excepting Vergil, and that he has appealed to a more varied circle of readers than any of his countrymen. This statement applies especially to his odes, since it is to them that his popularity with the general public is for the most part due. It has been said that the odes are not poetry of the highest type, and that when they are analyzed and their contents subjected to searching criticism, the sum total of poetic material is scanty. This is unquestionably true, yet it is equally true that their influence and popularity have none the less been great. This is due in part to the personality of the man and the sympathetic feeling which he rouses in his readers on account of his broad humanity; and in part to the fact that the very simplicity of the odes and their ease of comprehension appeal to readers of all classes. As Mackail says, he realized that limited as was his own range of emotions, that of mankind at large was still more so. In some cases, notably in the love poems and the convivial odes, we are conscious that he did not always feel even the emotions which he describes. In spite of all criticism, the one undoubted fact remains, that the odes of Horace have pleased readers of all epochs and all sorts and conditions of men.

Horace's claim to originality is greater than is usually admitted. In his day the question of imitation of Greek models had ceased to exist, and the question was, rather, which model to choose. In the Augustan Age we find two schools, those who followed the Alexandrine writers, and those who went back for their inspiration to the Greeks of the classical period. Horace belonged to the latter class. His contempt for the followers of Alexandria is outspoken, and so undiscriminating as to include such really great poets as Calvus and Catullus. He certainly knew how to make what he borrowed his own, and many of his odes are so thoroughly national in character that they can have owed little except their external form to Greek sources. In his Satires, in spite of his avowed imitation of Lucilius in the beginning, his originality is far greater, and these are in reality his greatest works. While less popular with the general reader, they are of great interest for the light which they throw on Horace's life, personality, and habits, as well as for the vivid pictures which they set before us of the complex Roman life. In his daily walks about the city, Horace used his powers of observation, and drew material from all sides and from all classes of society. Above all we can trace in them his own self-improvement and the development of his character, and the gradual growth of that sound judgment and good taste which characterize the work of his mature years. The Satires are further characterized by a genial and good-natured humor. Like Dickens, he chose appropriate names for many of his characters — such as *Novius*, or Newman, for the parvenu, though, like those of Dickens, they were not always of his own coinage. The Satires also abound in the familiar phrases of every-day life, in puns and plays upon words, in proverbs and homely fables and stories.

Horace's works, as he himself humorously predicted, became school text-books at an early period. Juvenal implies that this was the case in his day. This fact and his general popularity led to the numerous commentaries on his works, which began to appear as early as the days of Nero, of which those of Porphyrio, of the early part of the 3d century, and the collection falsely attributed to Helenius Acron, have come down to us. The great number of manuscripts which exists testifies to his popularity in the Middle Ages. His fame at that time was, however, much less than that of Vergil, and, though he also was regarded as a magician, it was only at Palestrina and at Venusia that such legends were current. In modern times his influence on French and English satire has been great, as well as on modern poetry in general.

The date of the first edition is uncertain, but is earlier than 1471. Since then the editions of Horace's works, or of parts of them, have been legion. Of these may be mentioned as epoch-making that of Richard Bentley (Cambridge 1711), which has often been reprinted (the reprint at Berlin in 1869 contains a word-index by C. Zangermeister). The standard critical text is that of O. Keller and A. Holder (Leipsic 1864–70, a second edition of the first volume containing the 'Odes,' 'Epodes,' and 'Carmen Sæculare,' appearing in 1899). A commentary on this edition is furnished by Keller's 'Epilegomena zu Horaz' (Leipsic 1879–80). Of editions with notes may be mentioned: J. G. Orelli, 4th ed. by W. Hirschfelder and W. Mewes (Berlin 1886–92), containing a complete word-index; A. Kiessling (Berlin, 2d ed. 1890–8); H. Schutz (Berlin 1880–3); these two appear in new editions from time to time; L. Müller, 'Odes' (Leipsic 1900), 'Satires and Epistles' (Leipsic 1891–3); E. C. Wickham, 'Odes and Epodes' (3d ed. Oxford 1896), 'Satires and Epistles' (Oxford 1891); Page, Palmer, and Wilkins (London and New York 1896). The edition of the 'Odes and Epodes' by P. Shorey (New York 1896) is of special interest to the general reader on account of its large number of parallel passages from English poetry.

The simplicity and directness of Horace's thought have been a constant temptation to translators, and the number of English versions, particularly of the 'Odes,' is very great. But his care in composition and his inimitable skill in the use of words, his *curiosa felicitas*, as Petronius terms it, make him exceedingly difficult to translate, and, while some brilliant successes have been achieved with single odes, no one has done justice to him as a whole. Many of the attempts which have been made are reviewed in two articles in the 'Quarterly Review' (Vol. CIV., 1858, and Vol. CLXXX., 1895). The following may be mentioned: Lord Lytton, 'Odes and Epodes' (London 1869); Cooper, 'Horace's Odes Englished and Imitated by Various Hands' (London 1880); Martin, 'Works of Horace' (Edinburgh 1888); Conington, 'Odes and Epodes' (3d ed., London 1885), 'Satires and Epistles' (London 1892); Gladstone, 'Odes' (New York 1894); Green, 'Odes and Epodes' (London 1904). An edition of Horace's works, in six volumes, containing both text and translations, has recently been issued by the Bibliophile Society of Boston. To give an adequate literary criticism of Horace is nearly as difficult as to translate him, and is out of the question within the limits of a brief article. Consult: the various histories of Roman literature, especially that of Mackail (New York 1900); Sellar, 'Roman Poets of the Augustan Age — Horace and the Elegiac Poets' (London 1892); Nettleship, 'Lectures and Essays' (Oxford 1885); Patin, 'Etudes sur la poesie latine' (3d ed., Paris 1883); Tyrrell, 'Latin Poetry' (Boston 1895); Boissier, 'The Country of Horace and Virgil' (London 1896); Lang, 'Letters to Dead Authors' (London 1886).

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Horæ, hō'rē, in Greek mythology, goddesses of the seasons. They were generally regarded as attendants of the gods, and guardians of the Olympian gates. Their characteristics, however, varied, and their number was variously represented as two, three, or four. Hesoid names three — Euxomia (good order), Dike (justice), and Eirene (peace), and thus makes prominent their attributes as also guardians of social and political conditions.

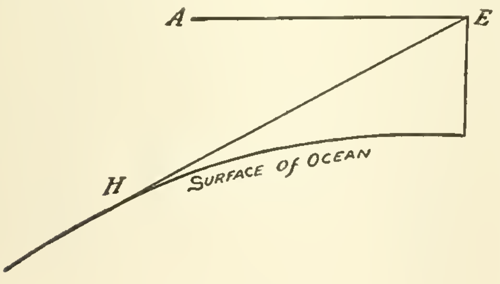
Horatii, hō-rā'shī-ī, three Roman brothers, who, in the reign of Tullus Hostilius, engaged the same number of Alban brothers (the Curiatii), in order to decide the contest between the two nations. A sister of the Horatii was betrothed to one of the Curiatii; but both sides forgot their private relations in the service of their country. Two of the Romans soon fell. The contest was unequal, but Horatius saw his antagonists faint with the loss of blood. In order therefore to separate them from one another, he feigned flight, and, while they pursued him as well as their wounds would permit, at unequal distances, he suddenly turned and slew one after the other. He was conducted back to the city amidst the rejoicings of the Romans, adorned with the spoils of the slain. There he saw, in the crowd, his sister in tears for the death of her betrothed. Angered that her lamentations for her lover should mingle with the rejoicings of the nation on his victory, the brother plunged his dagger into her breast. He was condemned by the duumviri to be scourged to death, but he was later pardoned.

Horeb, hō'rĕb, a mountain in the northern part of Arabia, of the same ridge as Mount Sinai, which lies not far distant from it, memorable in the history of Moses. The monks on Mount Sinai still point out the rock on Horeb from which water issued at the blow of Moses.

Horicon, hŏr'ĭ-kŏn. See George, Lake.

Hori'zon. In its most familiar sense the horizon is the line or circle around which earth and sky seem to meet. On the ocean this circle is smooth and easily visible, and is then called the *sea horizon.*

In astronomy the horizon is defined by a plane at right angles to the direction of gravity, extending out indefinitely on all sides, and called the *plane of the horizon.* The circle in which this plane cuts the celestial sphere is called the *astronomical horizon.* All points of it are apparently on a level with the eye of the observer. Owing to the rotundity of the earth



the sea horizon is lower than this astronomical horizon — a narrow strip of sky separating the two. The angular distance between them is called the *dip of the horizon.* The higher the observer is above the ocean, the greater is the dip. To an eye on the surface of the water, the sea horizon and the astronomical horizon coincide, so that there is no dip. The geometrical principle which determines both the dip and the distance of the visible horizon, are seen in the figure. The circular arc is here the surface of the ocean. The eye of the observer is situated at the point E, a short distance above the surface of the water. A tangent drawn from the eye to the surface meets the latter at the visible horizon, H. Let a horizontal line E A be drawn from the eye, the angle A E H is then the geometric dip of the horizon. The geometer will readily see that this is equal to the angle at the surface of the earth between O and H. Since one minute of arc in the curvature of the earth's surface corresponds to one nautical mile, it follows that, geometrically, the dip of the horizon in minutes is equal to its distance in nautical miles. But, in the actual case, the line of sight is curved in consequence of the refraction of the air. The result of this is that the actual horizon is further than given by the geometric theory, and the dip somewhat smaller. The following table shows the relation between the apparent dip and the height of the eye above the water and the distance of the sea horizon.

Height in Feet	Dip of Horizon	Distance of Horizon Miles
1	1.0	1.3
2	1.4	1.8
3	1.7	2.3
4	2.0	2.6
9	2.9	4.0
16	3.9	5.3
25	4.9	6.6

On board a steamship the eye of an observer on the promenade deck is generally from 15 to 20 feet above the water. It follows that the distance of the horizon is about five miles. A ship farther away than this will have more or less of her hull below the horizon. At double the distance the entire hull will be below the horizon, and only smokepipe and masts visible. As she goes yet further, these also will disappear, as if sinking below the water.

Simon Newcomb.

Horn, a tough, flexible, semi-transparent substance derived from the epidermis, which may be developed morbidly as a corn, or naturally, as in the callosities on the legs of a horse; or in connection with important functions, as when it forms the outer sheath of the outgrowths upon the heads of ungulate animals, called "horns," the "shell" of the tortoise, the nails, claws, and hoofs of animals, the beak of bird and turtle; and the hairs and feathers of mammals and birds, or their modification into spurs, scales, spines, bristles, whalebone, nasal horns, etc. This epidermal tissue consists largely of keratin, an albuminoid composed mainly of carbon (about one half), oxygen, nitrogen, and sulphur.

The horns of mammals are in effect modifications of the hairy integument covering parts liable to great wear, or needing to be hard and sharp, especially the outgrowths of the skull characteristic of male ruminants. Hollow horns are usually unbranched and persistent, but in the pronghorn (q.v.) they are shed annually while the bony cores grow and their vascular coverings persist and give rise to the new horns. Hollow horns are found usually in both sexes, but in some genera of antelopes only in the male. In the pronghorn the horns of the female are almost hidden in the hair of the head, and are small, short, and unbranched. Such horns as these are called hollow or sheath horns, and are very different from antlers (q.v.). Another form of true horn is that on the snout of the rhinoceros (q.v.) where, when more than one appears, the projections stand one behind the other in a median line, and not side by side. This nasal rhinoceros-horn is not a hollow sheath clothing a bony core, but a solid mass of coarse agglutinated hairs, arising from the skin and supported by a thickening of the underlying bone.

Utility of Horn.— In their natural form, the horn-sheaths of oxen, sheep and antelopes have been put to a great variety of use, as weapons, receptacles, handles, and musical instruments — the latter surviving in certain ceremonial usages and in the general term "horn" for a wind instrument. Cleaned and polished it served many additional needs, forming the primitive drinking cups; and it is from this ancient usage that the general name of "horns" has been given to a species of drinking cup, and its spirituous contents. The horns of victims sacrificed to the gods were often gilded by the Romans and suspended in the temples, more especially in those of Apollo and Diana. From the most remote times the altars of the heathen divinities were likewise embellished with horns, and such as fled thither to seek an asylum embraced them. Originally the horns were doubtless symbolical of power and dignity, since they are the principal feature of gracefulness in some animals, and instrument of strength in others. Hence these ornaments were frequently bestowed in imagination and art upon gods, and were actually worn by heroes. In more modern times ox-horns have been used the world over for carrying gunpowder; and museums abound in quaint relics of this kind elaborately ornamented by soldiers and hunters. Small bottles (inkhorns) of this substance were the first receptacles for ink, and are still used in the East, where opium for smoking is usually kept in horn-boxes. Before the general adoption of glass panes in windows thin plates of horn were often used, as they still are in barbarous parts of Asia; lanterns were made of them; and the faces of the mediæval horn-books were so protected. The material now lends itself to manufacturing into many other articles by reason of its toughness, pliability and capability of being softened by heat and then molded. The heat is applied in the form of hot water; and splitting into thin sheets, or welding pieces together, or molding fragments into various forms, may all be accomplished under combined moisture, heat and pressure. Both the natural horn and the molded substance may be carved, or impressed with a die, polished and dyed. Hence an enormous variety of useful and ornamental articles may be made, and the horns of cattle have commercial value.

Horn, a musical instrument, originally formed, as the name denotes, from the horn of an animal. The name includes a large family of wind-instruments, many of which have fallen into disuse. The hunting-horn was long the chief form extant. The French horn consists of a metallic tube of about 10 feet in length, very narrow at top, bent into rings, and gradually widening toward the end whence the sound issues, called the bell, or in French the *pavillon*. It is blown through a cup-shaped mouth-piece of brass or silver, and the sounds are regulated by the player's lips, the pressure of his breath, and by the insertion of the hand in the bell of the instrument. The compass of the instrument is three octaves. Music for the horn is always written on the key of C, an octave higher than it is played, with the key of the composition marked at the beginning of each movement. Great improvements have been made in the instrument by C. J. Sax of Paris, whose saxhorn gives a greater volume of sound than the old instrument. The buglehorn is a tube of 3 feet 10 inches in length bent into small compass. It is usually provided with keys, and has a range of two octaves, and notes commencing with the upper B of the bass clef.

Horn, Cape. See Cape Horn.

Horn-fly, a European fly (*Hæmatobia serrata*), since about 1890 become widespread in North America, which have a curious habit of clustering in masses about the base of the horns of cattle. It is closely related to the house-fly and stable-fly, and although annoying does no serious harm to the cattle or their horns

Horn'aday, William Temple, American naturalist: b. Plainfield, Ind., 1 Dec. 1854. He studied zoology and in 1875–9 visited as a zoological collector South American countries, India, Ceylon, the Malay Peninsula, and islands. In 1882–90 he was chief taxidermist of the United States National Museum, and in 1896 was appointed director of the New York Zoological Park. His publications are: 'Two Years in the Jungle' (1885); 'Free Rum on the Congo' (1887); 'The Extermination of the American Bison' (1887); 'Taxidermy and Zoological Collecting' (1892); 'The Man who Became a Savage' (1895).

Horn'beam (*Carpinus*), a genus of trees of the natural order *Cupuliferæ*, of which the species *C. betulus* is common in Europe, in some places growing to nearly 100 feet in height, although in Great Britain, where it is much planted, it is a small tree. It is also called horn-beech, hardbeam, and yoke-elm. It has barren flowers in a cylindrical catkin; fertile flowers in a lax catkin; nuts in pairs. It grows in woods and hedges, often in a damp tenacious soil, and forms a principal part of the ancient forests on the north and east sides of London. The wood is white, tough, and hard, and burns like a candle. It is used in turnery, for cogs of wheels, etc. The inner bark yields a yellow dye. The American hornbeam (*Caprinus Americana* or *Caroliniana*) is a small tree rarely attaining the height of 30 feet, sparingly diffused over most of the United States. It is also called water-beech, blue beech and ironwood. The wood, fine-grained, tenacious, and very compact, is used for handles, as of carpenter's tools, ets., its serviceability being restricted by reason of its inferior size. See Ironwood.

Horn'bill, a genus (*Buceros*) and of a family (*Bucerotidæ*) of birds now placed in the division *Coraciiformes*, and related to the hoopoes and owls. The species are numerous and are found in Africa, India, and throughout the Malayan region as far as New Guinea, are mostly large birds, the largest being more than four feet long, the smallest rather smaller than a magpie. They are bulky birds of heavy, noisy flight; their large bills are surmounted by bony crests or "helmets" of varied shape and sometimes of great size, but rendered light by the presence of numerous air-cells. Their food is principally fruits, but in certain circumstances they become to a great extent omnivorous. Thus a well-known South African ground-hornbill devours snakes, and is highly regarded by the negroes because of its enmity to them, and ability to overcome the largest and deadliest vipers. Several are mainly terrestrial in their habits. The most curious fact regarding these birds is that during the breeding season the female is imprisoned on her nest in a cavity in a tree-trunk, she herself apparently gradually plastering up the entrance by the use of her excrements, until there is left only a small aperture through which the male supplies her and her offspring with food until the young ones are nearly full grown. In captivity the male bird has been observed to disgorge at intervals the lining of his gizzard in the form of a bag, and it is supposed that the food supplied to the female during her term of captivity in the breeding season is enclosed in this structure. Consult: Newton, 'Dictionary of Birds' (1896).

Hornblende, hōrn'blĕnd, or **Amphibole,** an abundant and widely diffused mineral, remarkable on account of the various forms and chemical compositions that it exhibits, and its diversified colors. Almost numberless varieties of it are recognized, to many of which distinct names have been given. It crystallizes in the monoclinic system, and is brittle, with a hardness of from 5 to 6 and a specific gravity of from 2.9 to 3.4, according to its composition. It has a vitreous or pearly lustre, and its fibrous varieties often have a silky appearance. The variety most commonly known as "hornblende" is usually black or greenish black, and occurs in many rock formations, notably in granites and basalts, and in certain schists and slates. The strongly colored varieties are pleochroic. Common hornblende is a silicate of iron, aluminum, magnesium and calcium. The various hornblende minerals are now collectively known as the "amphibole group." See AMPHIBOLE.

Hornbook, an elementary school book in use in England down to the time of George II. It was made up of a single leaf on which was written the alphabet in large and small letters; the Roman numerals, and the Lord's Prayer. The leaf was sometimes set in a frame and sometimes pasted against a piece of sliced transparent horn; hence the name. There was a handle through which a string was inserted whereby the book might be tied around the waist.

Horne, C. Silvester, English Congregational clergyman: b. Sussex 1865. He was educated at Glasgow University and Mansfield College, Oxford, and after leaving the latter institution was pastor of the Kensington Congregational Church until 1903, when he became pastor of the Whitefield Tabernacle in Tottenham Court Road, London. He has been active in many social and religious enterprises and is one of the most prominent men in his denomination in England. He has published 'History of the Free Churches.'

Horne, Richard Henry, or **Hengist,** English poet and essayist: b. London 1 Jan. 1803; d. Margate 13 March 1884. He was educated at Sandhurst, and entered the Mexican navy as midshipman, serving till the close of the Mexican war of independence. He then returned to London to begin a literary career. To his early period belong two tragedies, 'Cosmo de' Medici' (1837), and 'The Death of Marlowe' (1837), both of which contain fine passages. A poem sent to him for criticism by Elizabeth Barrett opened the way to a cordial friendship and a correspondence of seven years. In 1852 Horne removed to Australia, and remained there until 1866; his book, 'Australian Facts and Principles,' being one outcome of this residence. Again returning to England, he continued literary work until his death. His last publications were tragedies, including 'Judas Iscariot: A Miracle-Play' (1848), and a curious prose tract, 'Sithron the Star-Stricken' (1883), which he pretended to take from the Arabian. His best known work, however, is his epic poem 'Orion' which Poe said might be called "a homily against supineness and apathy in the cause of human progress, and in favor of energetic action for the good of the race."

Horned Dace, Rattlesnake, Screamer, Viper, etc. See DACE, RATTLESNAKE.

Horned Toad, lizards of the family *Iguanidæ,* popularly called toads from a certain general resemblance in form and manner to those animals. The body and head are broad, thick, and flattened, the tail short and the usual attitude a sort of squatting posture with the head elevated. About a dozen species of the genus *Phrynosoma* occur in the arid parts of the southwestern United States and in Mexico. The best known are *P. cornutum* and *P. coronatum,* which, because of the bizarre appearance, quaint ways and tolerance of captivity, are often brought back as souvenirs by visitors to those regions. The scales on the body bear prominent conical spines, and the long horns of the head are supported by bony cores. Their mottled brown and gray colors harmonize well with their natural surroundings. The horned toads love to bask in the sunshine in the hottest weather and to bury themselves in the burning sand. Never very active, they become extremely sluggish in cool or dull weather and hibernate in the winter. They feed on all kinds of insects, for which they search only during the hottest hours of the day, and drink copiously of water when sprinkled in the form of drops. Like many other lizards, but unlike most of the *Iguanidæ,* they are viviparous.

Horned Viper. See VIPER.

Hornellsville, hôr'nĕlz-vĭl, N. Y., city in Steuben County; on the Canisteo River, and on the Erie and the Central N. Y. & W. R.R.'s; about 57 miles south of Rochester and 46 miles northwest of Elmira. The first settlement was made in 1790, but it was a part of Canisteo and was called Upper Canisteo until 1820. The present name was given in honor of George Hornell, who had done much for the early development of the town. It was incorporated as a city in 1890. Hornellsville is situated in a fertile agricultural region, noted for fruit. Its chief manufactures are sash, doors, and blinds, railroad supplies, furniture, leather, carriages and wagons, silk, bricks, tiles, wire-fencings, gloves, and agricultural implements. It has a good public high school, St. Ann's Academy, St. James Mercy Hospital, and a number of fine public and private buildings. The government is vested in a mayor, who holds office two years, and a city council. The subordinate officers are appointed by the mayor subject to confirmation by the council. Pop. (1900) 11,918.

Horner, William George, English algebraist: b. 1786; d. Bath, 22 Sept. 1837. He was educated at a private school near Bristol, and later taught there, becoming head master in 1806. In 1809 he established a school at Bath, which he conducted until the time of his death. His only work of importance was his discovery of a method of solving numerical equations of any degree, which he first announced in a paper read before the Royal Society in 1819, and afterward published in the 'Philosophical Transactions.' The method is still in use, and is known by Horner's name. See ALGEBRA, HISTORY OF THE ELEMENTS OF.

Hor'net. The true hornet is a European wasp (*Vespa crabro*); but in America the term is applied to almost any form of large stinging wasp, especially such as make papery nests. In some portions of the United States this is considered the only "hornet," but in the vicinity of New York the European hornet also occurs; and southward a somewhat smaller species (*V. carolina*) goes by this name.

Hornet, The, the name of two sloops-of-war in the American navy during the War of 1812. The chief was a ship-rigged 18-gun sloop, and did brilliant service. Through December and January 1812–13, under Master-Commandant James Lawrence, she blockaded the 20-gun English sloop Bonne Citoyenne in the harbor of Bahia, Brazil, till overmatched by a 74: Lawrence was surprised and himself had to take refuge in the harbor, but instead of being blockaded, slipped out the next night under the very guns of the man-of-war. After capturing a merchantman, on 24 February he fell in with the English sloop-of-war Peacock, Capt. William Peake, each at this time having 20 guns; they engaged at 5.25 P.M., and in eleven minutes the Peacock was a sinking wreck and surrendered. Her captors made every effort to keep her afloat, but in a few minutes she sank, carrying down 13 of her own crew and three of the Hornet's. Peake and four men were killed and three wounded; the Hornet had one killed and two wounded, besides two more hurt by an exploding cartridge. "A vessel moored for the purposes of experiment could not have been sunk sooner." said an English paper of the time; 'it will not do for our vessels to fight theirs single-handed.' On 22 Jan. 1815, under Capt. James Biddle, she encountered off Tristan d'Acumha, in the South Atlantic, the English brig Penguin, Capt. James Dickinson, with 19 guns of about the same metal as her own 20; in 22 minutes the Penguin surrendered, but on Biddle going forward, two British seamen shot him in the neck (not vitally), and were immediately shot down themselves. The Penguin lost her captain and 9 others killed, and 38 wounded; the Hornet, one killed and 11 wounded. The Penguin was shot to pieces, and could not be taken away, so she was scuttled; the Hornet was almost uninjured. On 28–9 April she had a long chase from the British ship of the line Cornwallis, the rear-admiral's flagship, and only escaped by thoroughly dismantling herself.

Horol'ogy. See CLOCK; CLOCK-WORK.

Hor'oscope. See ASTROLOGY.

Horrocks, hŏr'ŏks, **Jeremiah,** English astronomer: b. Toxteth, near Liverpool, about 1617; d. 3 Jan. 1641. He was educated at Cambridge and was appointed in 1639 to the curacy of Hoole, Lancashire, and in that village made his famous observation (24 Nov. 1639, O. S.) of the transit of Venus, the first on record. Newton, in the 'Principia,' bears honorable testimony to the value of Horrocks' astronomical work. The observation of the transit is by no means regarded as his sole astronomical achievement, as he added to our knowledge of the physical cause of celestial motions, deduced the solar parallax, corrected the solar diameter, and, made tidal observations. Hevelius printed the 'Venus in Sole Visa,' which was first published in Germany (1662); a translation of this work, with memoir by Whatton, appeared in 1859.

Horschelt, Theodor, German painter: b. Munich 1829; d. 1871. He began his early studies in the Munich Academy, and later became a pupil of Albrecht Adam. At first he painted horses, among which is 'The Poacher' (1850), and then turned to military scenes, painting 'The Seizure of Shamyl' and 'Cossacks Returning from a Razzia.'

Horse, in a general sense, a member of the ungulate family *Equidæ* (q.v.); but in ordinary use the word designates the single domestic species (*Equus caballus*), the wild original of which is unknown. It is not decided, in fact, whether a single species, or more than one, was the source, nor where the domestication of the horse was first effected. The evolution of the species, elsewhere sketched, took place in the American continent, and the writings of some of the earliest voyagers to the eastern coast of South America contain allusions which some commentators regard as evidence that horses survived and were known to the people who occupied the La Plata valley at that time, but this is open to doubt. It is probable that at the dawn of civilization the wild ancestors of our modern horses roamed in bands over the whole extent of grassy uplands stretching from northern Africa to eastern Manchuria, on the steppes of Russia, and wherever in Europe open country might be found; and it is also probable that they were among the first animals which men killed for food and afterward captured and tamed in order to keep a supply of food under control. This act must have been one of the earliest steps toward community life and civilization. The oldest paintings and carvings left by the ancient inhabitants of the valley of the Euphrates show that saddle-horses were familiar to them; and it is fair to suppose that the supremacy primitively gained by the people of central Asia over other parts of the world was largely due to their use of horses in war, giving them a great advantage over unmounted tribes; but it was not until much later — probably no earlier than 2000 B.C. — that the animal came into use in Arabia and Egypt, where before had been only camels and asses. So far as can be judged, these early Assyrian war-horses were rather small, robust, large-headed and shaggy beasts, much like Przewalsky's horse or the kiang (q.v.). A very similar animal was domesticated by the men of the Polished Stone Age in Europe, excellent portraits of which were etched by neolithic artists upon pieces of bone, and have come down to us among the contents of graves opened by archæologists in France, Switzerland and elsewhere. Later, but still in the prehistoric period, Europe was repeatedly invaded by Asiatic hosts who brought with them eastern horses. These modified, if they did not supersede, the local stock. When Rome conquered the barbarous inhabitants of Europe its horses, which were of Asiatic stock, with perhaps some African mixture, largely superseded those of the conquered tribes, and from the mingling there sprang the big heavy breeds which characterized the Middle Ages, and were intended for strength and weight-carrying, rather than for nimbleness and speed. It was not until near the end of the 17th century that the introduction into France and England of certain sires of Arabian breed — a clean-limbed, small-headed, agile, hardy race, which arose in Arabia and Palestine about 2,000 years ago — began the improvement of British stock, which has reached its highest development in the modern European racehorse, hunter and hackney. From this stock was derived the American horses which have been perfected in at least one new direction — that of the trotter.

Horse, Care and Diseases of the. *Breeding.*—As *heredity* is the basis of all permanence in breeding, and *variation* the condition of advancement, we can, under intelligent selection, environment, and control, attain to a constant improvement. In selecting horses for breeding, certain leading principles must guide. These may be shortly stated as: (1) adaptability to the use of the breed; (2) quality, style; (3) strength, endurance; (4) good conformation; (5) good constitution; (6) good pedigree; (7) prepotency; (8) no violent crossing of equally prepotent animals; cross the desirable prepotent animal on a non-prepotent cross-bred animal; (9) a speedy amelioration of a large number is most certainly obtained through a prepotent stallion, which leaves a large number of his offspring every year; (10) sound, vigorous health; the prepotent parent must be at his best, and no non-prepotent one should be bred to him, none that is old, feeble, or reduced by disease, overwork, underfeeding, etc; the lack of prepotency will not prevent the transmission of the systemic weakness to the offspring; (11) secure an environment calculated to enhance the qualities we seek in the progeny. Systematic exercise that is not exhausting, generous tissue forming, but not fat forming regimen, and pure, dry, genial but bracing air are especially important.

Contagion Through Sexual Congress.—Many maladies may be transmitted during coition, but some are especially liable to be so. Dourine, glanders, genital eczema, contagious acne, horse-pox, mange, and contagious abortion are to be specially guarded against. Some, like strangles, influenza, and contagious pneumonia, may be transmitted by an animal that has already passed through the disease and acquired immunity. Special care, therefore, or even veterinary supervision of horses devoted to breeding is a desideratum.

Care of the Pregnant Mare.—Exercise is a valuable provision too often neglected. Free range on breeding ranches, or, for valuable mares, separate paddocks, secure this, while working mares are better to continue the work, provided it is not unduly straining nor jarring, nor productive of excessive fatigue, exhaustion, or debility. This maintains appetite, digestion, assimilation, muscular tone, and vigor, favors the development of a stronger, better foal, and keeps the dam fitter for foaling and nursing. Feed well, avoiding what is hard of digestion, or liable to cause impaction, indigestion, fermentation, or, above all else, diarrhœa. On good pasture grain may be omitted, unless in the last month of gestation, or if the mare is visibly running down. Good, clear, sound oats or barley, or bran mash with some boiled flaxseed may be given, and heating agents like maize, buckwheat, or wheat avoided. During gestation violent purgatives and active diuretics are liable to bring on abortion.

Care of the Foal.—To avoid danger to both mare and foal in parturition, provide a roomy box-stall with door opening outward, or a paddock. The foal born indoors is always in danger of infection through the raw surface of the navel. The common or box-stall swarming with microbes is more to be dreaded than exposure to storms outside. When severe weather forbids foaling outdoors, the box should be thoroughly cleansed, disinfected, and whitewashed to obviate this danger. Navel infection may cause simple inflammation, swelling, and abscess, or the germ may propagate itself through the inactive umbilical vein to the liver, causing infective hepatitis with abscesses or necrosis; or, reaching the bowels, it causes infective diarrhœa (white scour); or it may colonize the joints, as infective arthritis (joint ill); or again it may cause pneumonia, or multiple abscesses in different organs. The gravity of the resulting disease varies with the infection, and a deadly germ, located in a stable, is liable to attack all foals that come later in the season. Both stable and navel should be disinfected. The foal should be delivered on clean straw, which may be sprinkled with carbolic acid. The navel-string may be severed with an emasculator previously cleaned and boiled, or tied with a carbolized new cord painted with tincture of iodine, and, when dry, dusted with tannic acid impregnated with iodine and carbolic acid.

The new-born foal may have the back (flexor) tendons contracted so as to stand over at the knee and fetlock, and in the worst cases the extensor pedis tendon, the opponent of these, is found to be divided across and the muscle wasted and degenerated. A succession of such cases in the same stable suggests infection. Slight cases will recover under splints and bandages, while for more severe ones an aseptic surgical operation may be required. The foal should have the first milk (*colostrum*) to clear away tenacious bowel contents and prepare for healthy function. A mild laxative of raw linseed or olive oil may be requisite in the absence of colostrum. In the absence of the dam's milk the foal may be raised on cow's milk reduced by adding one third boiled water and sugar to sweeten. After two or three weeks the undiluted cow's milk may be allowed. The cow should be free from tuberculosis.

For the pure bred racer or trotter the foal should have half a pint of oats daily at a month old, to be increased with his growth. Even draft breeds are benefited by such early grain-feeding.

Exercise is essential to the growing foal. The quality of bone, muscle, brain, and other parts depends largely on physiological use, and rich blood, active digestion, and assimilation, vigorous health, strength and endurance are incompatible with confinement and inactivity. This may at first be secured by freedom to play in pasture, or by careful handling and training by a judicious manager. But to put the two-year-old into a severely contested race, or full training, or to devote the draft colt to regular work, is but to invite disaster. The bones are as yet too soft, they contain too much organic matter and too little mineral, the muscles lack firmness and power of endurance, the whole system is immature and imperfect, and overtaxing exhausts or deranges the functions, and direct injury or impaired development is the natural result.

CARE OF THE FEET.

Overgrown Hoofs.—With unlimited exercise on firm ground, the unshod foot is sufficiently worn down, but when confined for months indoors or in a limited straw yard overgrowth occurs, especially at the toe, and a dangerously increased strain is thrown on the joints, ligaments, and back tendons. Distorted and twisted feet, bruises of the sole by the ingrowing heels and quarters, ringbones, ossified cartilages, sprains of the flexor tendons, and diseases of the fetlock, pastern, and coffin joints are common, and irreparable results. The feet exposed to this should be frequently pared and adjusted. Remove excess of toe, reduce and balance the inner and outer sides of the wall, file or cut to the level the incurving heels and quarters, and round off the sharp outer edge of the hoof. Dry, imprisoned plates of horn pressing up on the sole must be set free and removed. But do not file the surface of the hoof-wall. This removes nature's protective covering and exposes open horn tubes to exhale moisture, and conduces to dryness, brittleness, shrinking, compression, and inflammation of the sensitive parts, atrophy, and lameness.

Defective Growth of Hoof.—Imperfect growth of hoof may arise from shoeing, pinching, filing, paring, etc., to excess, but also from compulsory idleness. The circulation inside the hoof is greatly accelerated by the ascent and descent of the foot within the horny box in action, and a free blood supply in a healthy tissue favors growth. Life at pasture on firm ground tends to abundant, strong, tough, durable hoof, while close confinement in a stall makes for a thin, friable, brittle, and shrunken horny covering. Constant soaking in water softens the hoof, reducing its tenacity, and tending to flattening of both wall and sole. The Belgian and other horses bred on wet, swampy ground generally show large, flat, pliant, and most undesirable hoofs. Such feet are especially liable to thrush, canker, corns, bruises, grease, and laminitis. Feet habitually resting on piles of reeking manure in stalls, sheds, or yards suffer the additional injury of softening and disintegration from the ammonia gas, and attacks by the swarming putrefying microbes which abound in such material.

Good hoofs, beside use and care, depend on generous living. The fuller growth on the spring and summer grass, forming a permanent ring, illustrates this. Daily washing of the hoof is important, and a subsequent smearing with an ointment of tar and vaseline or oil is useful in preserving the natural moisture and preventing the attacks of microbes.

Shoeing.—For good feet, shoes may be dispensed with on soft ground or mud roads, but they become necessary on hard roads and for hard-worked animals. Tips, extending back to the broadest part of the foot only, are the least objectionable. Full sized shoes are too often made to pinch, distort, bruise, or injure the foot beyond repair; and a poor foot is as injurious to a horse as an unstable foundation to a building. The first consideration is the preparation of the foot, giving due balance to heel and toe, inner side and outer, sole and wall, heel and bars. While removing all overgrown wall and bars, and all sole-plates that have become detached from the tough living horn beneath and now act as foreign bodies, the tough horn itself should not be exposed, nor removed except as a thin margin around the outer edge, where it is smoothed to the same level as the wall, to which it acts as a support, and the bearing surface of which for the shoe it slightly extends. The outer surface of the wall must be spared abrasion by the file, with consequent drying and contracting as already noticed. Shoes should be removed and reset every four weeks at the utmost, to avoid pinching, setting in, bruising, and other injuries. Intelligent shoeing, conserving the feet, goes far to obviate diseases of the feet, the most common and harmful of equine diseases. Among these may be specially named corns, bruises, pricks, quittors, sandcracks, thrush, canker, sidebones, laminitis, navicular disease, contracted hoof, cleft hoof, wry hoof, crooked hoof, loose wall, hollow wall and graveling. As the integrity and easy normal function of the foot is further one of the best means of protection against distortions and diseases of the various joints of the limb, it follows that the preservation of sound feet by good shoeing and intelligent care is one of the greatest desiderata in horse management.

FEEDING AND DIGESTIVE DISORDERS.

The natural food of the horse is *grass* and though charged with excess of water, and at first liable to scour, and always to cause flaccid muscles and lack of energy and endurance, yet a run at pasture, with pure air, normal, easy exercise, and stimulation of stomach, liver, bowels, metabolism, and excretion will often improve or arrest infirmities of digestion, assimilation, elimination and even innervation. Heaves (broken wind), chronic bronchitis, various forms of nasal discharges, indigestion, torpid liver, gall stones, and kidney affections are examples of maladies which improve at pasture. Dried grass in the form of hay is the standard food of the domesticated horse. This is best from natural pastures with a mixture of grasses, to be followed by blue grass, timothy, ryegrass, and clover, the latter being the most dangerous as a horse fed. Upland hay is more aromatic and choice than that from low, damp or irrigated meadows, and the first crop is always the best. New hay will sometimes disagree, while the old, though lacking aroma and less palatable, is less likely to cause digestive disorder. At a year old and over it is brittle, dried, more fibrous and less nutritive. Badly cured hay is always innutritious, and often directly poisonous, when altered by bacterial ferments, molds and their products. The results are shown in heaves, gastric disorders, liver troubles, brain affections (staggers), kidney and skin diseases. Second crop hay, clover and alfalfa hay are especially dangerous in this sense, the excess of proteids in the last two, and especially of foliage, delaying curing and favoring the multiplication of ferments. Oats are the standard grain feed for horses. But like hay they must be well matured on good soil, and well cured. Mustiness brings essentially the same evils as in hay, and newly harvested they are liable to disagree. Kiln-dried oats are to be avoided, also those that have sprouted. The composition of oats and hay shows the excess of proteids, carbohydrates and fats in the first, with and a given weight of oats is of more value than an equal amount of similar nutritive elements in wheat or barley.

Good judgment and regularity in feeding and watering are essential to success with any feed. Feeding in irregular amounts at varying intervals, and with uncertain watering will undo the good effects of a generous ration. The small stomach (16 quarts) cannot admit a large feed of oats and saliva without suffering, and, if overdistended, it becomes paretic or torpid, and dangerous fermentation and gaseous distension may ensue. Again, if feeding is delayed the hungry craving and nervous excitement cannot be undone by a generous feed later. Then again, if the perspiring and exhausted animal is allowed to slake his thirst with a bucket of ice-cold water, he may have heart failure, or

	Water	Proteids	Carbohydrates	Fats	Cellulose	Salts
Meadow hay	14.59	10.11	40.90	2.34	25.52	6.54
Oats	14.3	12.0	60.9	6.0	10.3	3.0
Maize	10.6	10.3	70.4	5.0	2.2	1.5

Maize is notorious for the deficiency of proteids relatively to the carbohydrates and fat. With a great excess of heat and energy producing constituents and a deficiency of earthy salts it is less calculated to foster growth and development, and predisposes rather to fat. It tends more to impactions of the bowels and indigestion, with resulting skin eruptions, and above all to the destructive recurrent inflammation of the eyes, which ruins so many young horses. Yet it is fed over large areas as the exclusive grain feed, and such is the adaptability of the living system that the minimum evil results. To obviate the evils it can be fed with cooling, laxative agents as wheat bran, carrots, or turnips, or an ounce of Glauber salts may be given daily.

Barley, rye and wheat have been successfully fed to horses but are not equal to oats in supporting the animal and fitting for hard work.

Beans, peas and other leguminous seeds are fed when a horse is subjected to an extraordinary strain of work or endurance, being especially valuable for the excess of proteids they contain. They should be thoroughly matured and dried as the fully formed and partially ripened seeds of several species contain a narcotic poison.

The relative amount of hay and oats for a horse of 1,000 pounds live weight may be stated as follows: *Cavalry horse:* Oats 12 pounds, hay 14 pounds. *Carriage horse:* Oats 10 pounds, hay 12 pounds. *Draft horse:* Oats 15 pounds, hay 12 pounds. The horse at rest can live on a mere maintenance ration sufficient to keep up bodily temperature and repair waste. A horse in active work will need about one half more. For very severe or rapid work about one third more must be added. For hard work a broad ration-proteids 1, to carbonaceous matter 6, is preferable to a narrow ration-proteids 1, to carbonaceous matter 3. An economical feed can often be made of a number of agents compounded from their known chemical composition, to form such a balanced ration, but mere chemical ingredients are not final, as palatability and adaptability have still to be reckoned colic, or gastric congestion with sympathetic skin eruption or laminitis, or inflammation may attack any organ that has been previously weakened.

An excellent appetizing food is molasses. This has been largely neglected because of the mistaken idea that it contained heat producing elements only. But corn carbohydrates furnish energy to the acting muscles and other tissues as fuel does to an engine, and sugar, having no need of digestion, can supply force with less loss than can starch or fat. Not the least of its good qualities is the relish with which it is taken and that it imparts to other less attractive food taken with it. For the horse otherwise healthy, but debilitated by poor or faulty feeding or overwork, molasses is to be depended on to restore weight and energy alike. For this purpose it may be given in the amount of two pounds per day, and even in double that amount if subjected to severe work.

Overdistension of the Stomach.—Sudden inflation of the stomach with gas, the product of fermentation in unwholesome contents (frosted grass, roots, apples, green potatoes, overripe ryegrass, millet, vetch, etc., irritant plants); from overfeeding (at the cornbin, in ripe grain, etc.), from violent exertion on a full stomach, or from a full feed when debilitated from starvation, disease, or overwork, is liable to cause death in two hours or a little more. The horse can rarely vomit, or belch gas, the stomach does not absorb, and the outlet by the bowels is one hundred feet long, so that the organ is usually ruptured with fatal results. Among the other less rapid disorders are catarrhal inflammation of the stomach, intestinal colic, congestion, inflammation, impaction, twisting, invagination, calculi and worms. Of poisons may be named: lead through water, etc.; molds, fungi, and bacteria in food (causing gastric, intestinal, hepatic, pulmonary, nervous, cutaneous or kidney diseases); ergot, smut (causing gastric disorder, ulcers of the mouth, abortions, etc.); lupines, Senecio Jacobœa (causing cirrhosis of liver); astragalus, oxytropis (loco, brain disease), equisetum (gastric and intestinal catarrh); to which may be added cicuta, conium, œnanthe, aconite, rhus, ranunculus, larkspur, anemone, digitalis, wild cherry, wild onion, camas, helenium, hyacinth, clematis, thorn apple, colchicum, belladonna, hyoscyamus, bitter sweet, euphorbium, hellebore, wild parsnip, laurel, oleander, etc.

Liver Diseases.—These are notoriously prevalent in hot, damp regions in horses kept in close stables on rich, abundant feeding, in such as have dry feeding and scarcity of water in winter, and in such as have a poorly balanced ration with excess either of proteids or of heating carbohydrates. In damp tropical regions special care is needed as to the site, exposure, ventilation and purity of stables, the dietary, exercise and grooming to obviate liver complaints. Transient fevers, nervous digestion, skin and kidney disorders often originate from troubles in the liver.

Grooming is most important in the finer breeds of horses in clearing off oil and dandruff, rendering the skin pliant, and favoring secretion, exhalation, cooling and elimination. On the contrary, animals at pasture and exposed to cold and wet find a measure of protection in the sebaceous and thick hairy covering. When, however, drenched with perspiration or rain, and in a warm air, the relaxing effect on the skin and general system is very debilitating, hence clipping may become a necessity to be followed by special precautions against cold. The active friction (massage) of grooming renders circulation active, especially that of the lymph, relieving fatigue, favoring elimination and improving the tone of the muscles and general system. The heels need particular care. Clipped heels are irritated by the stubby hair in the folds back of the pastern often precipitating chaps and grease which would have been escaped in the unclipped. The heel is normally protected by the abundance of sebaceous secretion, but when this is rubbed off by dust, clay, sand, etc., the part suffers readily from cold, wet, dried gritty mud or other irritants. Washing the heels, above all with caustic soap, and leaving them to dry in cold air or draft is hurtful. Prompt drying of the heels will obviate the danger, and, if there is already any swelling, gentle massage with a little vaseline will improve the condition. In obstinate cases the source of the trouble may be sought in disorder of digestion, liver or kidney.

Many disorders of the nervous system, lungs, skin, eye and kidneys are due to constitutional troubles which cannot be dealt with here in general terms. Such diseases are usually manifested by elevated body temperature and accelerated or modified breathing or pulse. The temperature of the healthy, mature horse, at rest in a cool or moderate environment, is 99° to 100° F., respirations 10 to 12 per minute, and pulse 35 to 45.

Contagious Diseases.—These agree in one fundamental feature that each is due to a microbe, which passes more or less directly from the affected animal to the sound one, thus propagating the disease. The arrest of the epizootic and even its complete and final extinction, is merely a question of preventing such transmission and of destroying every infecting germ. This truth is not yet duly appreciated by stockowners, legislators nor sanitary officers, but when it is fully realized we shall be near the total extinction of most animal plagues to the unspeakable profit of humanity. The *Contagious diseases* may be divided into two classes: (1) Those in which the infection is either confined to solipeds, or mainly propagated by the equidæ, so that its extinction in these would mean the final extinction of the disease, and (2) those which are propagated in other genera as well, so that the extinction of the germ in other species also would be essential to its complete eradication.

To the first class belong strangles (distemper), contagious pneumonia, equine influenza, glanders, tetanus, vesicular exanthema, contagious acne, petechial fever, gastro-enteritis of the new born, South African horse sickness, dourine, surra, Nagana, Mal de Caderas, infectious paraplegia. The first four of these affections are constantly spread in the United States through sales, public stables, stockyards, railroad cars, ships, and sale-stables, and no radical measure is taken to destroy the germs in such infected places, or to prevent the infection of all solipedes that pass through them.

In the second class must be included: Horse-pox, contagious abortion, thrush of the mouth, infectious ophthalmia, tuberculosis, rabies, malignant œdema, anthrax and emphysematous anthrax. The first six of these are propagated more by other genera than the horse, so that the burden of the work for their extinction would have to be expended on these other classes. The last three are caused by germs which can live out of the animal body in the soil, and their extinction would involve the drainage and sanitation of the infected soils as well.

Parasitic Diseases.—A number of parasites that prey upon solipeds can live indiscriminately in other animals as well. Among these may be named the *Tricophyton* of ringworm; *Aspergillus* of pneumomycosis; *Actinomyces:* different species of wood ticks; *Dermanyssus* of poultry acariasis; *Trombidium Americanum* (and *F. Holosericium*): *Linguatula Denticulata; Eustrongylus Gigas; Filaria Medinensis; Distoma Hepaticum* and *D. Lanceolatum*. By reason of their variety of hosts these would be less easily got rid of. But another list includes the obligato parasites which must live in the soliped at some stage or perish. These accordingly can be extinguished on the same principle as can the microbes of exclusively equine plagues. They include the larvæ of four species of botfly (*Œstrus Equi, Œ. Hæmorrhoidalio, Œ. Pecorum* and *Œ. Nasalis*); three lice (*Hæmatopinus Macrocephalus, Trichodectes Pilosus,* and *Tr. Pubescens*); four mange acari (*Sarcoptes Scabei V. Equi, Psoroptes Communis V. Equi, Symbiotes Communis V. Equi,* and *Demodex Folliculorum V. Equi;* three tapeworms (*Tæmia Perfoliata, T. Mamillana,* and *T. Plicata*); two stomach worms (*Spiroptera Microstoma* and *Sp. Megastoma*); five intestinal worms (*Ascaris Megalocephala, Oxquris Curvala* and *O. Mastigodes, Sclerostoma Equinum* and *Sc. Tetracanthum*): one of the serous cavities (*Filaria Papellosa*); one of the lungs (*Strongylus Arnfieldi*); and four of the blood (*Filaria Hæmorrhagica, F. Irritans, F. Sanguinis Equi,* and *F. Reticulata*). For the obligato parasites their extinction on the victim, and his removal from the source of a fresh supply means a final extinction of the parasite, as the worm cannot be perpetuated without its host. In the case of worms, which survive as eggs and embryos in damp earth and water, the exclusion of solipeds for a year or two from infested stables and fields, from waters (ponds, lakes, wells, streams) that receive drainage from infested places, and from food derived from such verminous localities, entails the inevitable destruction of these parasites in such habitat outside the body. An essential condition of complete success is that the infested animals must be themselves cleared of the worms, to prevent their colonizing new places with the parasite, and, in the case of such as are entertained in the blood, or serous cavities or in cysts in the tissues, this takes time to allow of their migrating into the bowels or reaching their limit of life and perishing. The mere use of anthelmintics or vermifuges alone is no radical treatment for these parasites. A veterinary sanitation which is far reaching enough to do away for all time with the class of contagious and parasitic epizootics, is the only one worthy of twentieth century knowledge, or which will fulfill the duties of the age.

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Horse, Evolution of the. As a domestic animal the horse is to be found almost everywhere that man can live. He is spread all over the world — from torrid to arctic climates, in all the continents, in remote oceanic islands — he is completely cosmopolitan. But as a wild animal the horse is limited to the Old World, and is found there only in the open arid or desert plains of Central Asia and Africa. There are two species in Asia, the Asiatic wild ass (*Equus hemionus*), and the little known Przewalsky's horse (*E. przewalskii*), while in Africa there are the African wild ass (*E. asinus*) and the several species of zebra (*E. zebra, E. burchelli, E. quagga*). In the Americas and Australia there are no true wild horses, the mustangs and broncos of the Western plains and South America being feral (domesticated animals run wild) and descended from the horses brought over from Europe by the early white settlers. When the Spaniards first explored the New World they found no horses on either continent. The Indians were quite unfamiliar with them and at first regarded the strange animal which the newcomers rode with wonder and terror, like that of the ancient Romans when Pyrrhus and his Greeks brought elephants to fight against them.

The horse is distinguished from all other animals now living by the fact that he has but one toe on each foot. Comparison with other animals shows that thi. toe is the third or middle digit of the foot. The hoof corresponds to the nail of a man or the claw of a dog or cat, and is broadened out to afford a firm, strong support on which the whole weight of the animal rests. Behind the "cannon-bone" of the foot are two slender little bones, one on each side, called *splint-bones.* These represent the second and fourth digits of other animals, but they do not show on the surface, and there is nothing like a separate toe. So that the horse may be said to be an animal that walks on its middle finger-nail, all the other fingers having disappeared.

The teeth of the horse are almost equally peculiar. The molars are long, square prisms which grow up from the gums as fast as they wear off on the crowns. Their grinding surface exhibits a peculiar and complicated pattern of edges of hard enamel between which are softer spaces composed of dentine and of a material called "cement," much like the dentine in quality but formed in a different way. The dentine is formed on the inside surfaces of the enamel while the tooth is still within the jaw-bone; the cement is deposited on the outside surfaces of the enamel after the tooth has broken through the jaw-bone and before it appears above the gums.

Various other peculiarities distinguish the horse from most other animals; some of these are shared by other hoofed animals. The two long bones of the fore-arm (*radius* and *ulna*) are separate in the greater number of animals, but in the horse, and in many other hoofed animals, they are consolidated into a single bone. The same consolidation is seen in the bones of the lower leg (*tibia* and *fibula*). The lengthening of the foot and stepping on the end of the toe raises the heel in the horse, as in many other animals, to a considerable height above the ground, where it forms the hock joint, bending backward, as the knee bends forward. In these as in various other ways the legs of the horse are especially fitted for swift running over hard and level ground, just as its teeth are for grinding the wiry grasses which grow on the open plain.

The zebra and the ass have the same peculiar structure of teeth and feet as the domestic horse, and differ only in the color of the skin, proportions of various parts of the body, etc.

Fossil Horses of the Age of Man.— In the early part of the Age of Man, or Quaternary Period, wild species of horse were to be found on every continent except Australia. Remains of these true native horses have been found buried in strata of this age in all parts of the Unfted States, in Alaska, in Mexico, in Ecuador, Brazil and Argentina, as well as in Europe, Asia and Africa. All these horses were much like the living species, and most of them are included in the genus *Equus.* A complete skeleton of one of them (*Equus scotti*) was found by the American Museum expedition of 1899 in northern Texas. The difference between it and the domestic horse is chiefly in proportions, the skull shorter with deeper jaws, the legs rather short and feet small in proportion to the body. In these characters this fossil horse resembles an overgrown zebra rather than a domestic horse. We know nothing of its coloring. It may have been striped, and in this case would have been very zebra-like; but there are some reasons for believing that it was not prominently striped. The bones are petrified, brittle and heavy, the animal matter of the bone having entirely disappeared and having been partly replaced by mineral matter. They are not much changed in color, however, and are so perfectly preserved that they look almost like recent bone.

All the remains of these native horses which have been found in America have been petrified more or less completely; this means that they have been buried for many thousands of years, for petrifaction is an exceedingly slow process.

It serves as an easy method of distinguishing them from bones of the domestic horse, found buried in the earth. These cannot in any case have been buried for more than four or five centuries, and have not had time to petrify. Remains of these fossil horses are found in various parts of the United States, chiefly on the Niobrara River in Nebraska, and in central Oregon. Many separate teeth and bones have been found in the phosphate mines near Charleston, S. C.; other specimens have come from central Florida, from southern Texas, Arizona, Kansas, Louisiana and even from Alaska. They are, in fact, so often found in deposits of rivers and lakes of the latest geological epoch (the Pleistocene) that the formation in the western United States has received the name of Equus Beds.

In South America, in strata of the Pleistocene Epoch, there occurs, besides several extinct species of the genus *Equus*, the *Hippidium*, a peculiar kind of horse characterized by very short legs and feet, and some peculiarities about the muzzle and the grinding teetch. The legs were hardly as long as those of a cow, while the head was as large as that of a racehorse or other small breed of the domestic horse. All these horses became extinct, both in North and South America. It may have been that they were unable to stand the cold of the winters, probably longer continued and much more severe during the Ice Age than now. It is very probable that man — the early tribes of prehistoric hunters — played a large part in extinguishing the race. The competition with the bison and the antelope, which had recently migrated to America — may have made it more difficult than formerly for the American horse to get a living. Or, finally, some unknown disease or prolonged season of drought may have exterminated the race.

In Central Asia, two wild races persist to the present day; others were domesticated by man in the earliest times, and their use in Chaldæa and Egypt for draught and riding is depicted in the ancient mural paintings. In Africa the larger species became extinct in prehistoric times, as in America, but the smaller zebras still survive in the southern part of the continent (one species, the quagga, abundant 50 years ago, is now probably extinct), and the African wild ass is found in the fauna of the northern part. The wild horse of prehistoric Europe, a small race, short-legged and shaggy-haired, was domesticated by man, a fact that is known from the rude drawings scratched on bone or ivory by men of the Neolithic or Polished Stone Age. But the domestic horse now in use is derived chiefly from the Asiatic race, although it is probable that in some breeds there is a considerable strain of this shaggy, short-legged European race, and it is possible also that African races may have been domesticated and to some extent mixed with the Asiatic species. The domesticated ass is a descendant of the African species.

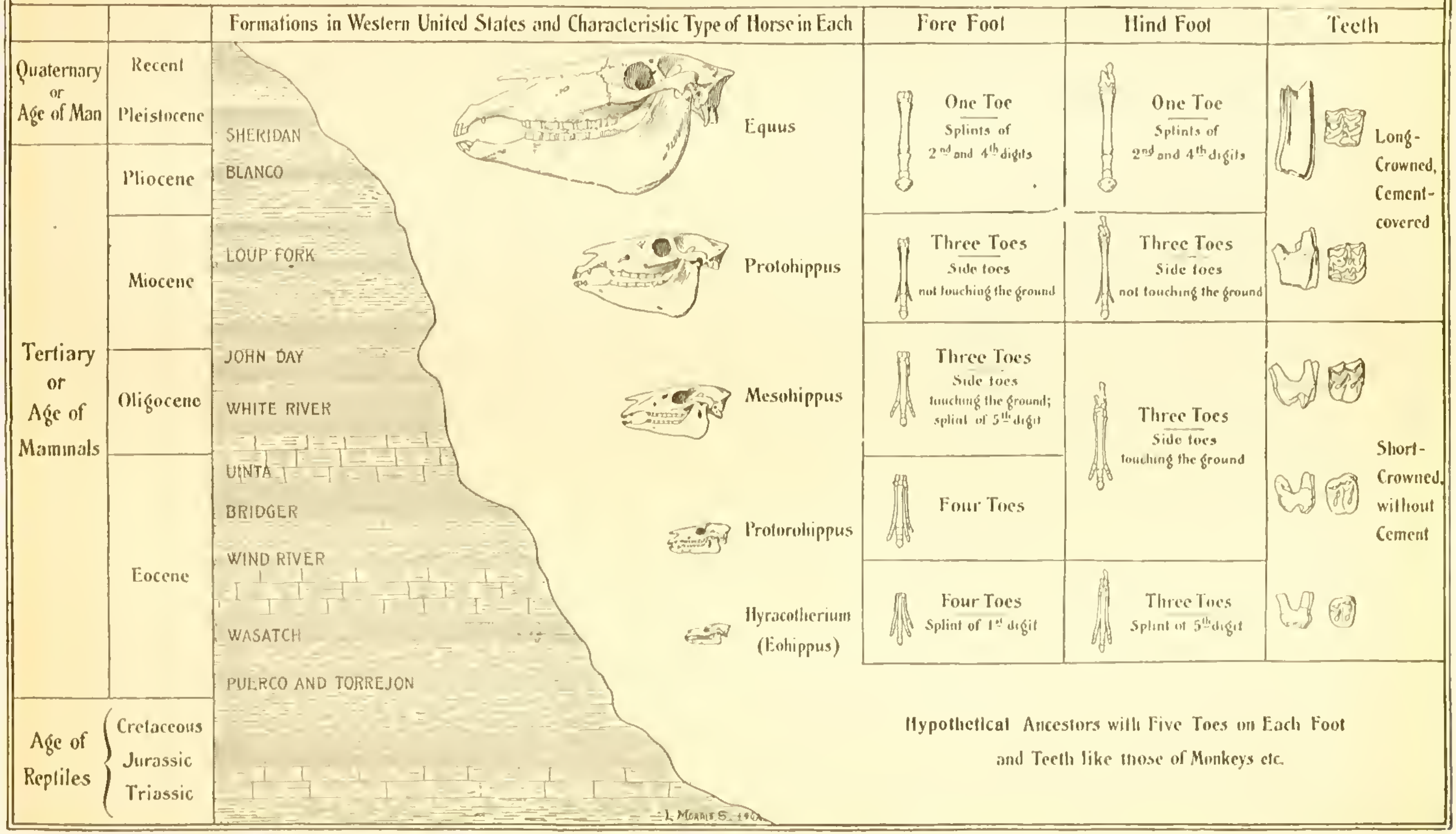
The Evolution of the Horse.— The history of the evolution of the horse through the Tertiary Period or Age of Mammals affords the best known illustration in existence of the doctrine of evolution by means of natural selection and the adaptation of a race of animals to its environment. The ancestry of this family has been traced back to nearly the beginning of the Tertiary without a single important break. During this long period of time, estimated at nearly 3,000,000 of years, these animals passed through important changes in all parts of the body, but especially in the teeth and feet, adapting them more and more perfectly to their particular environment, namely the open plains of a great plateau region with their scanty stunted herbage, which is the natural habitat of the horse. In the series of ancestors of the horse we can trace every step in the evolution of those marked peculiarities of teeth and feet which distinguish the modern horse from an ancestor which so little suggests a horse that, when its remains were first found 40 years ago, the animal was named by the great palæontologist Richard Owen, the *Hyracotherium* or "Coney-like Beast." Its relation to the horse was not at that time suspected by Prof. Owen, and was recognized by scientific men only when several of the intermediate stages between it and its modern descendant had been discovered. On the other hand, this first ancestor of the horse line is very difficult to distinguish from the contemporary ancestors of tapirs and rhinoceroses, and indicates how all the modern quadrupeds have diverged from a single type, each becoming adapted to the needs of its especial mode of life.

The earliest known ancestors of the horse were small animals not larger than the domestic cat, with four complete toes on each forefoot and three on each hindfoot. There is reason to believe that the still more ancient ancestors of this and all other mammals had five toes on each foot. In the forefoot of the earliest known stage we find a splint-bone or small, slender rudiment representing the missing first digit or thumb, which no longer appears on the surface of the foot, while in the hindfoot there is a similar rudiment representing the outer or fifth digit, but no trace is left of the innermost or first digit. The proportions of the skull, the short neck and arched back and the limbs of moderate length, were very little horse-like; recalling, on the contrary, some modern carnivorous animals, especially the civets (*Viverridæ*). The teeth were short-crowned and covered with low rounded knobs of enamel, suggesting those of monkeys and of pigs or other omnivorous animals, but not at all like the long-crowned complicated grinders of the horse.

Commencing with the *Hyracotherium*, 12 stages have been recognized from as many successive formations, showing the gradual evolution of the race into its modern form, and each stage is characteristic of its particular geological horizon. Some of the stages have been found in several parts of the world, but by far the most complete and best known series comes from the Tertiary Bad Lands of the Western States. Besides the main line of descent which led into the modern horses, asses and zebras, there were several collateral branches which have left no descendants. Of some stages all parts of the skeleton have been found, of others, only the jaws, or jaws and feet, are known. We can mention only the more important stages.

1. The *Hyracotherium* is the most primitive stage known, but only the skull has been found, so that it has not been determined exactly what the feet were like. The teeth display six rounded knobs or cusps on the upper molars and four on the lower ones, and these are just be-

THE EVOLUTION OF THE HORSE.



ginning to show signs of fusing into cross-crests. The premolar teeth have only one main cusp, except the third and fourth premolars (next the molars) in each jaw, which have two and three, respectively. The only specimens which have been found were in the London Clay or Lower Eocene of England and are preserved in the British Museum.

2. The *Eohippus* is much better known. It comes from the Lower Eocene of Wyoming and New Mexico, and is very like the *Hyrocotherium* except that the molar teeth have the cusps more clearly fusing into cross-crests, and the last premolar is beginning to look like one of the true molars. The forefoot of this animal has four complete toes and the splint of a fifth. The hindfoot has three complete toes and the splint of another.

3. *Protorohippus.* In these animals the splint of the first digit in the forefoot and the splint of the fifth digit of the hindfoot have disappeared, but there are still four complete toes in the fore- and three in the hindfoot. The crests on the molars are a little clearer and the last premolar has become almost like the molars, while the next to the last premolar is beginning to become so. A skeleton of *Protorohippus* shows an animal of the size of a small dog, and proportioned much like the breed known as the *whippet.* The *Protorohippus* was found by Dr. J. L. Wortman in 1880 in the Wind River Bad Lands of Wyoming, and was described by Prof. Cope and others under the name of the "Four-Toed Horse."

4. Of *Orohippus* we have only parts of jaws and teeth. A specimen of the forefoot is exhibited in the Museum of Yale University.

5. *Epihippus* (*Upper Eocene*).—Of this stage of the evolution of the horse only incomplete specimens have been found. The molar teeth have the once round cusps almost completely converted into crescents and crests, while another tooth of the premolar series has become like the molars. The toes are still four in the forefoot and three in the hindfoot, but the central toe in each foot is becoming much larger than the side toes. (This species happens to be somewhat smaller than those found in the Middle Eocene stage, but no doubt there were others of larger size living at the same time). *Palæotherium* and *Paloplotherium* of the Upper Eocene of Europe form a side branch. They were very abundant in Europe, but have not been found in the New World. On each foot they had three toes of nearly equal size, and the teeth show a rather peculiar pattern. One of these animals was thought by Prof. Huxley to be a direct ancestor of the horse, but it now is considered to be merely a collateral relative. Some species of *Palæotherium* were of large size, equal to a tapir. They were first described in the year 1804 by the celebrated Baron Cuvier from remains found in the gypsum quarries of Montmartre, Paris.

6. *Mesohippus. Oligocene* (*White River Formation*). In this stage there are three toes on each foot, a splint representing the fifth digit of the forefoot of the Eocene ancestors. The middle toe is now much larger than the side toes, which bear very little of the weight of the animal. Three of the premolars have now become entirely like the molar teeth, the crests on the crown are completely formed, and the outside crest in the upper molars has taken the shape of two crescents. In the Middle Oligocene is found *Mesohippus bairdi* about the size of a coyote, while in the Upper Oligocene occurs *Mesohippus intermedius* as large as a sheep. Of both these animals all parts of the skeleton are known.

7. *Anchitherium* (*Lower Miocene*).—This stage has been found both in Europe and in America. It is much like its predecessor, but is larger and has the crests of the teeth somewhat higher and more complete. It probably is not in the direct line of descent of the horses, but is on a side branch.

8. *Parahippus* and *Hypohippus* (*Middle Miocene*).—In *Parahippus* the tooth-crests are much higher, and the transverse ridges on the upper molars are beginning to change shape so as to become a second pair of crescents inside the outer pair. *Hypohippus* is off the direct line of descent; its teeth are like those of *Anchitherium,* by which name it has been generally called, but the animal was much larger, equaling a Shetland pony in size. A complete skeleton of the *Hypohippus* was found near Pawnee Buttes, Colorado, in 1901 by Barnum Brown, of the Whitney expedition. In the forefoot of *Hypohippus* small rudiments still remain representing the first and fifth digits, but there is no splint of the fifth, as in *Mesohippus.* The second and fourth digits still touch the ground, though lightly. The feet of *Parahippus* were much like those of *Hypohippus*, but the side toes were smaller.

9 and 10. *Protohippus* and *Pliohippus* (*Middle* and *Upper Miocene*).— In this stage the crowns of the upper molars have become much longer, the two pairs of crescents on the upper molars are complete, with two half-separated cusps within the inner pair. And the valleys between the crests have become filled with cement, so that with the wear of the teeth the edges of hard enamel are backed inside by dentine and outside by cement. In this way the surface of the tooth has a series of enamel ridges always projecting a little above the grinding surface, because the softer material on each side wears down into hollows, yet never breaking off, because they are braced so thoroughly on each side. This is a very efficient instrument for grinding hard grasses. In *Protohippus* and *Pliohippus*, especially in the former, the crowns of the teeth are by no means as long as in the modern horses; they must therefore wear more slowly or wear out at an earlier age. The feet in these two genera have but one toe touching the ground. The side toes (second and fourth digits) are complete, but much more slender than in the earlier stages, and are apparently useless, as they cannot reach the ground. In some species of *Pliohippus* they have almost disappeared. The forefoot of *Protohippus* still retains tiny nodules of bone at the back of the "wrist" (sometimes improperly called in the horse the "knee-joint"), which are the remains of the first and fifth digits.

11. *Hipparion* (*Pliocene*).—This genus, probably also a side branch of the genealogical tree of the horse family, is much like *Protohippus*, but larger and with more complication about the tooth pattern. It is common in the

European Pliocene beds and has been found in America also. The feet are still three-toed, the side toes as large as those of the older *Protohippus.*

12. *Equus* (*Pleistocene* and *Recent*).— In this stage, that of the modern horse, the side toes have entirely disappeared and are represented by splints on the fore- and hindfoot. No trace remains on the forefoot of the little nodules which in *Protohippus* represented the first and fifth digits. The crowns of the teeth are much longer than in the last stage, and of the two half-separated inner columns on the upper molars, one has disappeared, the other has increased in size and changed in form. The skull has lengthened and the animal is much larger.

13. *Hippidium* (*Pleistocene, South America*).— The feet are like those of *Equus*, except that they were short and stout. The teeth are like those of *Pliohippus*, from which it is supposed to be descended. The skull is large and long, with very long slender nasal bones. Casts of the skull and limbs presented by the Museo Nacional of Buenos Ayres, Argentine Republic, are exhibited here.

The Change in Feet and Teeth.— Along with the disappearance of the side toes in the evolution of the horse there is a considerable increase in the proportionate length of the limbs, and especially of the lower part of the leg and foot. The surfaces of the joints, at first more or less of the ball-and-socket kind, which allows free motion of the limbs in all directions, become keeled and grooved like a pulley-wheel, permitting free motion forward and backward, but limiting the motion in all other directions and increasing considerably the strength of the joint. By this means the foot is made more efficient for locomotion over a smooth regular surface, but less so for traveling over very rough ground, and it becomes of little use for striking or grasping or the varied purposes for which the feet of polydactyl animals are used.

The increased length in the lower leg and foot increases the length of the stride without decreasing its quickness. The heavy muscles of the leg are chiefly in the upper part, and to increase the length of the lower part changes the centre of gravity of the limb very little. Consequently the leg swings to and fro from the socket nearly as fast as before, since in an ordinary step the action of the leg is like that of a pendulum, and the speed of the swing is regulated by the distance of the centre of gravity from the point of attachment, as that of a pendulum is by the height of the bob. To increase the length of lower leg and foot therefore gives the animal greater speed; but it puts an increased strain on the ankles and toe-joints, and these must be strengthened correspondingly by converting them from ball-and-socket joints to "ginglymoid" or pulley joints. Additional strength, likewise at the expense of flexibility, is obtained by the consolidation of the two bones of the fore-arm (*ulna* and *radius*) and of the leg (*tibia* and *fibula*) into one, the shaft of the smaller bone practically disappearing, while its ends become fused solidly to its larger neighbor.

The increase in length of limb renders it necessary for the grazing animal that the head and neck should increase in length in order to enable the mouth to reach the ground. An example of these changes is the modern horse, in which we find the neck and head much elongated when compared with the little *Hyracotherium*, and this elongation has taken place *pari passu* with the elongation of the legs. The reduction and disappearance of the side toes and the concentration of the step on the single central toe serve likewise to increase the speed over smooth ground. The soft yielding surface of the polydactyl foot is able to accommodate itself to a rough irregular surface, but on smooth ground the yielding step entails a certain loss of speed. A somewhat similar case is seen in the pneumatic tire of a bicycle; a "soft" tire accommodates itself to a rough road and makes easier riding, but a "hard" tire is faster, especially on a smooth road. Similarly, the hard, firm step from the single toe allows of more speed over a smooth surface, although it compels the animal to pick its way slowly and with care on rough, irregular ground.

The change in the character of the teeth from "brachydont" or short-crowned to "hypsodont" or long-crowned enables the animal to subsist on the hard, comparatively innutritious grasses of the dry plains, which require much more thorough mastication before they can be of any use as food than do the softer green foods of the swamps and forests.

All these changes in the evolution of the horse are adaptations to a life in a region of the level, smooth and open grassy plains which are now its natural habitat. At first the race was better fitted for a forest life, but it has become more and more completely adapted to live and compete with its enemies or rivals under the conditions which prevail in the high dry plains of the interior of the great continents. The great increase in size, which has occurred in almost all races of animals whose evolution we can trace, is dependent on abundance of food. A large animal, as may be shown on ordinary principles of mechanics, requires more food in proportion to its size than does a small one, in order to keep up a proper amount of activity. On the other hand a large animal is better able than a small one to defend itself against its enemies and rivals. Consequently, as long as food is abundant, the larger animals have the advantage over their smaller brethren, and by the laws of natural selection the race tends to become continually larger until a limit is reached when sufficient food becomes difficult to obtain, the animal being compelled to devote nearly all its time to getting enough to eat.

Cause of the Evolution.— The evolution of the horse, adapting it to live on the dry plains, probably went hand in hand with the evolution of the plains themselves. At the commencement of the Age of Mammals the western part of the North American continent was by no means as high above sea-level as now. Great parts of it had but recently emerged, and the Gulf of Mexico still stretched far up the valley of the Mississippi. The climate at that time was probably very moist, warm and tropical, as is shown by the tropical forest trees, found fossil even as far as Greenland. Such a climate, with the low elevation of the land, would favor the growth of dense forests all over the country, and to such conditions of life the animals of the beginning of the Mammalian period must have been adapted. During the Tertiary the continent was steadily rising above the ocean-level, and at the

HYPOHIPPUS.

Courtesy of the Philadelphia Commercial Museum.

SKELETON FROM MIDDLE MIOCENE BEDS, NEAR PAWNEE BUTTE, COLORADO.

same time other influences were at work to make the climate continually colder and drier. The coming on of a cold, dry climate restricted and thinned the forests and caused the appearance and extension of open, grassy plains. The ancient forest inhabitants were forced either to retreat and disappear with the forests, or to adapt themselves to the new conditions of life. The ancestors of the horse, following the latter course, changed with the changing conditions, and the race became finally as we see it to-day, one of the most highly specialized of animals in its adaptation to its peculiar environment. At the end of the Age of Mammals the continents stood at a higher elevation than at present, and there was a broad land connection between Asia and North America, as well as those now existing. At this time the horse became cosmopolitan, and inhabited the plains of all the great continents, excepting Australia.

It is a question whether the direct ancestry of the modern horse is to be searched for in western America or in the little known interior plains of eastern Asia. It is also unknown why the various species which inhabited North and South America and Europe during the early part of the Age of Man should have become extinct, while those of Asia (horse and wild ass) and of Africa (wild ass and zebra) still survive. Man, since his appearance, has played an important part in the extermination of the larger animals; but there is nothing to show how far he is responsible for the disappearance of the native American species of horse.

Parallel Evolution in Other Races.—It is interesting to observe that while the evolution of the horse was progressing during the Tertiary Period in North America another group of hoofed animals, the *Litopterna*, now extinct, in South America evolved a race adapted to the broad plains of Argentina and Patagonia and singularly like the horse in many ways. These animals likewise lost the lateral toes one after another, and concentrated the step on the central toe; they also changed the form of the joint-surfaces from ball-and-socket to pulley-wheel joints; they also lengthened the limbs and the neck; and they also lengthened the teeth, and complicated their pattern. Unlike the true horse, they did not form cement on the tooth, so that it was by no means so efficient a grinder. This group of animals native to South America became totally extinct, and were succeeded by the horses, immigrants from North America, which in their turn became extinct before the appearance of civilized man.

Many of the contemporaries of the horse in the northern hemisphere were likewise lengthening the limbs, lightening and strengthening the feet, elongating the tooth-crowns to adapt themselves to the changing conditions around them, but none paralleled the horse evolution quite so closely as did the pseudo-horses of South America. But the camels in America, the deer, antelope, sheep and cattle in the Old World, progressed on much the same lines of evolution, although their adaptation was not to just the same conditions of life.

WILLIAM D. MATTHEW,
American Museum of Natural History.

Horse, the French Coach. The prevailing characteristic of a Frenchman is his devotion to those things that make life pleasant. From an artistic standpoint he leads the world. Pleasure and horses go together. A Frenchman is instinctively a horseman. The French cavalry is without an equal in the world. Since the time of Napoleon the French government has taken charge of the breeding of horses that are best adapted for cavalry uses, and in accomplishing this purpose the government has contributed to the production of a very high-class coach horse. The cavalry horse of France is usually selected after the committee has finished their work of picking out the very best stallions for breeding purposes. Nearly every French coach stallion that stands for public service in France is owned by the French government. The French have been willing to advertise and sell their other breeds of horses, but they have been loath to part with their coach horses. The instinct of self-preservation causes the French government and the French people to keep their French coach horses at home in order to have better horses than can be found in any other country.

The breed of French coach horses has its origin from the same source as the English thoroughbred. On the one hand, the English thoroughbred surpasses in speed, while the French coach horse is superior in all of those qualities that go to make up a high-class carriage horse. Like the Percheron, the French coacher is developed in its highest state of perfection in Normandy, but he comes from the northern part, while the Perche is in the south of Normandy.

The French coach horse is about 16 hands high; his average weight is between 1,200 and 1,300 pounds. His color is as a rule bay, brown or chestnut. His outline is most pleasing. He is a fast trotter, and under the conditions of horse racing in France under saddle over a turf track a distance of 4,000 metres he holds the record. The French method of developing their trotters cultivates a very high, attractive style of action. Not only is the French coacher seen in every French city hauling the most gorgeous equipages over the boulevards surrounding Paris, but he is to be seen in the best stables throughout all of the capitals of Europe, especially in London.

The French coacher supplies the English royalty with their most useful and most attractive carriage horses.

For more than 20 years French coach stallions have been brought to America very sparingly. Where they have been crossed with the best road mares, trotting bred mares, the result has been most satisfactory. High-grade carriage horses that go into our best markets and sell for the highest prices usually have a strain of French coach blood flowing through their veins.

A perfect type of the French coach horse when standing or in action is impossible to describe in words. To fully realize his superiority, to appreciate and admire his style and magnificent high action, one must actually see him. Words are inadequate to describe him, and the most perfect picture falls far short of the most perfect horse.

JOHN R. MCLAUGHLIN.

Horse, the Percheron. The Percheron horse is the production of the most patient care and the application of the best scientific principles of breeding. From the dawn of history the French breeders of draft horses have been most successful, and the horses they have raised have been renowned the world over.

In the 16th, 17th and 18th centuries the same rules of selection in breeding have been applied that prevail to-day. The good horses were permitted to reproduce themselves and multiply. The inferior and unsound ones were never permitted to breed. The result of this most careful selection, based on scientific principles, has given the French the best draft horse that the world produces.

In a very small portion of Normandy called the "Perche" the highest result has been attained. From this district the Percheron horse has been sent to all parts of the world with such satisfactory results that the word Percheron today means the ideal draft horse the world over. From the very beginning up until the present time the object of the Percheron breeders has been to produce the kind of horse that would move the greatest weight with the greatest speed.

In making their selections for breeding purposes the Frenchmen have not only picked out stallions and mares that would make the best horses, but comely appearance and pleasing outline have also in a measure been their guide, and as a result the Percheron horse to-day is not only the best draft horse in the world, but he is one of the most attractive. He is indeed a handsome horse. The prevailing color of the Percheron horse is from black to white, including all of the various gradations from black, dark gray, dapple gray, gray and white.

About 50 years ago the first Percheron stallions were imported from France to America, and those that became most famous came to Ohio. One, called Louis Napoleon, owned in Union County, Ohio, and afterwards sold to go to Normal, Ill., both here in Ohio and in his new home in Illinois, was admired by all. In a few years, when his colts began to appear, the reputation of the Percheron breed in America was so well established that hundreds and even thousands of them have been imported to America each year.

During the past hundred years the government in France has maintained a system of supervision over the horse-breeding industry. The government does not own every Percheron stallion, but every Percheron stallion must be approved by the government inspectors and must receive a certificate of approval before he can be used for breeding purposes in France. Many of the best stallions belong to the government. Many of those owned by private individuals receive a subsidy from the government if their owner will offer their services to the public.

On account of the very high tariff laws the French breeders supply nearly all of the horses used in France. The ups and downs of prosperity and depression do not affect the horse-breeding industry in that country. During the period of depression that prevailed in the United States ten years ago American breeders became very much discouraged. Most of the stallions were castrated and the best mares were disposed of, but in France these conditions did not prevail.

In '97, '98 and '99, when more prosperous conditions were brought about in this country, the demand for horses was very greatly increased. The French were able to supply the deficiency. Good stallions and mares could be found there in abundance when a surplus could not be found anywhere else in the world. Instinctively the French breeders keep their best stallions and mares, no matter what the foreign demand may be, and as long as they pursue this policy the best Percheron horses will be found in France and the best breed of draft horses in the world will be the Percheron.

JOHN R. MCLAUGHLIN.

Horse Bot-fly, a bot-fly (*Gastrophilus equi*) parasitic in horses. The adult is about .75 inch long; the wings transparent with dark spots forming an irregular band toward the centre; the body brown and very hairy, the head whitish in front, and the abdomen dark-spotted. The females (males are rarely seen) have an elongated tapering abdomen. The oblong light yellow eggs are glued, one by one, to the hairs of the forepart of the body, where they are likely to be licked off by the animal. The moisture of the tongue causes the developed larvæ to break through the shell almost instantly, and to be carried into the mouth and thence to the stomach. Many curious facts have been observed in connection with these eggs and their development, and may be found fully discussed by Osborn in his 'Insects Affecting Domestic Animals,' issued by the United States Department of Agriculture (1896). Reaching the stomach, the larvæ fasten themselves to its walls by hooks in the posterior end of the body, and great masses sometimes accumulate, seriously obstructing the pyloric outlet. They remain there, absorbing nourishment and interfering with digestion through the winter, and on the return of warm weather let go their hold, pass out through the intestines, enter the ground, pupate there for a few days, and then emerge as flies. This pest chiefly affects horses out at pasture, and can be prevented only by removing the eggs, which can easily be seen. The attempt to remove the bots from the stomach by turpentine or other drugs is a dangerous proceeding which should only be attempted under direction of a veterinarian.

Horse-chestnut, or Buckeye, a tree of the small family *Hippocastanaceæ* and genus *Æsculus*, represented in Europe by the horse-chestnut (*Æ. hippocastanum*), now cultivated in all parts of the world, but native to Greece, Turkey, and southwestern Asia; and three indigenous American species known as buckeyes, from the appearance of the fruit. These trees are shapely, have leaflets diverging from the stalk like fingers, and bear white or tinted flowers in large erect panicles, turning the whole tree into the semblance of a big bouquet. The fruit of the horse-chestnut much resembles a huge chestnut, and is prickly when young. In this respect the common or Ohio buckeye (*Æ. glabra*) agrees with it, but has only five leaflets in each leaf and its flowers are small and not showy. The unpleasant odor exhaled by the bark and leaves in all this genus is especially strong in this species. A more southern species, developed into fine trees in the southern Alleghanies, is the sweet or yellow buckeye (*Æ. octandra*) which with the red buckeye (*Æ. pavia*) bears smooth fruit. Though so handsome, rapid in growth and serviceable as ornamental or shade trees, they are otherwise of little value. The wood is light colored, soft, and useful mainly for paper pulp and small articles; it contains a large quantity of saponaceous material, so that country people use the mucilaginous sap as soap. The leaves and roots of the Ohio buckeye are poisonous. The seeds are bitter but are eaten by cattle and sheep, with the preparation of boiling in alkaline water which is necessary in Europe; and from them a flour is made especially adapted to bookbinders' and shoemakers' paste, as, besides having great tenacity, it will not be attacked by insects. In France starch is produced from horse-chestnut seeds on a large scale. The seeds are also used in the southern United States to impart a flavor of age to raw whiskey. The red buckeye has been naturalized in Europe as a park tree. California has a species of its own, Japan another, and a third grows on the Himalaya Mountains.

Horsefield, Thomas, American naturalist and explorer: b. Bethlehem, Pa., 12 May 1773; d. London, England, 1866. He was graduated in medicine at the University of Pennsylvania, and served as "medical apprentice" in the Pennsylvania Hospital from 1794–99, being the fifth interne in the hospital in the order of appointment. In October 1799 he accepted service as surgeon on the "China," about to sail for Java. He returned in the latter part of 1800, but in 1801 went again to Java for the purpose of thoroughly exploring the island, and was commissioned as regimental surgeon by the Dutch Colonial Government. From 1802 he devoted himself to the thorough examination of the flora, fauna, and geology of the island, at first under the auspices of the Dutch government, and, when possession of Java was taken by the English, under the especial patronage of Sir Thomas Stamford Raffles, the lieutenant-governor. A warm friendship, due to kindred tastes, sprang up between Horsefield and his celebrated patron, and, when the English tenure of Java ceased and Sir Stamford Raffles returned to England, Horsefield accompanied him, bringing with him the collections he had made, which were placed in the museum of the East India Company in London, of which he was presently made the curator, a position which he held for nearly fifty years until his death. Horsefield, by his explorations and writings, laid foundations for our knowledge of the natural history of the far East. He contributed while in Java many important papers to the publications of the Batavian Society of Arts and Sciences. In 1824 he gave to the world his great work entitled 'Zoological Researches in Java and the Neighboring Islands,' and from 1838–52 issued in folio parts the 'Plantæ Javanicæ Rariores.' Both works are sumptuously illustrated by colored plates. In 1856–58 he published the 'Catalogue of the Birds in the Museum of the East India Company,' and in 1857–59, with Frederic Moore, the 'Catalogue of the Lepidopterous Insects in the Museum of the East India Company.' Besides these larger works he was the author of a multitude of papers published in the 'Transactions' and 'Proceedings' of societies.

To him perhaps more than to any other single naturalist are we indebted for the first correct account of the botany and zoology of the regions with which he became familiar in his early life.

W. J. Holland,
Director Carnegie Museum, Pittsburg.

Horse-fly, Gad-fly, or **Deer-fly,** any species of the family *Tabanidæ,* usually large, robust, flies, with a broad head pointed in front and concave behind, with immense eyes, and fitting closely to the thorax. The legs are long and stout; sometimes hairy, but without stiff bristles. The females are provided with a long sharp proboscis with which they pierce the skin of animals, and are especially annoying to such short-haired kinds as horses and deer. No poison is injected into the wound, but injurious bacilli may be introduced, causing bad sores. One of the most widely distributed in the United States is the large black *Tabanus americanus.* These flies attach their eggs to grass and sticks in wet places. The larvæ find their way into water or wet earth, and are carnivorous, feeding on other insects, snails, etc. They pass the winter before pupating and emerge as flies in the early summer. To the same family belong many smaller green or yellow species of the woods more usually called deer-flies.

Horse-mackerel. The horse-mackerel, tuna or tunny (*Thunnus thynnus*), is the largest member of the mackerel family (*Scombridæ*), attaining a length of 10 feet or more and a weight of 1,000 to 1,500 pounds. It is found in all warm seas, both of the Atlantic and Pacific oceans, and wanders as far north as Newfoundland, appearing on our shores with the menhaden and mackerel. See Tunny.

Horse-power, the power of an ordinary horse or its equivalent, the force with which a horse acts when drawing. The mode of ascertaining a horse's power is to find what weight he can raise and to what height in a given time, the horse being supposed to pull horizontally. From a variety of experiments it is found that a horse, at an average, can raise 160 pounds weight at the velocity of 2½ miles per hour. The power of a horse exerted in this way is made the standard for estimating the power of a steam-engine. Thus we speak of an engine of 60 or 80 horse-power, each horse-power being estimated as equivalent to 33,000 pounds raised one foot high per minute, but this estimate is considered much too high, 17,400 foot-pounds per minute being generally considered nearer the truth. As it matters little, however, what standard be assumed, provided it be uniformly used, that of Watt has been generally adopted. The general rule for estimating the power of a steam-engine in terms of this unit is to multiply together the pressure in pounds on a square inch of the piston, the area of the piston in inches, the length of the stroke in feet, and the number of strokes per minute, the result divided by 33,000 will give the horse-power deducting one tenth for friction. As a horse can exert its full force only for about six hours a day, one horse-power of machinery is equal to that of 4.4 horses.

The motive power used in the manufacturing establishments of the United States in 1900, according to the census report, aggregated 11,300,081 horse-power, as compared with 5,954,655 horse-power in 1890, 3,410,837 horse-power in 1880 and 2,346,142 in 1870. Of the total power used in manufactures during the census year, steam-engines furnished 8,742,416 horse-power, or 77.4 per cent of the aggregate; water wheels supplied 1,727,258 horse-power, or 15.33 per cent; electric motors, 311,016 horse-power, or 2.7 per cent; gas and gasoline engines, 143,850 horse-power, or 1.3 per cent, and other forms of mechanical power 54,490 horse-power, or five tenths of 1 per cent. Rented power was used to the extent of 321,051 horse-power, or 2.8 per cent of the total. Of this rented power 183,682 horse-power was electric and 137,369 horse-power was from other sources of energy. See POWER.

Horse-racing, a national pastime, which has been called the sport of kings because it has been one of their amusements since the earliest dawn of civilization. The racing horse is of three distinct types, the running horse, the pacing horse, and the trotting horse. For many centuries the running race has been the traditional turf sport in Great Britain and on the continent, with many varieties, such as flat racing, or racing on level ground; steeple-chasing, or racing over ground not specially prepared for the purpose, and hurdle-racing, in which the horses have to leap over obstacles purposely placed in the way. Trotting is primarily an American institution, the outcome of thoroughbred development. Late in the 19th century horse-racing made a wonderful advance in the United States and easily became the great national pastime of the country.

Early History.— Thothmes I., of the 18th Egyptian dynasty, left a papyrus letter telling of his conquest of Mesopotamia, and priding himself upon the acquisition of the racing horse (the Arab) and being the first to introduce him in Africa. Somewhat later the records tell of King Solomon buying horses from Egypt, and paying as much as $3,000 for some of them. Among the Greeks it was introduced into the Olympic games in the 33d Olympiad (648 B.C.). From Greece it was introduced into Rome, where it gained a place as one of the games of the circus. The institution of horse-races in England, where the sport has become a great national pastime, belongs to a very remote period. The first regular horse-races, however, did not take place till the reign of James I. The successors of James I. down to Queen Anne were all more or less attached to the sport. In the reign of the latter, in 1711, the York Plates were founded, and about that date the passion for betting on the turf began to be general. Under George I., the successor of Queen Anne, horse-racing became more flourishing. The two most celebrated horses of that period were Flying Childers (foaled in 1715) and Eclipse (foaled in 1764), which long had the reputation of being the fleetest horses that ever ran. From the latter are descended many of the first-class thoroughbreds of the present day. None of the English sovereigns was more devoted to horse-racing than George IV. Between 1784 and 1792, while yet Prince of Wales, he gained 185 prizes, including the Derby of 1788. Horse-racing was introduced into France from England during the reign of Louis XIV., and under Louis XV. was pursued with the utmost enthusiasm.

Breeding and Training.— The training of a running horse begins with its second year, and is a slow process, requiring great care and attention. During the period of training the horse is under the charge of a stable-boy. In the first part of the training the exercise to which the horse is subjected is comparatively gentle, but in the latter part a gallop of half or three quarters of a mile is taken every other day. Before a race takes place the powers of the horse are put to the test by its being made to run over about half a mile against an older horse, which is weighted to make up for the difference in age. The breeding of thoroughbred horses, that is, of horses which can trace an unbroken pedigree through the best sires and the best dams, is when well conducted a very profitable business. The prices given for stallions are sometimes enormous. In 1900, when the Duke of Westminster's racing stud was sold, the average price reached the high level, and the world's record price of $187,500 was brought by Flying Fox, which had won the Derby the year before. Before this, Ormonde, another Derby winner, had sold for $150,000. The large sums now given for the use of stallions in breeding studs are the cause of race-horses being withdrawn much earlier than they used to be from the turf, for as soon as they have acquired a reputation the owner of a good race-horse can make much larger sums by hiring it out for breeding purposes than he could by entering it for races. The pedigrees of all thoroughbred horses are registered in the stud-book, so that if any particular animal is omitted in that register the inference is that its pedigree is not without some blemish more or less remote. The effects of a careful system of breeding in improving the quality of horses are very marked. No pure Arabian horse can be compared in point of speed with a thoroughbred. In size and shape, too, the horses of the present day surpass those of former times, the average height of a thoroughbred now being 15 hands 3 inches, while formerly it seldom reached 15 hands. See also HORSES, AMERICAN THOROUGHBRED.

Race Meetings.— In Great Britain the chief race meetings are those at Epsom, Newmarket, Ascot in Berkshire, Doncaster, Goodwood, Liverpool, Manchester, and Leicester. Those at Newmarket are the oldest of all, dating from the reign of Charles II. The Ascot races are considered the most fashionable, being largely attended by the aristocracy, and sometimes honored with the presence of royalty. The Goodwood races, which are held in the Duke of Richmond's park in Sussex, are also a favorite rendezvous of the aristocracy. But the most popular meeting throughout the year is the Epsom, which owes its popularity partly to the proximity of Epsom to London and partly also to its being the meeting at which the Derby and the Oaks are run. At the Oaks the ladies are the chief bettors, and the bets are not thousands of pounds, but dozens of Paris gloves. The principal racing meetings in France are those held in spring and autumn at Chantilly and the Bois de Boulogne.

In the United States the season opens at the Bennings track at Washington early in the spring and closes there in the fall. Following Bennings comes the Aqueduct, and Morris Park, Gravesend and Sheepshead, the latter track being the show track of this country, occupying the same position as the Ascot of the English turf, which is also named "The Ladies Meet." Then follows the Brighton Beach season during July and August. Although the classic events of England and France are of longer standing they cannot be said to outrank or outinterest the famous Brooklyn Handicap, founded in 1887; the Suburban (1884); the Futurity (1888); the Realization (1889), and numerous other events. There are racing parks and tracks in nearly every city in the country, and there are many famous meetings in the West and South, like the Latonia in Kentucky, the Harlem and Washington Park in Chicago, Saratoga and others.

Racing Rules.— The conditions under which the most of the races are run are the following: Every horse that takes part in a running race must be entered as a yearling, that is, before the close of the year in which it is foaled, for a horse's age is always reckoned from the 1st of January of the year in which its birth takes place. On being entered a certain sum is paid by the owner, which is called a forfeit, because it is forfeited if the horse is afterward withdrawn, or, in the language of the turf, "scratched." The racing is conducted under association rules, and in England under regulations laid down by the Jockey Club, a body instituted in 1750. The stewards of the Jockey Club have power to grant and to withdraw licenses to racing officials, jockeys, and race-courses; to fix the dates on which all meetings shall be held, and to make inquiry into and deal with all matters relating to racing. At every regular race-meeting there must be at least two stewards, with a clerk of course, a handicapper, a stake-holder, a clerk of the scales (since the jockeys of course must be carefully weighed), a starter, and a judge, each of these officials being licensed by the club.

Handicapping.— Formerly all running races were what is called weight-for-age races, that is, all the horses entered to compete were of the same age and bore equal weights, or if in certain cases there was an inequality in point of age there was also a fixed difference in the weight carried. But it was found that when races were conducted on this plan the best horses came to be known, and the inferior ones withdrew, not venturing to compete with them, so that the race resulted in a walk-over. Hence arose the practice of handicapping, that is, of adjusting as nearly as possible the weight to be carried to the previously ascertained powers of the horse, so as to reduce the chances of all the horses entered to an exact equality. In England the principal weight-for-age race for two-year-olds is the Middle Park Plate, and for the three-year-olds the principal for both colts and fillies are the Two Thousand Guineas, the Derby, and St. Leger, and for fillies only the One Thousand Guineas and Oaks. The most important handicap races are the Great Northampton Stakes, the City and Surburban and Metropolitan Stakes at Epsom, the Northumberland Plate, the Goodwood Stakes, the Ascot Stakes, the Ebor Handicap (run at York), the Great Yorkshire Stakes (run at Doncaster), the Liverpool Spring, Summer, and Autumn Cups, the Cesarewitch, Cambridgeshire, and Newmarket Handicaps (run at Newmarket).

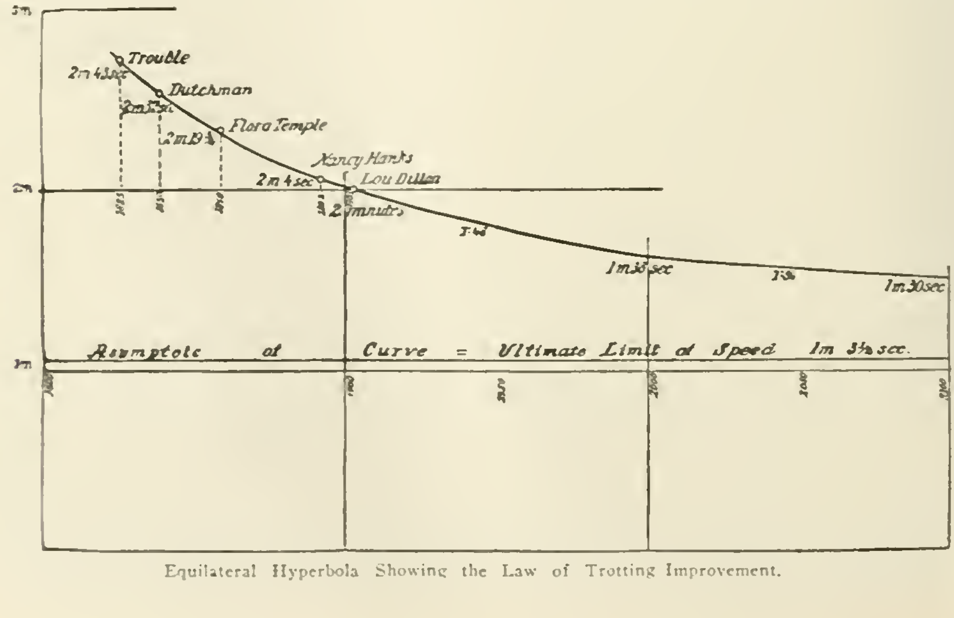
Betting and Book-making.— The prevalence of the practice of betting in connection with horse-racing is a fact so well known that it is needless to enlarge upon it, although it will be of interest to some to explain in what manner it is conducted. Bettors are divided into two classes — the backers of horses, and the book-makers, or professional bettors, who form the betting ring, and make a living by betting against horses according to a methodical plan. Backers of horses may be again divided into those who have special information about the qualities of the horses which are to engage in a race, which enables them to back a particular horse with a certain amount of confidence; and those who have no such means of information, and accordingly back horses pretty much at random. The former class, if their information is good, have a very fair chance of success in their speculations, and the horse that wins any great race usually brings in to his owner vast sums in payment of bets, compared with which the stakes, considerable as they often are, are insignificant; but the latter class are pretty certain in the long run to lose. By the method adopted by the professional bettor the element of chance is as far as possible removed. Instead of backing any particular horse, the professional bettor lays the same sum against every horse that takes the field, or a certain number of them, and in doing so he has usually to give odds, which are greater or less according to the estimate formed of the chance of success which each of the horses has on which the odds are given. In this way, while in the event of the race being won (as is usually the case) by any of the horses entered in the betting-book of a professional bettor, the latter has always a certain fixed sum (say $5,000) to pay, he receives from the backers of the losers sums which vary in proportion to the odds given. Thus, if a book-maker is making a $5,000 book, and the odds against some horse is 4 to 1, he will, if that horse wins, have to pay $5,000, while, if it loses, he will receive $1,250. If the sum of the amounts to which the horses in a particular race have been backed in some professional bettor's book is $6,500, and if the odds against the first favorite were 5 to 2 (or $5,000 to $2,000), then the total sum received by the book-maker, in the event of the race being gained by the first favorite, would amount to $6,500, $2,000 or $4,500, so that he would suffer a loss of $500; while if a horse had won that had long odds against him (say 200 to 1, or $5,000 to $25), his total receipts would amount to $6,475, and his gains to $1,475. Very frequently the receipts of the book-maker are augmented by sums paid on account of horses which have been backed and never run at all.

Americans Abroad.— In 1855 an American horse had never won a race abroad and an American jockey had never ridden in an English race. The first American to go to England with a stable of thoroughbreds was Richard Ten Broeck, who sailed for England in 1856, taking with him Lexington, Lecompte, the only horse that ever beat Lexington: Pryor, and Prioress. Lecompte died of influenza the first year, and Pryor soon followed. It was left for Prioress to retrieve the fortunes of the stable. Her great victory was in the Cesarewitch, a race at 2 miles, 2 furlongs, and 28 yards. There were 37 starters, the very best horses on the English turf. After one of the most exciting races ever run, Prioress, El Hakim, and Queen Bess finished in a dead heat. In the run off, the American horse won by a length in 4 minutes and 15 seconds. American successes really began in 1878, when Pierre Lorillard and James R. Keene shipped stables to England. The former's Parole won the Newmarket Handicap, defeating the English favorite, Isonomy, a horse that was called the best ever foaled on English soil. The American gelding next took the great Metropolitan, the Great Cheshire, and the Epsom Gold Cup in quick succession. Iroquois followed Parole, winning four important stakes in 1880, including the St. Leger. The subsequent invasion of England by W. C. Whitney, Clarence A. Mackey, Richard Croker and others with famous winning horses, and the successes of Sloan, Reiff, Martin and other American jockeys, have brought renown to the American turf. In 1902, American horses ridden by American jockeys took part in 561 races in England, of which they won 85, were second in 80, third in 52, and unplaced 344 times. The stakes and purses won amounted to $234,120. In 1903, up to 15 September the Americans have done even better proportionately, starting in 453 races, winning 74, second in 81, third in 47, and unplaced 251 times. The winnings amount to $259,000. American horses were second in the Oaks and third in the Derby.

Trotting.— The evolution of the trotting horse in America, and the gradual reducing of the one mile record, is a history coincident with the improvement and progress made in breeding. Beginning with the record of Trouble, who trotted a mile in 2.43 in 1826, of Dutchman (2.32) in 1839, and Flora Temple (2.19¾) in 1859, the evolution proceeds to George Wilkes, Dexter, Goldsmith Maid and the others who followed. In 1818, at a Jockey Club dinner, discussion drifted to the trotter, and a wager was made that no horse could be produced which could trot a mile in three minutes. Boston Blue was named at the post by Maj. William Jones, and the old chronicle says that he "won cleverly and gained great renown." The New York Trotting Club was organized in 1825, for the purpose of improving the speed of road-horses. The initial purses were for races of two-mile and three-mile heats. In 1835 trotting was in almost daily vogue in New York. It was not until 1845 that a mile was trotted in less than 2.30. In 1863, the American trotting horse was an unknown quantity abroad, while in 1903, American trotting stock was in demand throughout Europe. Germans, French, Russians, and Austrians have bought some of our best bred animals.

The National Trotting Association was formed in 1870 as a result of a meeting of breeders and track owners the previous year. In 1887 the American Trotting Association was formed with headquarters in Chicago, and it works with the National Trotting Association to detect and punish fraud. Some of the ablest men in the country sit on the boards of appeals, and the decisions command respect and are accepted as final. The careers and records of famous trotters like George Wilkes; Dexter; Harrietta; Axtell (2.12); St. Julian (2.11¼); Sunol (2.10½); Maud S. (2.08¾); Kremlin (2.07¾); Stamboul (2.07½); Beuzetta (2.06¾); Directum (2.05¼); Nancy Hanks (2.04); Alix (2.03¾); The Abbot (2.03¼), and the mile of Major Delmar (2.00¼), Cresceus (1.59¾), and Lou Dillon (1.58½) in 1903, tell the brief but wonderful story of the trotting horse in America. See also Horses, Trotting.

Record Possibilities.— The gradual lowering of the trotting record from a mile in three minutes to the 1.58½ record of Lou Dillon on 24 Oct. 1903 has led many to question if a limit is ever to be reached. The mathematician has a rule to guide him in a guess at the answer to such questions, and the 'Scientific American' has prepared the accompanying chart which is of vast interest. The vertical lines represent the years in which the record has been lowered, the spaces between the lines indicating the time interval, the length of each vertical line indicating the record for that year. A curve is next sought that will pass through as many of the points as possible, or close to them, and the continuation of this curve across lines indicating future years shows the best answer to the main question that the facts warrant. If the curve



Equilateral Hyperbola Showing the Law of Trotting Improvement.

proves to be a hyperbola, it will afford confidence in the accuracy of the solution, for a peculiar property of the hyperbola is that it constantly approaches but never reaches a straight line called an asymptote, and this asymptote represents the ultimate rate of speed. With Lou Dillon at the two minute mark, a point is indicated on the chart showing this hyperbolic curve as the law of improvement. It is now possible to pass the curve of a hyperbola through the record points of Trouble in 1826, Dutchman in 1839, Nancy Hanks in 1892 and Lou Dillon in 1903. This curve will be within a few seconds of many other records in which the time was notably reduced.

The hyperbola is represented by the equation $xy = 10.000$, in which x equals the number of years since 1726, y equals the number of seconds over 63½ seconds to trot a mile. The notable records of Maud S. in 1881 and 1885, with the high-wheel sulky, are 2¼ to 3¼ seconds above the curve, which would indicate that the change to the pneumatic sulky will account for this measurement of the improvement. This curve places the ultimate limit of trotting speed at a mile in 63½ seconds, which, though constantly approached, will never be reached actually, and it indicates the minute and a half mark as two centuries away.

Horse-radish, a species of water-cress (*Roripa armoracia*), native to Europe, but now cultivated everywhere, and becomes naturalized in most parts of the world. Its basal leaves are oblong, finely crenelate and irregular in outline, and its flowers are white and showy. The roots furnish the highly pungent ingredient of a well-known sauce, prepared by grating them, adding vinegar and sealing. They have also some medical use.

Horse-radish-tree. See Ben, Oil of.

Horsefoot Crab, Horse-shoe Crab, or King Crab. This marine animal (*Limulus polyphemus*) was formerly regarded as a crustacean, and is the sole survivor of an extinct group of arthropods intermediate between the trilobites and arachnids. It belongs to the order *Xiphosura,* class *Merostomata,* and phylum *Palæopoda.* By some English authors it is regarded as an arachnid allied to the scorpion. This difference of opinion regarding its affinities is due to the generalized structure of the animal, and to the fact that its nearest allies are extinct.

The body of the horsefoot crab is sometimes two feet in length, and consists of a head and a hind-body or abdomen, the latter ending in a long spine (telson), which is elevated by the creature in defense. The head is in shape somewhat like a horse's hoof, and in burrowing it acts as a shovel, being bent down at nearly right angles to the hind-body. There are a pair of compound and of simple eyes; the mouth is on the under side, nearly surrounded by six pairs of walking legs, while on the hind-body are six pairs of broad swimming legs. There are no antennæ, jaws, maxillæ, or foot-jaws, as in the lobster. The horsefoot crab breathes by means of gills attached to the under side of the last five pairs of abdominal legs, which consist of a pile of about 100 thin broad sacs growing out, one pile on each side, from the base of the legs. The nervous system is peculiar from the nature of the brain, and the œsophageal ring; while the entire system behind the brain is enveloped by the arteries, the latter ending in remarkably fine branches. The heart is large, tubular, the liver very voluminous, and the kidneys are represented by four pairs of excretory red glands, arising from a stolon-like base. The animal is bisexual, the male differing from the female in the second pair of legs ending not in a forceps, but in a sort of hand, with an opposing thumb. The ovaries and testes are voluminous, and the sexual products, eggs and sperm, pass out through a pair of papillæ situated on the under side of the first pair of abdominal legs.

The female lays her large round eggs loosely in the sand between high and low water, spawning in May and June; in about a month they hatch, and the young, after passing late in embryonic life through a trilobite stage, assumes the form of the parent, differing in the short rudimentary caudal spine. It molts frequently, and during the process the front edge of the carapace or head splits open, enabling the animal to draw itself out of the old shell. The recently hatched Limulus is strikingly like a trilobite, but while in the latter new segments are added after birth, in Limulus no new ones are added. The young horsefoot is about 4 millimetres in length. Specimens an inch long are about a year old, and it probably requires several years to grow to the length of a foot or more.

Limulus polyphemus inhabits the eastern coast of North America from Boothbay, Maine, to the West Indies and Honduras, but is most abundant in shallow, retired, sandy, or muddy bays on the coast of New Jersey, Virginia, and North Carolina. Several other species inhabit the seas of the Eastern Archipelago, China, Philippines, and southern Japan. In the United States it is used as a fertilizer, while in the Malayan markets the animals are sold as food.

The Limuli date from the Devonian. An allied group, in shape and structure approaching scorpions, is the Eurypterida (q.v.), one of which (*Stylonurus laccoanus*) of the Devonian of New York and Pennsylvania was about five feet in length, while the British *Pterygotus anglicus* is estimated to have been about six feet in length and two feet across. It is now thought that the scorpions have descended from some merostome, which became adapted for a terrestrial life.

Alpheus S. Packard,
Late Professor of Zoology, Brown University.

Horseheads, N. Y., village, in Chemung County; on the Erie & Central N. Y., and branches of the Delaware, L. & W. and the Northern C. R.R.'s; about six miles north of Elmira. It is in a fertile agricultural region. Its chief manufactures are creamery products, bricks, screens, doors, blinds, men's clothing, cigars, cattle-feed, shoes, and hardware. Pop. (1900) 1,901.

Horsemanship. See Riding.

Horses, American Thoroughbred. The American thoroughbred is the production of pure breeds imported from England, first during the 17th and 18th centuries. They first found their way into the Old Dominion of Virginia, where they founded a tribe of early racehorses, to which trace to-day many of the most fashionable pedigrees. From Virginia the thorough breds finally found their way into the Carolinas and as far south as Mississippi and Louisiana, and, upon the formation of Tennessee and Kentucky as States, the breeding of thoroughbreds became with them what might be termed an industry.

The early part of the 20th century finds Kentucky in the lead in the production of thoroughbred horses, followed next by California and then by Tennessee. Missouri and Illinois have recently greatly increased their thoroughbred holdings, while both New York and New Jersey produce a goodly number. Many of the other States take rank as fair producers of thoroughbreds, and, in fact, the breed has found its way into every section of the country, even as isolated a State as Oregon annually producing a number of thoroughbred horses.

The requirements of an American thoroughbred horse are that the pedigree contains five uncontaminated crosses, but the average pedigree traces through 16 to 18 crosses, some having as many as 25. Those reaching an origin of a Natural Barb source are considered the most fashionable, but many great racehorses have descended from lines unknown to early English or Arabian pedigrees.

Diomed, the winner of the first English Derby, imported to this country in 1799, when he was 20 years old, is classed as the greatest of early importations, and he has left a marked impress upon American pedigrees. The most successful importation of the 19th century was unquestionably Glencoe (imported in 1836), and in later days Leamington ranks the highest. In more recent years, the ranks of the American thoroughbred have been greatly increased by almost unlimited importations from England, France, Australia, and other foreign countries, and horses are produced in this country now that are of entirely foreign pedigrees, while there are numerous instances where the first few crosses are strictly foreign lines.

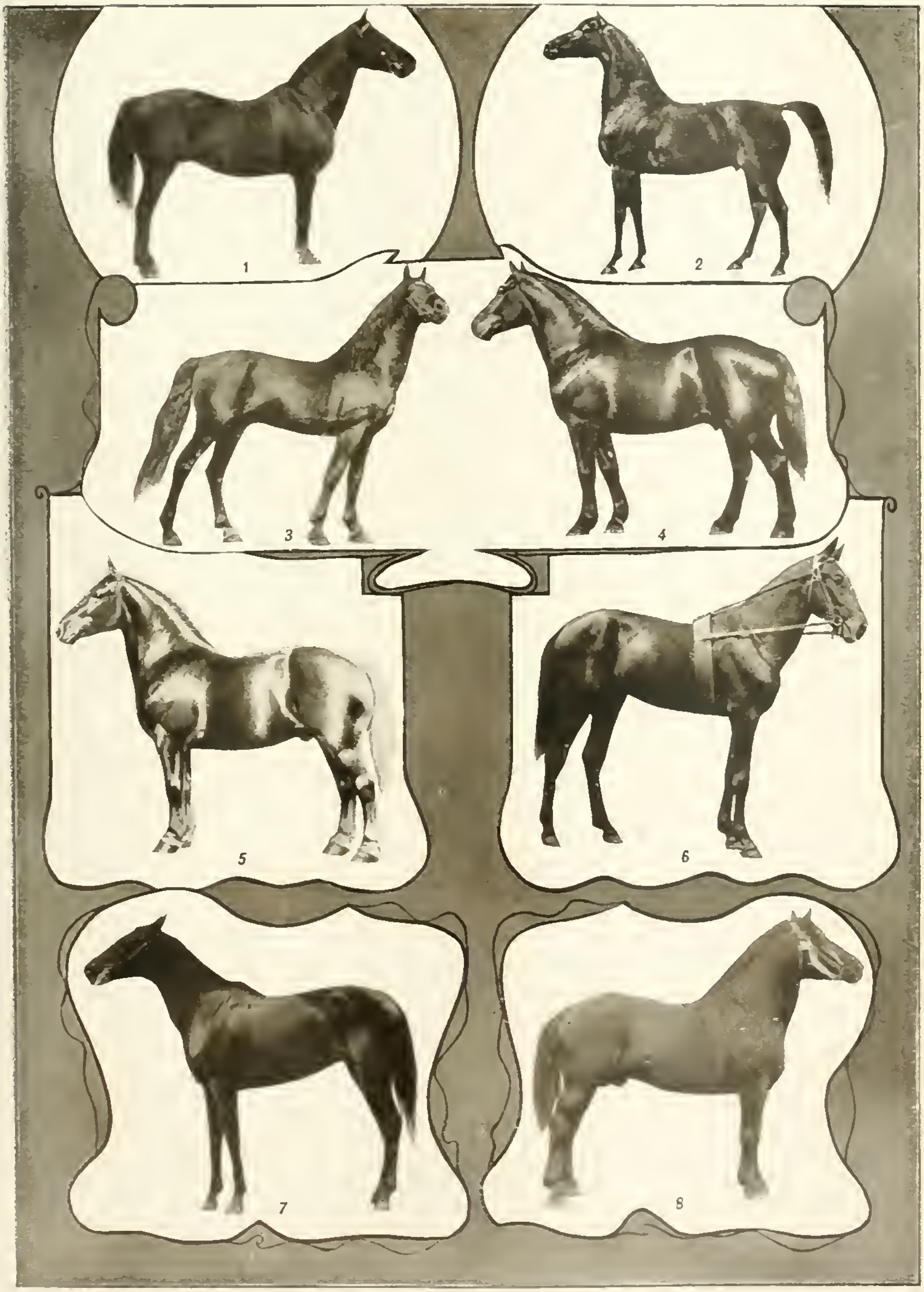
The average height of the early thoroughbred horse was something less than 15 hands, but at this time they average over 15 hands 2 inches, and weigh 150 pounds more than they did a half century ago. In individuality, too, the improvement is very marked, the types now being far superior in form to the horses of early times.

In soundness and general service the American thoroughbred has no superior, this being the result of judicious breeding and favorable rearing conditions. The statistics of the American turf (commonly known as Turf Guides) extend over a period of about 30 years, and in this time these records show that the thoroughbred horse has improved some 30 pounds, which is an equivalent of from 5 to 6 seconds to the mile. This marked improvement can be attributed to an accepted theory of breeding that like begets like, to intelligent methods of training, and to superior riding.

The most favorable condition which has proved so successful in raising the thoroughbred in this country is that he is housed less and has, at all times, access to lands covered by the finest of grasses, which brings his feet constantly into contact with moisture. The frog of the foot, being like a sponge, absorbs this moisture, thus creating a gentle pressure which spreads the hoof. A horse having bad feet naturally favors them, which has a tendency to make bad ankles and tendons on account of their not being freely used, and it is a conceded fact that "no foot, no horse."

In America the horse has been bred more for business than pleasure. The invention of the elliptic spring and the use of American hickory in the production of light vehicles for pleasure and business, together with the invention of macadam and Telford roads, turned the demand from the running to the trotting horse. The first private coach was introduced into New York in 1745; but coaches were scarce until after the Revolutionary War, and not until after 1840, when the light one-horse vehicle came into use, did the changed conditions of travel develop a harness-horse for purposes of business and pleasure. Along with the change in vehicles incident to the evolution of the trotter came as great a change in the style of harness and trappings.

About the beginning of the 19th century there came from the lines of breeding of the thoroughbred, traceable to Flying Childers, Byerly Turk, and the Darley Arabian, Messenger, a gray, stoutly built horse, of wonderful power and stamina, with a slashing, open gait, fitted to found a race of trotters. He was foaled in 1780, and became the progenitor of the trotting families in America. In 1793 Justin Morgan was foaled, sired by one believed to be thoroughbred. Three of his sons, Bulrush, Sherman, and Woodbury, became noted as the sires of horses of intelligence, courage, and speed, and the get of some of them excelled as roadsters and stage horses. From Black Hawk Morgan, sired by Sherman out of a fast trotting English mare, has come the beautiful, useful, and courageous line of Morgans. The original horse (2.40) died in 1856 at the age of 23. In 1849 was foaled Rysdyck's Hambletonian, the founder of the most noted family of trotters, sired by Abdallah, who traced to Messenger by both the sire and dam, out of a dam by Bellfounder, with Messenger crosses on the dam's side. As early as 1876 the interest in breeding and rearing trotters had become so great that fabulous prices were paid for colts, simply on the strength of their breeding. Two fillies, untrained, sold for $13,000. The three-year-old colt Steinway was sold for $13,000 in 1879. Maud S., bred at Alexander's noted stock farm in Kentucky, was sold to Mr. Bonner for $21,000 when four years old, with a record of 2.10¼, and the title "Queen of the Turf." Smuggler sold for $40,000, Pocahontas for $45,000, Goldsmith Maid for $36,000, Dexter for $36,000, and so on, until we come to Axtell, who sold for $100,000 after he had eclipsed the time of all stallions, and retired to the stud, where his service fee was $1,000. The stallion, Rysdyck's Hambletonian, was purchased with his dam for $125, and earned in the stud $205,750. Thirty-six of his get trotted in 2.30 or better, and the prices for which they could have been sold in their best days amounted to $325,000. Among them were Sentinel, George Wilkes, Jay Gould, and Administrator, all noted sires. Their united progeny was worth many thousands for stud and track uses. Some of his sons, without a 2.30 record, became successful in the stud. Alexander's Abdallah was sold for about $3,500, but he got Goldsmith Maid, who made a record of 2.14, and won on the turf close to $250,000; Almont sired 22 2.30 trotters; Bel-



1. English Running Horse.
2. English Coach Horse.
3. Morgan Trotting Horse.
4. Percheron.
5. Percheron.
6. Wilkes-Hambletonian Trotting Horse.
7. American Thoroughbred.
8. Belgian Stallion.

mont got nine with records better than 2.30. So the descendants of Alexander's Abdallah have been worth to their owners hundreds of thousands of dollars. Volunteer was another who ranked among the most successful of the noted Hambletonian sires, having to his credit 23 2.30 performers. Electioneer, bought by Gov. Stanford, proved a noted sire, getting the fastest yearling, 2.36½; the fastest two-year-old, 2.21; the fastest three-year-old, 2.19½; and the fastest four-year-old, 2.18¾. The bracing climate of Palo Alto, and the methods of handling peculiar to Gov. Stanford's breeding farm, aided in these accomplishments. These are but a few of the thousands of good horses that owe success to the Hambletonian blood. The value of trotters has been measured largely by their speed, taken as a measure of ability to win future races, or as evidence of blood lines that will make the animal valuable in the stud. Success in campaigning is undoubted evidence of pluck and stamina; and the breeding and training of the trotter, and his contests on the track, have developed these qualities in so high a degree that no other class can equal him. The evolution of the trotting horse has also shown the value of a training peculiar to America as a factor in breeding.

It is pertinent to notice that in the first years of the last century running races became common in the Middle and Southern States, while a strong sentiment against racing prevailed in the Northern States. In 1820, Pennsylvania, for example, not only forbade racing, but also enacted that no person should "print or cause to be printed, set up or cause to be set up, any advertisement mentioning the time and place for the running, trotting, or pacing of any horses, mares, or geldings," etc. A similar law was in the statutes of Connecticut until within 30 years. New York passed an act to prevent horse-racing 19 March 1802, which was amended 30 March 1821, permitting the "training of pacing, trotting, and running horses" in Queens County for five years. The sheriff was required to be on hand to witness these "trials of speed," as called in the statute. This amendment was re-enacted 3 April 1826, without a time limit. In 1825 the New York Trotting Club was organized, with a view of "improving the speed of road horses." This track was probably the first trotting course in the world. The Hunting Park Association was formed in Philadelphia in February 1828, and the next year a trotting club was organized in Baltimore. These facts show a changing public sentiment, and the records begin to fall. The keeping of records became an established custom as early as 1829, when the 'American Turf Register' began. The English had not then begun to keep records, but the American custom has enabled us to mark the development of speed and establish well-defined breeds during the threescore and more years it has been in use. Wallace's 'American Trotting Register' was started in 1871 by J. H. Wallace, New York, since which time the business of breeding trotters has increased, until now it is estimated by good authority that the number of registered standard-bred trotters exceeds 120,000. In the early history of the record many animals were admitted to registry that are not now classed as standard-bred. The term "standard" indicates to-day ability of one or more ancestors to trot within 2.30.

Before the days of macadam roads and light vehicles, saddle-horses were as common as trotters are to-day. They were of no particular breeding, but traced to the thoroughbred, the Narragansett pacer, or the Scottish Galloway. Herbert suggests that they were of Spanish origin, their ancestors coming from Cuba. There is now a revival of interest in the saddle-horse as a luxury, the demand being beyond the supply. From the ideal set up, especially in Kentucky, it is safe to predict that there will soon be an improved breed of American saddle-horses.

Prior to the introduction of railroads Vermont had what Herbert called a distinct breed of cart-horses. He described them as "the models of what draft-horses should be, combining immense power with great quickness, a very respectable turn of speed, fine show, and good action." They had "none of the shagginess of mane, tail, and fetlocks which indicates descent from the black horse of Lincolnshire," and none of the curliness of mane and tail which marks the Canadian or Norman blood, and were characterized by short backs, close ribbing up and round barrels. The only other breed of American horses we have to notice is the Conestoga, which before the days of the Pennsylvania Railroad was common on the farms and highways of Pennsylvania. It seems to have descended from the stock brought by emigrants from Flanders, Denmark, and Germany. It was a mixture of several breeds, resulting in a large, patient burden bearer, held in high esteem by the Germans of that State. Although we have not originated and permanently established any American breed of draft-horses, the number of heavy horses has greatly increased, and the quality has improved. The increasing heavy business of factories, jobbers, importers, and transfer and express companies in our well-paved cities has called for a great number of powerful horses. This demand has led to the importing of heavy horses from France, England, Scotland, and Germany. The Vermont cart-horse and Conestoga draft-horse excelled the types of foreign heavy horses, as a rule; and it is to be regretted that our pride in American animals has not led our people to perpetuate and further develop these useful horses. Tens of thousands of dollars have been sent abroad since the fad of importing heavy elephantine horses became common in the Western States. The enterprising importers scoured France, England, Scotland, and Germany for the heaviest animals. They imported more than they could sell, and then adopted the plan of leasing stallions for a term of years. Since 1890 there have been many disastrous failures among this class of importers. There were, however, several importers who imported the best type of the draft and heavy coach breeds to be found abroad, establishing breeding farms not excelled in the world. The earliest importer of high-class draft-horses was Edward Harris, of Moorestown, N. J. In 1839 he imported two mares and the stallion Diligence, who was in many respects similar to the McNitt horse, but heavier and more compactly built, being a little over fifteen hands high. The next valuable importation was made by Charles Fullington, of Union County, Ohio, in the spring of 1851. He bought and brought home from France the famous Louis Napoleon, a "short-legged, closely ribbed, blocky, and compact gray, three years old." In 1853 he was sold to A. P. Cushman, of De Witt County, Illinois, and after his colts in Union County proved his worth, a company was formed for importing other horses of his type. The author of the 'Percheron-Norman Stud-Book' says of him that he was undoubtedly the best-known and most popular French horse ever brought to America. The first importations west of the Wabash were made in 1868 by W. J. Edwards, of Chicago, in the great stallions Success and French Emperor. The latter went to Iowa as the property of Hon. J. B. Grinnell. Success was sold to the Fletcher Horse Company, of which M. W. Dunham, of Wayne, Ill., was an active member. In 1874 he purchased the entire interest of the company, establishing his celebrated importing and breeding farm at Wayne. Success's colts at the average age of two years and eight months sold at the average price of $450 per head, and in 1874 alone the sales of his get amounted to $36,000. The Clydesdale has been the strong rival of the Percheron-Norman; is popular in Canada, and has numerous representatives in the Northwest. The secretary of the American Clydesdale Association, Alexander Galbraith, says: "No importations into the United States appear to have been made until about 1870 and 1872, when John Reber, of Lancaster, Ohio, and the Fullingtons, of Union County, began the work. From that date small importations were made by various parties, the most prominent being the Powell Brothers, of Shadeland, Pa. Importations steadily increased up to 1888. To-day the largest breeder in America is Col. Holloway, of Illinois; N. P. Clarke, of Minnesota, and R. B. Ogilvee, of Wisconsin, coming next. These three breeders have among them about 175 brood-mares, and have the very cream of Scotland both in blood and individual merit. As high as $10,000 has been paid for one Clyde. Eight volumes of the 'American Clyde Stud-Book' have been published, containing 8,000 entries." The Shire horse is little esteemed in Canada, but in the American craze for heavy horses he finds admirers. There is an American stud-book of three volumes, with 4,100 entries, 3,500 of which represent imported horses. See HORSE-RACING; HORSES, TROTTING AND PACING.

MILTON YOUNG,
Lexington, Ky.

Horses, Military. The relative importance of the horse as a factor in the progress of civilization has been somewhat reduced by the introduction of steam and electricity, but mechanical devices such as the bicycle and automobile are not likely to wholly supplant the indispensable ally of man for war purposes. The value of cavalry has not, within the century, been so fully recognized as during the recent South African campaigns, where the supply of horses reached enormous proportions. The kind of horse for cavalry and artillery use is controlled by the character of service for which he is to be used. Hardy range horses are desirable in a campaign where the question of forage supply is a difficult one, but, if fully armed and equipped men of average size are to be transported and held in readiness for mounted combat with opposing cavalry, then larger and better trained horses are desirable.

The source from which cavalry horses are obtained differs in various countries. Some European nations breed and raise their remounts, while others provide the services of selected stallions gratuitously to breeders, the foals being held subject to purchase by the state. The American plan differs from the European practice and involves only the inspection of such animals as are presented by contractors. This encourages all farmers to breed a fair class of horses, and whenever the requirements of the markets increase the breeding usually increases until prices sometimes fall below a level at which colts can be profitably reared. Only a small percentage of horses raised in the United States are adapted to the requirements of cavalry service. This arises from the existence of a special and narrowly defined object to be attained, and which requires animals of particular conformation and character. The inspection of remounts for soundness and conformation is a very important duty, demanding technical training and intelligence. It requires judgment, much instruction and long practice to correctly estimate the relative value of various points of the horse and to determine whether the good qualities counterbalance the existing defects. Contractors do not usually present ideal animals, but the market from which they draw is so large that there is no serious difficulty in supplying the remounts annually required for the United States cavalry.

In European armies horses are accepted at four years of age, and sometimes under that age. It has been found in practice in the United States preferable to buy no horses under six years of age for immediate use in field service. Younger horses may be accepted during peace when there is no likelihood of immediate hard service, but they are subject to influenza or shipper's fever to a degree which often renders them unserviceable for many months. Good points in a cavalry horse are not mere matters of beauty, but shapes which, on mechanical principles, are likely to answer required ends. Cavalry horses must have certain qualifications, the most important of which are the possession of sufficient mobility to execute tactical maneuvers at varying degrees of speed and the ability to stand hard service while carrying great weight. The weight of trooper and equipment averages about one fourth the weight of the horse. Ability to carry flesh under stress of short rations is a commendable quality in a cavalry horse, since it enables him to stand hard work and to avoid a sore back. As a result of many years of experience the requirements demanded in the cavalry horse of the United States are laid down in the regulations in this language:

"The cavalry horse must be sound and well bred; gentle under the saddle; free from vicious habits; with free and prompt action at the walk, trot, and gallop; without blemish or defect; of a kind disposition; with easy mouth and gait, and otherwise to conform to the following description:

"A gelding of uniform and hardy color; in good condition; from fifteen and one fourth to sixteen hands high; weight not less than 950 nor more than 1,150 pounds; from four to eight years old; head and ears small; forehead broad; eyes large and prominent; vision perfect in every respect; shoulders long and sloping well back; chest full, broad, and deep; fore legs straight and standing well under; barrel large and increasing from girth toward flank; withers elevated; back short and straight; loins and haunches broad and muscular; hocks well bent and under the horse; pasterns slanting, and feet small and sound." See also HORSES, RIDING AND DRIVING.

W. H. CARTER,
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Horses, Riding and Driving. In the latter days of this country one can hardly go to even an insignificant town or village without finding that a number of its residents spend time and money in raising, training, and driving as good horses as their means will afford. Another striking feature of this country horsemanship is the rivalry and constant vying of each horse-fancier to excel among his fellows, and the interest manifested to-day in buying, selling and "swapping" horseflesh is typical of the American.

The county and state agricultural fairs, which now make the exhibition of horses a special feature, are largely the outgrowth of this far-reaching interest in horses. Nearly every country fair has, besides trotting and perhaps running races, a department for harness horses and breeders' competitions. As freight and passenger rates are commonly commuted by the railroads or the fair corporations, these meetings enable the farmer to see the best the country for miles around can produce, raise his standards and teach him the results to be attained by proper breeding.

The horse shows, held annually in many of our large cities, at regular seasons throughout the year, and so arranged that they may not conflict as to dates, invite competitors from all parts of the country, who exhibit what they have with fair prospects of making their expenses from the prize money won. These horse shows are fostered both as sporting and business institutions, and the best horsemen in the country form their directorates and act as judges. These large shows do much to establish the types of animals that meet with favor, and their growth and popularity has cultivated the taste and interest of the general public in horses more than any other factor.

The types of horses highly valued in the large cities and in the country are, of course, similar to a large extent. A good horse is good anywhere. Nevertheless, the requirements of a metropolitan market are much more exacting and extend to the many qualities which we will try to outline in this article. While the country is often satisfied with mere "getting there" qualities in the horse, regardless of how it is done, or perhaps a mere combination of speed and endurance, the standard of a large city calls for certain definite requisities and qualifications — "points" — which are well nigh indispensable if the horse is to command a good price.

To fill the requirements of the affluent class it is estimated that not more than 5 per cent of the horses throughout the country, including those raised with this object solely in view, can be utilized. Indeed, taste has become so fastidious that the right kind can only be found by diligent search, and prices verge into sums that 10 years ago would have been unbelievable. It must not be thought that the general run of horses in this country, or indeed that the quality of our native bred horses, has deteriorated in the past few years. Such, in the writer's opinion, is not the case. The fact is, that to fill the high requirements of the metropolitan market has become the recognized goal of all horse breeders; and it is now generally understood throughout the country that the market for the inferior horse is limited to those who can afford to pay so little that the breeder is not compensated for his care and outlay in breeding anything but the best. The general introduction of trolleys and electric vehicles has been an important factor in curtailing the market for horses that are merely "serviceable" and has reduced it to a competitive point that is unprofitable.

The high qualifications for the metropolitan market have reduced the available horses to such a small number that expert buyers search this country and the Dominion of Canada from one end to the other. Buying as cheaply as possible, so thorough has been the scouring of the country that the prices paid would seem fabulous to the seller if the cost alone of raising the horse were taken into consideration. The buyer must also assume the risk and expense of transportation to market.

The "points" for which the breeder is striving are well defined, but the individual may vary so much in combining them that the interesting feature of personal taste remains as the determining factor in selecting horses for personal use.

Heavy-Harness Horse.— The term "heavy-harness horse" is a general one. Under it may be classed anything from the 12 hand pony for basket-phaeton or village cart, through the various types suitable for the runabout, gig, brougham, victoria and other vehicles that fashion prescribes for various uses, to the 16–1 hand carriage horse for pulling the capitalist's omnibus.

The importation into this country, since 1883, of English hackneys and the exhibition of them has undoubtedly done much to educate the public to a type of carriage horse. While no disparagement is intended to the standard bred trotting horse, whose origin, indeed, is allied to the hackney — although his later history is somewhat different — the serviceable, short-backed, straight-legged and intelligent horse now the standard for metropolitan use is nevertheless nearer the hackney type than the old style American trotter. It should be stated, however, that very few either of the trotters or hackneys of 25 years ago would generally fill the requirements of the harness horse to-day. A type having been once well established, however, horses filling the requirements can be selected from carefully bred trotters as well as from hackneys, and one breed is often mistaken for the other, such is their closeness in resemblance and the result of breeding with particular ends in view. The elements to be taken into consideration in the harness horse are as follows: Conformation, manners, action, speed, color, size and age. Conformation ranks first in point of importance, but manners are an absolute essential also. These two although somewhat variable must be present in any horse required for harness; the others vary considerably according to the type and weight of the vehicle to which the horse is to be harnessed and the purchaser's personal taste.

The elements in the order of their importance from a purely selling point of view are:

1. Conformation as to head and neck. This is probably the first feature the average purchaser will look for. The horse should possess a small head, delicately molded nostrils and a small tapering muzzle. His jaw-bones should be well apart so that when the head is reined in they will not interfere with his breathing. He should have good sized eyes, well separated; a narrow forehead or small eyes being general indications of lack of intelligence, nervousness or a tendency to fright or bad temper. The ears should be small and well apart. The neck should be gently tapering and well cut out in the throat, and the so-called "crest" from which the mane grows should have the slight convexity which indicates strength, maturity and condition. The neck should be set on sloping shoulders, so that the head will be naturally held erect, turning upward from the forward line of the trunk nearly perpendicular. A tapering neck is an indication of breeding and fineness as distinguished from the coarseness of draft blood and the common horse in ordinary use.

2. Conformation as to legs. The general requirements are that all four legs shall be approximately straight and not too long. A moderately short-legged horse is generally preferred, both for looks and service, to one that depends upon long legs for height. The forelegs should be perpendicular when the horse is standing erect, bones flat, but not heavy or coarse. The hind legs, when in a natural position, should be so formed that a plumb line dropped from posterior point of the haunch will be nearly tangent at the point of the hock, the rear line of the leg below the hock being approximately parallel to the plumb line. The thighs should be moderately heavy at the height of the lower line of the trunk. The modern idea is that the horse's buttocks should be round and muscular viewed from behind. The pasterns of all four legs should be springy and long rather than short.

3. In general. The horse should be "close-coupled"; in other words, there should not be too much space between the last rib and the quarter. His trunk should be round and just fleshy enough so that his ribs may be felt — not seen. Standing on level ground the height of his withers and croup should be about the same. The trunk, directly under the withers, should be deep and the chest from the front view broad, giving room for the heart and lungs and an appearance of power. The belly should be well picked up beneath the kidneys with a gentle, convex, upward curve from between the front legs — not enough, however, to produce the waspy effect sometimes seen in horses otherwise well formed. The back should be short, lending to the trunk an appearance of compactness and solidity. The quarters should not fall away back of the kidneys more than an inch or so to the root of the tail. The tail, if set well forward of the posterior line of the horse's haunches, is generally admired, and in this position will be carried at the proper angle naturally.

Under the subject of *Manners*, full technical treatment should be sought in various books relating to horse training and breaking. We will endeavor to point out, however, to what extent manners in a harness horse is supplemental to ordinary training; to treat the subject fully being like attempting to describe what a gentleman should do under all circumstances. A few salient points will perhaps give a fair indication of the general subject.

The well-mannered horse should be so trained that when bitted his head is carried almost vertical, and close to his neck, which will be gently curved; the head and neck taken together being straight with the line of direction in which he is traveling. This position is not only graceful but gives the driver the utmost command over him. He should "fill his collar" without urging, but be light mouthed and susceptible to the slightest hint from the reins, voice or whip. He should be afraid of nothing and possess sufficient intelligence so that after first acquaintance with motor vehicles, railroad trains and other startling objects, he will pay no attention to them.

Into this subject therefore the question of natural disposition necessarily enters, as without a sensible but willing and high-strung disposition, it is impossible to produce a fashionable carriage horse. The horse should be trained to back and turn for the voice or with the slightest pressure of the reins without manifesting any disposition to shake his head or bore upon the bit. Plunging, rearing or trickiness must be absolutely eliminated, so that he is safe for a lady to drive through crowded city streets. He should be broken single, double and tandem, and to the saddle for convenience sake, and should be ready at any moment to serve in any one of these capacities.

All this mannering constitutes a supplemental or post-graduate education, for the horse as delivered from the country is broken, but commonly utterly devoid of manners. To accomplish this a training extending over a period of as much as three months is often necessary even with a horse that would be considered thoroughly broken in the country; and after mannering him as to how he shall carry his head and respond to the driver, it is necessary, so perfectly must the horse be trained to suit the metropolitan purchaser to spend a week or more in thoroughly accustoming him to city pavements and sights. It is almost superfluous to state that many horses cannot be brought to this high state of perfection, but the question of manners enters very largely into the price consideration, and the schooling should be carried on to as high a point as the disposition of the individual will admit.

While *Action* is not absolutely indispensable, it is nevertheless the feature that many amateur horsemen will look for first, often neglecting much more important points to secure the flashiness of the high actor. Many dealers say, "Give me action and I can sell anything." Without going to this extreme, it is undoubtedly true that high action will cover many sins, and if a horse will only "get his head up and act" he is apt to be salable. Without action speed seldom attracts the city purchaser, and while it is undeniable that high action, except with careful driving and stable attention, will often cripple a horse on hard pavements who might otherwise go sound for years, the average high-price buyer not only asks for clean, straight action, but verges to the danger point in its height. The expert will seek horses having action both in

1. Pure Arabian.
2. Arabian Stallion.
3. Shetland Pony.
4. Welsh Mountain Pony.
5. English Shire Stallion.
6. Clydedale Gelding.
7. French Coach Horse.
8. English Hackney.

front and behind as he knows that without hock action, little, if any, speed will be produced, the propelling force lying in the power of the thighs. He will look at the horse going, coming and sideways, first to see that the horse neither toes in, paddles or interferes in front; second, to see that he keeps his hocks close together as they pass, and consequently does not "straddle" or place his hind legs at the extreme forward stride outside of the line taken by his fore legs, or interfere by brushing either fetlock joint; third, that he does not forge and that his action is even when looked at from the side, each leg advancing at a stride the same distance and height as the corresponding leg on the other side.

The only gait admissible in the heavy harness horse is a trot. Pacing, racking, single-footing, or any gait other than a square line trot, by whatever term it may be called, have no place in the metropolitan market. The horse should strike out straight from the shoulder in front, the whole leg straightening at the instant the hoof touches the ground, the hoof striking flat. The straightened foreleg then passes under the body of the horse and is rolled up when it leaves the ground, the hoof nearly touching in extreme cases the point of the elbow joint. While still "folded" the arm bone reassumes the position for the next forward stride. As indicated above, the action of any single leg and hoof should be in a single longitudinal vertical plane. Some writers have endeavored to demonstrate, by projecting upon a longitudinal vertical plane the arc described by the forward point of the hoof from the time the horse picks up his foot from the ground until he touches it again, that the ideal action thus projected would form a symmetrical arc of an ellipse. While it is conceivable that such may be the case, it is practically impossible to determine slight variations from this ideal, and if the horse acts high, clean and straight without interference or forging he will not generally be open to criticism.

The modern buyer looks more and more nowadays for strong hock action, which means that the horse will cover ground and retain much of his action regardless of the amount of weight behind him.

While *Speed* is not a very important element in horses for carriage use, it would be a truism to state that people like to go fast, and of two individuals equal in other respects, the purchaser will prefer the horse that has the most "step." A discriminating dealer will commonly aim to secure horses that can go a mile under ordinary circumstances in 3½ minutes, and if possible in 3 minutes. This is, ordinarily, quite fast enough for salability, and the horse that will "road" steadily at 10 to 12 miles an hour and can increase the speed a little for a short spurt, fills the market requirements pretty fully.

In *Color,* modern fashion prescribes bays, chestnuts and browns, a dark seal brown being perhaps the most popular. Golden chestnuts are also popular, and blood bays are in high favor. Very few purchasers will consider a white or black horse, regardless of any number of other good qualities. Grays, except of the dark dapple variety, are rarely used, except in a cross-matched pair, and then only as a matter of personal fancy. In a road coach four, however, they are approved by the best authorities.

The amount of white on a horse is a matter of personal taste, many people liking white fetlocks and a star, stripe or blaze on a chestnut or bay's head, others preferring solid color. Bays are generally most popular with black points, but in general it may be stated that the horse possessing too much white will not please. One or two white legs, with white extending a short way to the knee or hock, will not be objected to, but it can be stated positively that, except for a leader or wheeler in a road coach team, where a showy effect is desired, there should be no white upon the body of the horse.

A sleek, shiny coat is a recommendation for any horse, as it usually bespeaks condition and breeding.

The question of *Size* is one that is a matter of personal taste primarily, and secondly, one of suiting the vehicle to which the horse is to be harnessed. The salable horse for ordinary city use is rarely under 14½ hands, and in the opinion of most judges should not exceed 16¼ hands. For a lady's phaeton a small team with considerable substance and not usually less than 14½ hands in height is required, and for a heavy omnibus sufficient weight and strength are usually secured in the horse whose height does not exceed 16 hands. The most salable size for horses in general use is about 15–2½ hands. Most buyers will restrict their purchases to horses between 15–1 and 16 hands, unless the animal is very remarkable in other respects, because customers for extremes in size are few in number, and such horses are consequently less readily salable.

A word should be said as to the *Age* of the marketable horse. It is pretty well understood that colts suitable for heavy harness do not attain maturity and maximum strength until they reach the age of five or six years, and the ordinary purchaser will prefer the six-year-old horse. From seven to 10 years the horse is at his best. While some horses hold their good qualities and are serviceable up to an extreme age of perhaps 20 years,— in the city horses rarely stand the strain of travel on hard pavements for many years without showing signs of usage sufficient to render them unsalable, except at small prices.

Horses kept for the show-ring and therefore not subject to usage on hard pavements exemplify the fact that there is little or no advantage *per se* in the young horse. Indeed, the horse may be at his best at the age of 10 years, and many of the blue ribbon winners of the past few years are even somewhat older.

The Saddle Horse.— Neglecting the subject of chargers and hunters, the former having but a limited market and being generally subject to army specifications, and the latter constituting too large a subject for discussion in an article of this character, and of more interest abroad, especially in England and Ireland, than in America, we shall say a few words of the saddle horse, presenting as briefly as possible some of the facts which should be borne in mind in supplying the market.

The conformation of the saddle horse will not be found to differ very materially from the carriage horse, and many private owners, who do not feel able or warranted in stabling horses for saddle purposes only, will find a combination horse for saddle and harness use a possibility. A saddle horse is not improved in gait by being harnessed to a vehicle, particularly a heavy one, in fact is impaired thereby, but moderate driving to light vehicles will not incapacitate him wholly for the saddle.

In a "park hack" we should look for somewhat substantial conformation. As in a carriage horse, depth of girth should be sought and the back should be short, all the distance possible, however, separating the forelegs from the hind, the horse having much of his length in his shoulders and quarters. The croup should be long, so that, taken in combination with high and prominent withers and heavy shoulders, the saddle will have a good seat and be prevented from slipping forward. As in the hind legs reside the seat of propelling power the thighs should be long and muscular, and some people prefer the hocks well bent. The pasterns should be somewhat longer and have more spring than in the harness horse.

As in the harness horse the saddle horse should be about the same width in front as behind. Many will not object, however, to a horse slightly wider behind than in front, as the claim is made that, in a gallop, the hind legs will better pass outside of the forelegs; but, under no conditions should the horse be wider in front than behind. He should have a moderately long and upright neck and a prominent crest, as this is the muscle that supports his head, and the neck should be arched. With this combination a horse will usually carry his head erect without support from the reins, and the rider will have better control and feel that he has something in front of him.

The manners of a saddle horse is an element worthy of particular notice. Besides the qualities and disposition valuable in a harness horse, primarily he must possess a high degree of intelligence and be absolutely fearless: and he needs a further education to make him "bridle wise." By this term is indicated response to the slightest pressure of the rein on either side of the neck, so that the horse turns readily by the lateral movement of the rein hand. This allows the rider one hand free for use or emergency.

As to gait and action, the horse should have a fast walk, so that when ridden in company he will keep up without breaking into a jog. The trot should be even, springy and regular, so as not to jolt the rider. Extreme action is not a necessary feature, but the horse should possess enough action to be noticeable in company; and high action is not a detriment if unaccompanied by pounding. An easy canter and gallop are necessities, and particularly is this true of the horse intended for long rides or to be used in the country. These gaits should be accomplished with a maximum of forward motion and a minimum of rocking.

Types and sizes of saddle horses vary greatly according to personal taste and the weight to be carried. Some desire a short-legged, thickset cobby horse for weight-carrying, while those of lighter build may prefer a taller horse of less substance and more speed. Above all things the horse should be free and willing, as no man desires, or will tolerate, a horse needing constant urging.

Breeding.— A word or two as to breeding may not be inappropriate, as the requirements of the market are so exacting that every breeder should take them into consideration, in order to produce and raise as large a percentage of marketable horses as possible.

Much has been written upon the subject of horse breeding and genealogy in America, and careful investigation reveals much shallow erudition. The results of recent research have shed sufficient light upon this subject to show that much of the published matter as to the ancestry of the American trotter will not bear close investigation. Heretical as it may seem, the history and origin of the Hambletonian strain of blood, which for years has been held in high esteem among breeders throughout the country, we believe is open to reasonable doubt as to its authenticity. It does not seem unlikely that some of the breeders, in their desire to create a lineage for their horses, drew on their imagination for the breeding of the ancestors. After many years of assumption that the published facts were correct, grave doubt is now cast upon the breeding of some of the original stock. Perhaps, therefore, the less we attempt to demonstrate results by referring to the lineage of the standard bred trotting horse the safer.

Of the other breeds of this country perhaps the best known are the Morgans and Clays, but generally speaking, such numerous and often careless crosses have been tolerated that these breeds in anything like purity of blood have mostly disappeared. In the author's opinion, up to a recent date, the breeder in America has sought speed to the detriment of action, even going so far as to make conformation a secondary element.

A word should be said about the Hackney. Much confusion has resulted temporarily, and probably only temporarily, from the placing on the market of so-called Hackneys, which are such only in conformation and not in the action and speed which are characteristic of the Hackney of honest blood. This breed lends itself exceedingly well to the requirements of the heavy harness horse when proper individuals are used in the stud. Although at present there are but few such individuals in this country, the Hackney dates back in England to the 18th century. It was originally a cross between the shire or English cart horse, an animal somewhat coarse but of much substance, power and action, and the sleeker thoroughbred of delicate conformation and high strung temperament. So well has this breed been cultivated, to the elimination of the coarser individuals by a few reputable breeders in this country, that it is not difficult for the careful judge to discriminate.

Recently, American breeders have achieved extremely satisfactory results by crossing hackney stallions with clean-limbed, nicely turned trotting-bred mares, and while this cross is one that breeders claim should not be carried beyond one generation for fear of the infusion of cold blood in the offspring, a single cross certainly produces a large percentage of good marketable stock. This cross commonly combines high action and much substance with speed and breedy appearance.

As most scientific breeders now acknowledge, the main fact of all breeding is that it is a matter primarily of individuals, good lineage counting for little in the produce if the breeding stock do not themselves fill all the requirements desired. Not only should care be taken to use proper individuals, but if a slight fault exists in either parent — no horse being absolutely perfect — the other should be selected especially proficient in what the one lacks.

Back of the standard bred trotting horse, Morgan, Hackney and French coach horse — another imported breed — stand practically the same Arabian ancestors, and as all are to-day bred with one end in view, the choice of one breed as against the others is a matter of selecting the individual best filling requirements.

If the main purpose be to breed for that market which is the most profitable, that of the heavy harness horse, it seems to the author that, instead of horses becoming standard by performance on the track if they became standard by performance in the show-ring all the qualities desired as well as speed would be more properly conserved. Of course, many practical difficulties, some of which would defeat the very ends sought, stand in the way of such a movement unless it were conducted by the government. A stud book formally conducted by the government and authentically recording the lineage and performances of stock, so that the history of a strain and the results of crosses might be generally published and read, would be of immense value to the horse breeder and to the government itself by raising the quality and value of the horses raised both for domestic use and export.

An interesting commentary on the subject of the harness horse and an evolution well worth notice is the gradual elimination of the unreliable small dealer in the metropolis: in fact, the market is fast falling into the hands of the comparatively few reputable dealers who endeavor to conduct their business on broad commercial lines. The purchasing public are beginning to recognize that it is best for their interests to patronize such dealers as can rather afford to take a loss on an unsound or unsafe animal by giving him away than to sell him under a misrepresentation and make a financial gain at the expense of reputation. This fact is not only an assurance that the interest manifested in the horse in our large cities will not decrease, but the business being in good hands that many who have in the past been slow to venture into this field of pleasure and sport can now enter into it as beginners without a long, unsatisfactory and expensive experience as a preliminary. See also Horses, American Thoroughbred.

Arthur Max,
Sec'y Standard Coach Horse Co., New York.

Horses, Trotting and Pacing. The harness racing horse has two gaits, namely, the trot aand the pace. They were both originally the connecting link between the walk and the gallop, but by development and careful training have come to take the place of the latter so far as extreme speed in harness is concerned. The term "diagonal gait" is applied to trotting because the horse employing it raises simultaneously a front and hind foot at opposite sides of the body. In pacing the front and hind feet on the same side move together, and this is best expressed as the "lateral gait." No one has yet been able to explain why a horse goes at one or other of these gaits when urged from the walk and guided by the rein to keep from the gallop.

The history of harness racing in America is practically contemporaneous with that of the Republic of the United States. After the Revolution the development of speed in the horse had its attractions here as in Europe. At first the running gait was the only one considered, but the importation of an English sire called Messenger marked the beginning of a new era. He was brought over in 1788 and landed at Philadelphia. Though descended from stock that inclined to the gallop and practically a thoroughbred, this horse was more inclined to the trot. What is more remarkable he transmitted this habit or instinct to so marked a degree that he made a great reputation in the New World through the superiority of his progeny over all other breeds. So "Imported Messenger," as he was popularly known, was the patriarch of the American trotter, and nearly all of the immense troop of harness racers in this country to-day trace descent to him. His death in 1808 near Oyster Bay, N. Y., was looked upon as a national calamity, and he was buried with military honors, the funeral being attended by prominent horsemen from all the neighboring States. As this horse was the founder of a notable family and represents a type in some respects separate and distinct from others of the *genus equus* it seems unfortunate that no portrait or drawing of him was ever made. There is a pen picture which in some measure atones for this, and is worth quoting. It describes Messenger as of a gray color, standing full 15 hands 3 inches in height, with a thin mane and tail, ears larger than most well bred horses, but erect and lively.

At the time of Messenger's death the limit of speed at the trot was in round numbers a mile in three minutes. The saddle was chiefly in vogue for this gait as well as running, but the employment of a vehicle with two wheels followed the building of better roads. According to J. H. Wallace, an authority on the thoroughbred, a chestnut horse trotted at Philadelphia in a sulky 25 Aug. 1810, one mile in 2:48½ for $600. The horse was fourteen years old and barely 15 hands high. There is an earlier feat now accepted as authentic of a horse called Yankee, trotting a mile in 2:59 in 1806 on Harlem Lane, a favorite driving place for New Yorkers. The breeding of these first champions of the sulky remains in obscurity, but it was not long before the descendants of Imported Messenger began to do greater things Topgallant, who is credited with three miles in 8:11 and easily the best trotter of his day, was inbred to Messenger, his sire and dam both being by the potent English stallion. Screwdriver, who went three miles to saddle in 8:02 a year before this, was another of the stars descended from Messenger, as was Dutchman, another long distance trotter, who went his three miles under saddle in 7:32¼; but the most famous of the Messenger brood in the nearer generations was Lady Suffolk. She was the first queen of trotters, her reign being a long and undisputed one from 1838 to 1852. She enjoys the special distinction of being the first trotter to score as fast as 2:30 for a mile in harness. Following Lady Suffolk there were a few lesser lights that improved slightly on her best record, but her real successor as a conqueror of time was Flora Temple. She was foaled in 1845, her turf career beginning in 1852. Five times this wonderful mare reduced the figures that represented the speed limit, her greatest effort being 2:19¾. Then came the mighty Dexter, who reduced the record to 2:17¼. His public career was cut short when Robert Bonner purchased him and took him to New York for his private driving on the road. Goldsmith Maid came out in 1871 and clipped a fraction from Dexter's mark. She was foaled in 1857, made her debut at 10 years and continued to fill engagements in races and against time up to 1877. Rarus managed to improve Goldsmith Maid's record a trifle during a very creditable career. The gelding St. Julien eclipsed him a year after by a full second. Then a new queen appeared in Maud S., and between this fleet pair was a lively duel for the championship. The figures were improved by fractions of a second until the mare reached 2:10¾ in 1880, which proved too much for the gelding. After his surrender another candidate appeared in Jay Eye See. Meantime Maud S. had got down to 2:10¼, but Jay Eye See enjoys the distinction of being the first to touch the even 2:10. This was in 1884, and then the mare showed that she was the better horse by compassing the track in 2:09¾, and again in 2:08¾.

The greatest mechanical aid to the harness horse that has yet been devised came into use during 1892. This was the application of the ball-bearing axle first applied to the bicycle, with the pneumatic tire and a wheel of about 28 inches diameter. Its first public trial was in a race at Worcester, Mass., early in May, where its manifest advantage enabled a slow horse to fairly play with a field of faster competitors. None of the prominent trainers had seen this new contrivance, and it was not until well along in July when they awoke to a full realization of its merits. The writer was privileged to see and try this sulky with its frictionless gear before it had come into general use, and on exploiting it with a conservative opinion that a horse could go at least two seconds faster than if hitched to the high wheel sulky, was informed by Budd Doble, the leading reinsman of that day, that he was the victim of a hoax. Less than three months after this same Doble had driven Nancy Hanks to one of these smooth running machines a mile in 2:04, or nearly five seconds faster than the record of Maud S. This material reduction was only the beginning of a new era in speed, as four other trotters have taken advantage of this appliance and earned the championship in turn. Alix only clipped a quarter of a second from the mark set by Nancy Hanks, but she did this after a hard race campaign that took away from her real ability. It was six years before this resolute overworked mare had to surrender the crown, when in 1900 the Abbot trotted in 2:03¼. He had previously won his spurs in several creditable races, but his successor and conqueror, Cresceus, proved to be a much more remarkable representative of his kind. Starting at three years this Hercules among trotters met and defeated older and more seasoned campaigners in his colthood, scoring 2:11¼ in the eighth heat of a winning race. Then each successive season found Cresceus able to add to his laurels until in 1901 he earned the championship twice. His record of 2:02¼ was followed by the famous match against The Abbot at Brighton track, Brooklyn, N. Y., 15 August, when, in the presence of an immense crowd, many of whom came hundreds of miles to see this battle of the giants, Cresceus was the victor. It was no light task at first, as The Abbot forced him to go in 2:03¼, the fastest mile by nearly two seconds ever scored in a trotting race. Besides these feats Cresceus has lowered many other records, including the one for two miles which he placed at 4:17 late in 1902. During the season of 1903 he again battled against time, and after his previous championship record had been several times beaten by Lou Dillon and Major Delmar this stout warrior trotted in 1.59¾ at Wichita, Kan., in October 1903.

Before this great feat his star was momentarily eclipsed by the advent of the long expected and much desired two-minute trotter. So suddenly has this new marvel appeared, and so rapidly has she reached the goal that hitherto seemed unattainable that the world at large cannot fully appreciate the merit of what Lou Dillon has accomplished. To begin with, she is the youngest of all the champions, being but five years old. What is even more remarkable, her turf life extends over little more than 12 months, and up to last June she had never filled a public engagement. Yet within a few weeks this marvelous mare has smashed records and on 22 Aug. 1903 she electrified the country by a mile in two minutes. This was done over the track at Readville, near Boston, where six years before the pacer Star Pointer scored the first mile ever made faster than "even time." An analysis of Lou Dillon's unparalleled flight for a trotter shows that she was rated with great skill. At the Brighton track just a week before she had gone a first quarter in 28¾ seconds, and a half mile in 59 seconds, a killing rate, which destroyed any chance she had of finishing in time to break the record. Profiting by this experience her driver and those who handled the two gallopers hitched to separate carts that accompanied her as pace makers, did much better work at Readville. This is shown by the time at the various quarters, which was 30¼, 30½, 30¼, and 29 seconds, respectively. While a full meed of praise is always due to the man or horse that does something better than what has previously been achieved, it is only fair to state that Lou Dillon has enjoyed special advantages in her preparation for record breaking. She was first trained in the winter of 1902 on the track at Pleasanton, California, her native State, and on the death of her breeder and owner this year was brought to Cleveland and sold at auction. The purchaser, C. K. G. Billings, of Chicago, got a rare bargain at $12,500, and being strictly an amateur he promptly canceled all engagements previously made for this promising mare. She then received special training for miles against time, and not only astonished the world by her mile in even time at Boston, but a few days later drew the old-style sulky with high wheels, in 2:05 at Cleveland, clipping three seconds and three quarters from the record Maud S. made nearly 20 years before. Later on, at Memphis, Lou Dillon added to her fame by another mile in 1:58½ to sulky, and one to wagon in exactly 2 minutes. She also defeated Major Delmar in a race for the Memphis Gold Cup, and being only in the heyday of her power, it is within the realm of possibility that she will pass the mark for pacers. This now stands at 1:56¼, made by Dan Patch at Memphis, 22 October 1903.

The following table gives the names of all the record makers among the trotters, and shows how the figures have been reduced from 2:30 to 2:00:

Lady Suffolk, gr. m. foaled 1833, by Engineer 2d, dam by Don Quixote. Driven by David Bryan, Beacon Course, Hoboken, N. J., Oct. 13, 1845, *2:29½*.

Pelham, b. g. foaled 1837, pedigree not traced. Driven by William Whelan, Centreville, N. Y., July 2, 1849, *2:28*.

Highland Maid, b. m. foaled 1847, by Saltram; dam Roxanna, by Hickory. Driven by F. J. Nodine, Centreville, N. Y., June 15, 1853, *2:27*.

Tacony, ro. g. foaled 1844; by Sportsman; dam not traced. Union Course, N. Y., July 14, 1853, *2:27*.

Flora Temple, b. m. foaled 1845, by Bogus Hunter; dam Madam Temple, by Terry Horse. Driven by Hiram Woodruff, Union Course, East New York, N. Y., Sept. 2, 1856, *2:24½*.

Flora Temple. Driven by James D. McMann, Centreville, N. Y., Aug. 9, 1859, *2:23½*.

Flora Temple. Driven by James D. McMann, Centreville, N. Y., Aug. 9, 1859, *2:22*.

Flora Temple. Driven by James D. McMann, Cincinnati, Ohio, Oct. 7, 1859, *2:21½*.

Flora Temple. Driven by James D. McMann, Kalamazoo, Mich., Oct. 15, 1859, *2:19¾*.

Dexter, br. g. foaled 1858, by Hambletonian; dam Clara, by American Star. Driven by Budd Doble, Riverside Park, Boston, Mass., July 30, 1867, *2:19*.

Dexter. Driven by Budd Doble, Buffalo, N. Y., Aug. 14, 1867, *2:17¾*.

Goldsmith Maid, b. m. foaled 1857, by Alexander's Abdallah; dam Ab. by Abdallah. Driven by Budd Doble, Milwaukee, Wis., Sept. 6, 1871, *2:17*.

Goldsmith Maid. Driven by William H. Doble, Mystic Park, Boston, Mass., June 9, 1872, *2:16¾*.

Occident, br. g. foaled 1863, by Doc; dam Mater Occidentis, pedigree not traced. Driven by George Tennet, Sacramento, Cal., Sept. 17, 1873, *2:16¾*.

Goldsmith Maid. Driven by Budd Doble, East Saginaw, Mich., July 16, 1874, *2:16*.

Goldsmith Maid. Driven by Budd Doble, Buffalo, N. Y., Aug. 7, 1874, *2:15½*.

Goldsmith Maid. Driven by Budd Doble, Rochester, N. Y., Aug. 12, 1874, *2:14¾*.

Goldsmith Maid. Driven by Budd Doble, Mystic Park, Boston, Mass., Sept. 2, 1874, *2:14*.

Rarus, b. g. foaled 1867, by Conklin's Abdallah; dam Nancy Awful, by Telegraph. Driven by John Splan, Buffalo, N. Y., Aug. 3, 1878, *2:13¾*.

St. Julien, b. g. foaled 1869, by Volunteer; dam Flora, by Harry Clay. Driven by Orrin Hickok, Oakland, Cal., Oct. 25, 1879, *2:12¾*.

Maud S., ch. m. foaled 1874, by Harold; dam Miss Russell, by Pilot Jr. Driven by W. W. Bair, Rochester, N. Y., Aug. 12, 1880, *2:11¾*.

St. Julien. Driven by Orrin Hickok, Rochester, N. Y., Aug. 12, 1880, *2:11¾*.

St. Julien. Driven by Orrin Hickok, Hartford, Conn., Aug. 27, 1880, *2:11¼*.

Maud S. Driven by W. W. Bair, Chicago Driving Park, Chicago, Ill., Sept. 18, 1880, *2:10¾*.

Maud S. Driven by W. W. Bair, Homewood Park, Pittsburg, Pa., July 13, 1881, *2:10½*.

Maud S. Driven by W. W. Bair, Rochester, N. Y., Aug. 11, 1881, *2:10¼*.

Jay Eye See, bl. g. foaled 1878, by Dictator; dam Midnight, by Pilot Jr. Driven by Edwin Bither, Providence, R. I., Aug. 1, 1884, *2:10*.

Maud S. Driven by W. W. Bair, Cleveland, Ohio, Aug. 2, 1884, *2:09¾*.

Maud S. Driven by W. W. Bair, Lexington, Ky., Nov. 11, 1884, *2:09¼*.

Maud S. Driven by W. W. Bair, Cleveland, Ohio, July 30, 1885, *2:08¾*.

Sunol, b. m. foaled 1886, by Electioneer; dam Waxana, by Gen. Benton. Driven by Charles Marvin, Stockton, Cal., Oct. 20, 1891, *2:08¼*.

*Nancy Hanks, br. m. foaled 1886, by Happy Medium; dam Nancy Lee, by Dictator. Driven by Budd Doble, Chicago, Ill., Aug. 17, 1892, *2:07¼*.

Nancy Hanks. Driven by Budd Doble, Independence, Ia., Aug. 31, 1892, *2:05¼*.

Nancy Hanks. Driven by Budd Doble, Terre Haute, Ind., Sept. 28, 1892, *2:04*.

Alix, b. m. foaled 1888, by Patronage; dam Atlanta, by Attorney. Driven by Andy McDowell, Galesburg, Ill., Sept. 19, 1894, *2:03¾*.

The Abbot, b. g. foaled 1893, by Chimes; dam Nettie King, by Mambrino King. Driven by Ed. Geers, Terre Haute, Ind., Sept. 25, 1900, *2:03¼*.

Cresceus, ch. h. foaled 1894, by Robert McGregor; dam Mabel, by Mambrino Howard. Driven by George H. Ketchum, Cleveland, Ohio, July 26, 1901, *2:02¾*.

Cresceus. Driven by George H. Ketchum, Columbus, Ohio, Aug. 2, 1901, *2:02¼*.

Lou Dillon, ch. m. foaled 1898, by Sidney Dillon; dam Lou Milton, by Milton Medium. Driven by Millard F. Sanders, Readville, Mass., Aug. 24, 1903, *2:00*.

Lou Dillon. Driven by M. F. Sanders to high wheel sulky, Cleveland, Ohio, September 12, 1903, 2:05.

Cresceus. Driven by George H. Ketchum, Wichita, Kan., Oct. 19, 1903, *1:59¾*.

Lou Dillon. Driven by M. F. Sanders, Memphis, Tenn., Oct. 24, 1903, *1:58½*.

*First champion mile to bicycle sulky.

The progress and development of the lateral or pacing gait has kept side by side with trotting. Before Lady Suffolk had opened the door for the 2:30 list, the pacer Drover had gone a mile in 2:28. For over a century the lateral gait has kept a second or more ahead of the diagonal one. Dividing the century, since speed in harness for a mile was first considered, into two decades we are able to compare the two gaits and note the progress of each by the following table. The names of pacers are in italics:

	1800-1810.		
Yankee, b. g.	Harlem, N. Y.		2:59
	1810-1820.		
Boston Horse, ch. g.	Philadelphia, Pa.		2:48½
Bolton Blue, bl. g.	Jamaica, N. Y.		3:00
	1820-1830.		
Topgallant, b. g.		1829—3 miles	8:11
Bowery Boy.		1829—2 miles	5:04½
	1830-1840.		
Edwin Forrest, bl. g.	(to saddle)	1834	2:31½
Sally Miller, b. m.		1834	2:37
Drover, b. g.		1839	2:28
	1840-1850.		
Lady Suffolk, gr. m.		1845	2:29½
Moscow, b. g.		1845	2:30
Pelham, b. g.		1849	2:28
Jomes K. Polk, ch. g.		1845	2:27
	1850-1860.		
Flora Temple, b. m.		1859	2:19¾
George M. Patchen, b. h		1859	2:26¼
Ethan Allen, b. h.		1858	2:28
Pocahontas, ch. m.		1855	2:17¼
Pet, ro. g.		1852	2:18½
	1860-1870.		
Dexter, br. g.		1867	2:17¼
Goldsmith Maid, b. m.		1869	2:19½
George Wilkes, br. h.		1868	2:22
George M. Patchen, b. h.		1860	2:23½
Ethan Allen, b. h.		1860	2:25½
Billy Boyce, b. g.	(to saddle)	1868	2:14¼
	1870-1880.		
St. Julien, b. g.		1879	2:12¾
Rarus, b. g.		1878	2:13¼
Goldsmith Maid, b. m.		1874	2:14
Smuggler, br. h.		1876	2:15¼
Sleepy Tom. ch. g.		1879	2:12¼
Rowdy Boy, bl. g.		1879	2:13¾
	1880-1890.		
Maud S., ch. m.		1885	2:08¾
Jay Eye See, bl. g.		1884	2:10
St. Julien, b. g		1880	2:11¼
Axtell (3 yrs.), b. h.		1889	2:12
Maxie Cobb, b. h.		1884	2:13¼
Phallas, b. h.		1884	2:13¾
Johnston, b. g.		1884	2:06¼
Gold Leaf (4 yrs.), ch. m.		1889	2:11¼
Little Brown Jug, b. g.		1881	2:11¾
Brown Hal, br. h.		1889	2:12½
	1890-1903.		
Lou Dillon, ch. m.		1903	2:00
Cresceus, ch. h.		1903	1:59¾
Major Delmar, b. g.		1903	2:00¼
Cresceus, ch. h.		1901	2:02¼
The Abbot, b. g.		1900	2:03¼
Alix, b. m.		1894	2:03¾
Nancy Hanks, br. m.		1892	2:04
Azote, b. g.		1895	2:04¾
Directum, bl. h.		1893	2:05¼
Stamboul, br. h.		1892	2:07½
Arion, b. h.		1893	2:07¾
Kremlin, b. h.		1892	2:07¾
Martha Wilkes, b. m.		1892	2:08
*Lou Dillou.		1903	2:05

*Sunol, b. m.	1891	2:08¼
*Palo Alto, b. h.	1891	2:08¾
*Direct.	1891	2:06
Dan Patch, br. h.	1903	1:56¼
Prince Alert	1903	1:57
Star Pointer, b. h.	1897	1:59¼
John R. Gentry, b. h.	1896	2:00½
Prince Alert, b. g.	1902	2:00
Joe Patchen, bl. h.	1897	2:01¼
Robert J., b. g.	1894	2:01½
Mascot, b. g.	1892	2:04
Hal Pointer, b. g.	1892	2:04½
Direct, bl. h.	1892	2:05½

*Made to high wheel sulky.

In the matter of breeding, reference has already been made to the fact that the imported horse Messenger, who played so important a part in the generation of harness horses, was of running stock. His descendants that have influenced this type more than any others were Rysdyck's Hambletonian and Mambrino Chief. The former was the son of Abdallah, whose sire Mambrino was by the English Messenger. This same Mambrino was also the grandsire of Mambrino Chief, so that his blood more than that of any of the get of Messenger has been potent in the production of the numerous fast exponents of the two harness gaits. Bellfounder, another English horse, brought over to Boston in 1823, had also much to do in founding the American trotter. His origin seems to be obscure, but he was probably of the type known as the Norfolk Roadster, from which the hackney has sprung. The most famous of his progeny in the first generation was the Charles Kent Mare, the dam of Rysdyck's Hambletonian. At least 75 per cent of what are called "Standard bred" trotters trace to this sire, and as none of the rest of Abdallah's get amounted to much there is every reason to believe that this daughter of imported Bellfounder had the inherent quality which made the Hambletonian strain so valuable. Every one of the champion trotters that succeeded Flora Temple are descended directly from this horse, Dexter himself being one of his sons.

To show how the "fast list," as it is called, has increased since the day of Lady Suffolk and Drover, it may be stated that up to the close of 1902 there were 18,548 trotters with records of 2:30 or better, and 9,713 pacers credited with marks of 2:25 or better. In each case these figures represent what is known as "standard" speed at the respective gaits. See HORSE-RACING.

CHARLES ARNOLD MCCULLY,
Secretary New York Trotting Association.

Horseshoe Falls. See NIAGARA FALLS.

Horstmann, Ignatius F., American Roman Catholic prelate: b. Philadelphia, Pa., 16 Dec. 1840. In 1857 he was graduated from the Central High School, and afterward attended Saint Joseph's College, Philadelphia. Desirous of studying for the priesthood, he went to the Preparatory Seminary of Glen Riddle in 1859, and in 1860 entered the American College, Rome, where, after completing his course, he was ordained priest by Cardinal Patrizzi, 10 June 1865. In 1866 he took in Rome the degree of doctor of theology, and in the same year returned to Philadelphia and accepted the chair of mental philosophy in the diocesan seminary of Saint Charles Borromeo, continuing to hold the same position in the new seminary at Overbrook. In 1877 he became pastor of Saint Mary's Church, Philadelphia, and in 1885 was named chancellor of the archdiocese. On 29 Nov. 1891 Leo XIII. appointed him to the vacant see of Cleveland, Ohio, and he was consecrated bishop 25 Feb. 1892. The diocese now (1905) has a Catholic population of 300,000; 296 priests; 287 churches; 1 seminary; 166 parochial schools; 7 orphanages; 9 hospitals, and several charitable institutions.

Horticulture, the art of growing plants, flowers, and vegetables for aiding in sustaining life, maintaining health, and for ornamental purposes. While as an art it is the highest type of work which pertains to the cultivation of the soil, its principles are based on many branches of science. Plant physiology, chemistry, and physics play important roles in every branch of this work and the application of their laws, directly and indirectly, constitutes the more essential features of the art.

Adopting Bailey's plan of division (Annals of Hort., 1891), horticulture may be discussed under four heads: (1) Pomology or fruit-growing; (2) olericulture or vegetable-growing; (3) floriculture or the growing of flowers and plants for ornamental and other purposes; (4) landscape gardening, or the growing of plants and the grouping of them for the purpose of enhancing the beauty and value of landscape.

In no country in the world has pomology or fruit-growing made such advances as in America. In the early history of the country fruit-growing was of necessity given minor attention. The clearing of the wilderness and the opening of new territory always involve attention to purely utilitarian projects first; hence there is little record of systematic or extensive fruit planting in this country prior to the beginning of the 19th century. Naturally, fruit was planted by the very earliest settlers, but this was done more as an effort to supply individual needs than as a means of profit. Thus, in the middle of the 16th century the early Spanish settlers made plantings of fruits in Florida and elsewhere, and early in the 17th century the English did considerable in the matter of planting fruits in Maryland and Virginia and elsewhere in what is now the eastern United States. Grapes especially received early attention, and numerous attempts were made to establish vineyards of European sorts in different parts of America. None of these early attempts, however, was very successful; and when it was found that the European kinds were so poorly adapted to the conditions of the regions then occupied by settlers, attention was turned to the improvement of our native forms. There is probably no more striking example of what can be accomplished by careful horticultural work than the results secured in the improvement of our native forms of American grapes. From the wild types so abundant in our native woods have come practically all of the fine table and wine varieties that are grown in the United States and Canada east of the Rocky Mountains to-day. The work mentioned did not involve any questions of fruit-growing on an extensive scale such as we find now. Nearly every farm in those early times had fruit grown upon it, partly for home use and partly for sale if there was produced more than was required for home consumption. With varying changes caused by the increase in population, the improvement in living conditions, and the demand for more fruits, fruit-growing progressed, until about 50 or 60 years ago it began to take on a new aspect. It was at this time that fruit culture in its broadest sense showed marked development as an independent commercial industry; hence in looking back we find the beginning of such important lines of work as commercial apple, pear, peach, and grape growing, commercial small-fruit-growing, etc. With the advancement of this work came the gradual development of horticultural sections or the localization of horticultural work in certain special localities where experience had shown that the best results were secured in the matter of production, marketing, etc. The peach districts of Delaware, Maryland, New Jersey, Michigan, Connecticut, and Georgia, the grape districts of New York and Ohio, and the apple region of western New York are examples of this movement toward centralization or specialization. With the further increase of population, especially in cities, the improvement in transportation facilities and better knowledge as to climatic and soil conditions, more and more centralization and specialization resulted. With the growth of the fruit interest of the Pacific coast and of Florida and other portions of the South, new features were added to the entire work. Thus has been developed commercial pomology as we find it to-day in this country, involving (1) the production of fruits of high quality, and (2) the harvesting, packing, storing, and transportation of such fruits to market so as to secure the highest prices with a minimum expenditure of outlay for the work. Still further involved in these questions are, of course, other important ones, such as tillage, pruning, spraying, etc., which it is not necessary to discuss here.

According to the figures of the 12th census, the value of all fruits produced in the United States for 1899 was, in round numbers, $131,000,000. Of this amount the orchard fruits had a value of $83,000,000, grapes $14,000,000, small fruits $25,000,000, and sub-tropical fruits $8,000,000. The great fruit districts are shown by the fact that of the $131,000,000 of fruit produced, California furnished $28,000,000 worth, New York $15,000,000, Pennsylvania $10,000,000, Ohio $9,000,000, Michigan $6,000,000, Illinois $5,500,000, Missouri $4,500,000, and Indiana $4,500,000, all in round numbers. The exportation of American fruits to foreign countries is rapidly assuming important proportions. For the fiscal year 1902 the total value of fresh, dried, and canned fruits and nuts exported from the United States was $8,719,344. With the rapid development of fruit-growing in this country there has been felt the need for careful systematic studies of the many varieties in cultivation and offered for cultivation. Systematic pomology, therefore, is an important branch of the work, and is being given special attention by the General Government and by the various State experiment stations and agricultural colleges.

Olericulture or vegetable gardening is an important branch of horticulture, and from time immemorial the art has been practised both for pleasure and for profit. Vegetable gardening proper does not include the growing of such crops as Irish potatoes, sweet potatoes, sugar-beets, shell beans, etc., where the same are produced in large quantities and are handled as ordinary farm produce. Vegetable gardening proper, as we understand it, embraces market gardening, truck-growing, and the growing of vegetables under glass. No sharp lines can be drawn between any of these industries, as they merge in many cases one into the other. Growing vegetables, as already indicated, has long been practised and was a feature in nearly every home in the early days of the country. With increasing population and the consequent demand for more luxuries and more variety, gardens began to expand, and thus was developed the work of market gardening in the vicinity of the larger cieies. Although market-gardening and truck-farming merge closely into each other, market-gardening proper, as a rule, is held to apply to the growing of vegetables for the local market, while truck-growing and truck-gardening imply the shipment of produce to a considerable distance, either by rail or in other ways. Truck-growing proper, on a large commercial scale, has developed practically within the last 25 years and owes its rapid growth largely to the improved transportation facilities and the rapid extension of railroads north and south along the Atlantic coast. The trucking interests proper were an outgrowth from the market garden work in the vicinity of New York. Gradually this work was pushed out to Long Island, and thence it spread to the lands adjacent to Chesapeake Bay, where fast sailing boats made it possible to bring the produce quickly into the markets of the larger cities. The work at first centralized at points where good harbors made regular steamship service available, but rapidly extended south along the lines of the Atlantic coast railways, and now has reached important developments in Virginia, North Carolina, South Carolina, Florida, and other Southern States. There is also another important truck region which has developed along the lines of the Illinois Central Railway in the Mississippi Valley, the crops grown in this region being shipped to the cities north and from them disseminated to large towns and cities, both east and west. More recently there have been large developments in this line in eastern Texas and southern and central California, each region now shipping early vegetables northward and eastward to the extent of thousands of carloads annually. The development of the winter growing of vegetables in the South and elsewhere has to some extent modified the methods of producing crops in the North, especially where glass is used. There is still, however, important work of this nature in progress in the vicinity of all large cities, particular attention being given to the growth of vegetables in greenhouses and under frames. According to figures secured by the writer in 1899, there were at that time 4,500,000 square feet of glass devoted to the growing of vegetables. The value of the establishments aggregated $2,250,000; the wholesale value of the annual product amounted to $2,250,000, and the retail value to $4,500,000. The number of men employed in this work — that is, the growing of plants under glass — was 2,250. According to the figures of the 12th cen- us there were devoted to the growing of vegetables for market in 1899, 1,175,200 acres, and the ma ket value of the product was $67,399,348. There were devoted to the production of vegetables for home use 940,370 acres, yielding a product valued at $46,477,087. This includes only miscellaneous vegetables, and does not cover such crops as Irish potatoes, sweet potatoes, onions, sugar-beets, etc. Thus it appears that, exclusive of glass, there were devoted to the growing of vegetables for the market and for the home 2,115,570 acres, giving an annual product valued at $113,876,435.

The development of floriculture in America has been coincident with that of vegetable gardening and pomology, excepting, of course, that flowers, being more or less of a luxury, were the last to receive special attention. Flower gardens, to a certain extent, formed a part of nearly all the home surroundings of the early settlers. See article FLORICULTURE IN AMERICA.

Landscape gardening literally means the creation of landscape pictures with plants. The pictures may be formal or they may be natural; that is, they may deviate widely from the bits of beautiful scenery which nature so lavishly bestows, or they may attempt to copy these bits of nature or perchance improve upon them by modifying them to meet the immediate surroundings. The picture created may be a matter of taste. Hence, in one country and in one place we find extreme formality, grotesque figures, and various-colored foliage beds forming a part of these pictures, while monstrous forms carved from shrubs and evergreen trees may form another part. Again we see the true lover of nature copying as closely as possible nature's own landscape, which is, after all, true landscape gardening. A bit of lawn, a fringe of foliage, and a clustering group of trees may be all that is required to form this picture, but it is a natural picture, and if harmony is kept in view the results are always charming. The art has long been practised, and its various types and modifications are to be found in our public parks and in private grounds throughout the country. There has been a growing interest in landscape gardening in America in recent years, owing chiefly to the advanced ideas set forth by such men as Downing and Olmsted, who have done much to create an appreciation and love for the purely natural in this work. More recently a still broader conception has been given to landscape effort, and work in this direction has been made to cover important matters connected with the relation of landscape surroundings to buildings, the proper arrangement of roads, etc. Thus we have had developed the field of landscape architecture, which is a broader term than landscape gardening. The landscape architect makes a study of his problem and works out a scheme of operation involving everything that may be connected with it. The landscape gardener may be called upon to carry out part of this scheme, but the architect proper will also be involved.

The literature on horticulture is exceedingly voluminous, covering many writings and textbooks, special papers, reports, etc. The more important standard American pomological works are Downing's 'Fruit and Fruit Trees of America,' Barry's 'Fruit Garden,' and Thomas's 'American Fruit Culturist.' In vegetable culture, Henderson's 'Gardening for Profit,' Bailey's 'Forcing Book,' and Rawson's 'Market Gardener' are standard works. Of the American publications on landscape gardening may be mentioned: Downing, 'Landscape Gardening'; Parson, 'Landscape Gardening'; Long, 'How to Plant the Home Grounds'; Waugh, 'Ornamental Gardening.' The most useful work on horticulture recently issued is Bailey's 'Cyclopedia of American Horticulture,' published in four volumes, the last of which appeared in 1902.

B. T. GALLOWAY,
U. S. Department of Agriculture.

Hor'ton, Robert Forman, English Congregational clergyman and author: b. London 18 Sept. 1855. He was educated at New College, Oxford, and in 1879 he was made a fellow of New College, and lecturer on history. In 1880 he became the pastor of the Congregational church at Hampstead, and in 1893 pastor of the Lyndhurst Road church there. In 1893 he delivered the Lyman Beecher lectures at Yale; in 1903 he was chairman of the Congregational Union of England and Wales. His writings include 'History of the Romans' (1885); 'Inspiration and the Bible' (1887); 'The Teaching of Jesus' (1895); 'Oliver Cromwell' (1897); 'Women of the Old Testament' (1897); 'The Commandments of Jesus' (1898); 'England's Danger' (1898); 'The Pastoral Epistles' (1901); 'The Trinity' (1901).

Horton, Samuel Dana, American publicist: b. Pomeroy, Ohio, 16 Jan. 1844; d. Washington, D. C., 23 Feb. 1895. He was graduated from Harvard in 1864, and from the law school in 1868, and also studied abroad. He began the practice of law in Cincinnati, but devoted himself mainly to the study of monetary questions, spending much time abroad; he was one of the first to advocate the establishment and maintenance of an international ratio between gold and silver. He was a recognized authority on all questions concerning coinage, was secretary of the international monetary conference at Paris in 1871, and a delegate from the United States at the conference of 1881; shortly before his death he went to Washington at the request of the administration for a conference concerning the financial situation. His writings include 'Silver and Gold and their Relation to the Problem of Resumption' (1876); 'The Silver Pound and England's Monetary Policy since the Restoration' (1887); 'The History of the Guinea' (1887); 'Silver in Europe' (1890).

Hosack, hŏs'ak, **David**, American physician and author: b. New York 31 Aug. 1769; d. there 23 Dec. 1835. He was graduated from Princeton College in 1789, and concluded his medical studies in Philadelphia in 1791. In 1795 he was appointed professor of botany in Columbia College. In 1796 the chair of materia medica was assigned to Hosack, who held it with that of botany until 1807, when he accepted the department of materia medica and of midwifery in the College of Physicians and Surgeons. He held at different times several public trusts, as physician to the New York hospital, and the Bloomingdale asylum, resident physician of the city of New York, etc. He was among the original projectors of the New York Historical Society, of the Horticultural Society, and of the New York Literary and Philosophical Society. He was the author of 'Annals of Medicine' (1793); 'Hortus Elginesis' (1808); and numerous papers on medical subjects.

Hosea, hō-zē'a, the first in order among the minor prophets of the Old Testament, but more probably the third in order of time. Nothing is known of his life, except what can be gathered from the introduction to his prophecies, namely, that he was the son of Beeri, and that his ministry belonged to the reigns of Uzziah, Jotham, Ahaz, and Hezekiah, kings of Judah, beginning probably about the end of the reign of Jeroboam II., king of Israel. His prophecies are addressed almost equally to both kingdoms. His book was admitted into the canon after the Babylonish captivity. He has represented in the three first chapters of his book, the guilty violation of their covenant with God by an allegory, very common among the Hebrew poets, of a marriage covenant which the wife has violated, referring to the covenant which God had concluded with the Israelites. The remaining chapters treat of the same subject, under different figures, with reproaches, exhortations, and threats; he predicts the approaching exile of his countrymen, and the consoling promise of the final return of an improved people forms the conclusion of this prophetical book. He is remarkable for his laconic style, hastening from image to image, and from reflection to reflection. The stream of a powerfully excited fancy forces him irresistibly onward. Hence he does not exhibit the roundness, grace, and harmony which characterize the other prophets.

Hosiery, hō'zhėr-ĭ, a word properly applied only to the making of hose or stockings, but used as a general term for all kinds of knitted articles. The materials used for the purpose are cotton, linen, and wool, the last of which is sometimes mixed with cotton or silk. Silk is also frequently used alone. Since 1841 the Jacquard loom, and similar looms have been employed in the manufacture of articles of hosiery. See *Knitting; Textiles*, under KNIT-GOODS,

Hos'mer, Harriet, American sculptor: b. Watertown, Mass., 6 Oct. 1830. She early showed skill as a modeler in clay, and after receiving a general education studied anatomy in a medical college at St. Louis. Her first work, a reduced copy of Canova's Napoleon, was followed by an ideal head of Hesper (1852). She went to Rome in 1852 and studied under John Gibson, the English sculptor. About this period she produced ideal busts of Daphne and Medusa, and in 1855 completed her first life-size figure, Œnone. To the same year belongs Puck, which gained her a great reputation in the United States, and the next year she executed a Will-o'-the-Wisp. The statue of Beatrice Cenci in the public library of St. Louis was finished in 1857, and her colossal statue of Zenobia in 1859. Her next work was a statue of Benton, the Missouri statesman, a bronze cast of which was erected in Lafayette Park, St. Louis. Other works are: Sleeping Faun, exhibited at Dublin in 1865 and at Paris in 1867; a statue of the Queen of Naples as the Heroine of Gaëta; a monument to Abraham Lincoln; and Waking Faun.

Hosmer, James Kendall, American librarian and biographer: b. Northfield, Mass., 29 Jan. 1834. He was a professor in Antioch College, Ohio, and the University of Missouri, in 1874–92, was professor of English and German literature in Washington University (St. Louis, Mo.), and in 1892 became librarian of the public library of Minneapolis. Among his works are: 'The Color Guard' (1864), a record of experiences as a private in the Civil War; 'The Thinking Bayonet' (1865), a novel; 'History of German Literature' (1879); 'Life of Samuel Adams' (1885); 'Life of Sir Henry Vane' (1888); 'A Short History of Anglo-Saxon Freedom' (1890); 'How Thankful was Bewitched' (1894); and a 'Life of Thomas Hutchinson' (1896).

Hos'pital, an institution for the treatment of sick, injured or infirm persons, supported in most cases by voluntary contributions, but in special instances from the funds of the government, state or civic municipalities. Hospitals are of various kinds: medical; surgical; for the reception of incurables; for consumptives; for the deaf, dumb, and blind; for the aged and infirm; for the care and treatment of the insane; emergency and field hospitals for the care of wounded in battle, etc. Modern hospitals are so constructed and their interior is so arranged as to enable a limited staff of physicians and nurses to attend to the wants of the greatest possible number of patients with a view to the most speedy recovery.

The site selected for a hospital should be on high ground; the soil should be clean and dry, free from damp ravines and undrained marshy ground, and the drainage should be ample. If possible it should not be surrounded by other buildings than those belonging to the hospital itself. The structural arrangements should be such as to secure perfect, free circulation and sunshine. The size of the wards depends on the number of patients to be therein maintained and having a capacity of 3,000 cubic feet for each inmate. The disciplinary and economical disposition in a hospital requires that each nurse should have the patients allotted to her under constant observation and personal supervision and that the arrangements are so constructed that the greatest number of patients can be attended and nursed by a given number of nurses. From 20 to 32 beds have been taken as a basis for ward construction. In some hospitals there are wards of one and two beds for cases of unusual gravity. The general form of ward construction is governed by the question of renewal of air and the superficial area allowed to each patient, for on this depends the distance of the sick from each other, the facility of changing the beds, cleanliness and many other important features. In a ward 24 feet wide, with a window for every bed or two, a 7 foot 6 inch bed space along the outer walls is sufficient. That would give 90 superficial feet per bed, which must however be increased in pernicious fevers, surgery and lying-in cases. In the Herbert hospital the smallest allowance is 99 feet per bed. The ceilings should be 12 to 14 feet high. With a view to economize heat in winter and to keep the wards cool in summer the walls should be hollow and all walls ceiled. The walls should be of an impervious polished surface, easily cleansed with soap and water. All corners should be rounded off and no cracks are to be tolerated, since they fill with impurities. Plaster, wood, paint and varnish all absorb organic impurities. The safest arrangement for walls is plaster, lime-whited or painted, which should often be scraped off or renewed.

The floors and woodwork throughout should be of oak, closely jointed, oiled and waxed, rubbed and polished. Confine the woodwork to absolute necessity. The forms of windows must be adapted to facilitate the entrance of light, as a factor to promote health, to promote ventilation, to facilitate nursing and to allow the patient to read in bed. In order to give cheerfulness to the ward and to renew the air easily, the windows should be inserted opposite each other; should extend to 2 feet 6 inches from the floor to within a foot of the ceiling. One cubic foot of window glass to every 50 or 55 cubic feet of space will afford a well lighted, cheerful ward.

The ward offices are those necessary for facilitating the nursing and administration, as the nurses' rooms, ward scullery, bath-rooms and lavatories.

They should all be well ventilated and lighted and all fittings finished in light color so that dirt can be at once detected. The nurses' room should command a view over the whole ward. The lavatory table should be constructed out of an impervious material, as slate or marble, with a row of sunk porcelain basins supplied with hot and cold water. The bathtubs should be porcelained iron. The toilets and urinals should invariably be placed against an outer wall, supplied with a siphon carrying a sufficient water capacity to thoroughly flush the basins. For the floor of these quarters, cement, marble or slate is preferable, and the walls are to be lined with glass, white-glazed tiles, marble, slate or Parian cement.

The administration building, that is, for offices, reception rooms, lodging the staff, operating rooms, kitchen, store-rooms, dispensary, etc., should always be subordinate to the question of the accommodation of the sick. In hospitals where a school is to be established, the necessary lecture rooms, laboratories and amphitheatre should be kept entirely separate from the sick: the morgue and dissecting rooms should be as far removed as possible. The consensus of professional opinion is opposed to the present plan of constructing large edifices for hospital purposes; that the benefits they confer are greatly diminished by the risk of hospital diseases — fevers of certain forms, erysipelas, pyæmia, etc., and which when once installed are most difficult and often impossible to eradicate. A system of cottage and hut construction, any of which could easily be destroyed and replaced, should the emergency demand, has been seriously advocated, but found impracticable because of the great expense and administrative difficulties. The profession to-day favors a system of construction known as the "pavilion plan," which can be called a compromise measure between the large block edifice and the cottage and huts. According to this system the wards are separate and distinct from the administration building and should be arranged to form pavilions, one story high, never more than two, and they should always surround the administrative blocks. This mode of construction is both applicable to large and small establishments. The Royal Infirmary of Edinburgh, the Herbert hospital of Woolwich, the New York hospital, the United States Marine hospital of San Francisco are among the best examples of the pavilion style. There should be free circulation of air between the pavilions, and the space between them should be exposed to the sunshine. The arrangements should be of a character to allow a covered communication between the wards, and each pavilion should have its own broad stairway.

The pavilion and general construction of the administrative building should be made quite subservient to the accommodation for the sick and should never interfere with the light and air of the wards.

Hospitals or asylums for inebriates, likewise hospitals for those addicted to the use of opium and other narcotics, have lately been established throughout the United States. Fever hospitals are maintained in all communities to secure isolation in infectious diseases, and hospital ships and floating hospitals are extremely valuable to promote complete isolation in cases of virulently infective disorders, such as smallpox (q.v.), etc. Children's hospitals are often provided with swimming tanks, indoor and outdoor playing, large ball and tennis grounds and in fact any and everything to promote healthy exercise and pastime for the inmates.

Military and naval hospitals, establishments for the care of sick and wounded soldiers and seamen, exist in all civilized nations. They are either temporary or permanent and if the former located in the immediate vicinity of the scene of operation. Hospital ships are ships fitted out as hospitals in all expeditions beyond the sea. They serve either as stationary hospitals or, if the sick accumulate sail home, or to the nearest station. See also QUARANTINE: RAILROAD HOSPITALS.

Hospitallers, charitable brotherhoods who devote themselves to tend the sick in hospitals. The name is specially applied to an order of knights, the Knights of Saint John. See ORDERS, RELIGIOUS.

Host, or **Hosta Sacra** (sacred host), in the liturgy of the Roman Catholic Church, the body of Christ present in the sacrifice of the Mass under the appearance of bread. The Latin word *hostia* denotes that which is offered in sacrifice; hence in the Mass, where the victim is the same who offered himself on the cross, "the cup" is no less the *hostia* than is "the bread"; but usage has sanctioned the appropriation of the word host to the latter. In the canon of the Mass, the priest, in offering the consecrated elements to God the Father, speaks of both the "bread" and the "cup" as *hostia*; and in the ancient Spanish missal (the Mozarabic) occurs the phrase "this host of bread and wine." But the word *hostia* is also employed to signify specially the bread before consecration: and this usage has its sanction in the Roman liturgy itself and in the rubrics of the Missale Romanum. In the rubric of the *ordo missæ* the altar-bread before consecration is called *hostia*, and after consecration it is called *hostia consecrata*. "Host" in the former sense, that is, the "altar-bread," is, in the Latin Church, a circular wafer made of fine wheaten flour mixed with water only, and it is unleavened. Usually the wafers are stamped either with an image of Christ crucified or with the letters I H S. They are of two sizes, a larger one which the celebrant himself receives (a host of this size is also reserved for the benediction (q.v.) of the Blessed Sacrament); and a smaller size for administration to those who may communicate at the Mass, or to the sick in their houses. The hosts destined for this use are kept in the pyx (called also *ciborium*), a silver vase gilt inside, and deposited in the tabernacle of the altar. As long as the host is thus reserved in the tabernacle the sanctuary lamp is kept alight before it. The Eastern churches in communion with the See of

Rome, except the Maronite and Armenian churches, retain the use of leavened bread in the Eucharist.

Hostage (French, *ôtage;* Latin, *obses;* Low Latin, *obstagius*), a person left as pledge or surety for the performance of the articles or conditions of a treaty. The taking or giving of hostages is now scarcely known in the relations of modern communities, but was formerly almost universal, and many questions in the law of nations arose out of the practice. Writers on international law have discussed how far the rights of conquerors extend over hostages, what circumstances may release them from their obligation, and what effect their escape will produce on the treaty proposed by the contracting parties. In modern civilized warfare hostages are not usually interchanged.

Hos'telry. See HOTEL.

Hot-bed. See HORTICULTURE.

Hot Springs, Ark., city and county seat of Garland County, and one of the most famous sanatoriums of the United States; in the southern centre of the State, 55 miles southwest of Little Rock and 397 miles from Saint Louis; on the Choctaw, O. & G., and Little Rock & H. S. W. R.R.'s. The location is 600 feet above sea-level and lies principally at the easterly base of the mountain complex known as the Ouachita Range, the nearby peaks of which are oftentimes called the Ozark Range — in a valley between two rocky and heavily wooded ridges called West Mountain and Hot Springs Mountain, 400 feet higher — and in its sheltered situation has a mild and pleasant climate. Lat. 34° N.; lon. 93° W. Through the valley runs the Hot Springs Creek starting two miles above; and into this the water from 47 hot mineral springs — originally 73, but many merged artifically or run dry — springing from vents in the gray volcanic tufa near the base of the Hot Springs Mountain on the east. Forty-four are in use or usable; the others rise in the bed of the creek. The former yield 830,000 gallons a day; contain large amounts of calcium and magnesium carbonates, and the presence of lithium, iodides and bromides, etc.; the total mineral matter in solution is between 275 and 280 parts per million and the results, as to the percentage composition of the mineral matter in each hot spring, are very much the same. The waters are prescribed for bathing and drinking and have remarkable curative properties. De Soto, it is said, sought to explore them as the veritable fountain of youth. The ordinary tub bath is the principal feature of treatment, but vapor, shower and plunge baths are also used. People suffering with consumption of the lungs; those afflicted with dilation of the heart; very old people, whose arteries are atheromatous; and paralytics, when their condition is the result of organic central lesions, should not bathe. Relief or cure may be expected in rheumatic, syphilitic, and numerous other conditions. The surgeon-general of the United States army, in an official circular of information issued by the War Department, says:

> The various forms of gout and rheumatism, after the acute stage, or inflammatory stage, neuralgia, especially when depending upon gout or rheumatism, metallic or malarial poisoning; paralysis, not of organic origin; the earlier stages of locomotor ataxia; chronic Bright's disease (the earlier stages only), and other diseases of the urinary organs; functional diseases of the liver; gastric dyspepsia, not of organic origin; chronic diarrhœa; catarrhal affections of the digestive and respiratory tracts; chronic skin diseases, especially of the squamous varieties, and chronic conditions due to malarial infection.
>
> In all forms of dyspepsia and in ulcers of the stomach and intestines the actual bathing which the diseased surfaces receive from the hot water drank materially aids in hastening cures.

As many as 90,000 patients and pleasure seekers visited here in 1902–3. The temperature of the springs varies from 97° to 147°. All issue from a space something over a quarter of a mile long and 200 to 300 feet up the slope, some 10 acres in all. By treaty with the Quapaw Indians in 1818 and by act of Congress in 1832, four sections (2,529 acres) became a reservation, and the springs are in the centre. Dunbar and Hunter of the Lewis and Clark expedition visited the place in 1804 and settlement was made in 1807. After 1832 numerous attempts were made to enter the lands, and title to property involved many years of contention and "shot-gun right." In 1870 Congress authorized suits against the United States in the court of claims. In 1876 title was held to be in the United States by the Supreme Court. Justice Field of the Supreme Court, in an opinion, said: "From the protracted litigation to which it has given rise the Hot Springs reservation is famous in the history of land titles of the country." And Justice Bradley: "The title to a well-known watering place in the State of Arkansas, called the Hot Springs, has been contested by a number of claimants for nearly half a century." In 1877 Congress created a commission to adjudicate squatter rights, giving right of purchase from the United States and to lay off the town. Under this act the Hot Springs were reserved by the United States to prevent monopoly or injury, and 911 acres are used as permanent parks. The government has expended nearly a million dollars in arching the creek, erecting the Army and Navy hospital (open to soldiers and sailors of the Civil War), and in developing and beautifying a system of parks not yet finished. These parks are covered with forest trees, and some are thoroughly fitted up for public enjoyment. Large sums have been spent on boulevards, walks, artificial lakes, landscape gardening, and handsome marble hot-water fountains scattered plentifully through the city. The grand entrance to Hot Springs Mountain, from Central Avenue, is a noble architectural feature, and the initial point of 15 miles of fine drives around the summits of Hot Springs, North and West Mountains.

With one exception, the springs are all enclosed in solid masonry, and the water is conducted by protected pipes into reservoirs near the base of Hot Springs Mountain or to the 23 bath-houses on and off this reservation. The exception is left open and accessible to the public. The government maintains a free bathing establishment for the indigent at which over 10,000 bathe annually, over 90 per cent being benefited. The prices of baths and fees of attendants are fixed by the Department of the Interior, with severe penalties for deviation. A rental of $30 per annum is collected for each tub; 716,053 baths were administered in 1902–3. A handsome city has grown up to house the guests and permanent residents. Along the front of the reservation bath-houses and on the slope of Hot

Springs Mountain is a fine park of 100 acres, with the most elegant buildings facing it. The creek is covered in, and sidewalks and roadways built over it. Several of the hotels, as the Arlington, Eastman, Park and Majestic, are among the largest and best appointed in the country.

Hot Springs received its city charter in 1876. It has a biennial mayor and a council. Being a pleasure resort, as well as a health resort, it has a large itinerant population. Large quantities of novaculite rock, "Arkansas" and "Ouachita," are quarried in the surrounding mountains, and 5,000 bales of cotton are marketed annually. The country abounds in cold springs, some of which have remarkable curative properties, notably Mountain Valley and Potash-Sulphur, 10 and 7 miles distant from Hot Springs; these are efficacious in conditions affecting the kidneys and intestinal tract. Pop. (1870) 1,276; (1880) 3,554; (1890) 8,086; (1900) 9,973.

CHAS. D. GREAVES,
Prest. School Board, Hot Springs, Ark.

Hot Springs, S. D., city, county-seat of Fall River County; on Fall River, the Fremont, E. & M. V. and the B. & M. R.R.'s; about 100 miles south of Deadwood. It is the trade centre for stock, lumber, and mining interests. The water-power is used for several manufactories, a stucco-mill, board and planing-mills, and machine shops. It has thermal and medicinal springs, and is the seat of the Black Hills College (M. E.), opened in 1890, and the State Soldiers' Home. Pop. (1900) 1,319.

Hotch'kiss, Benjamin Berkely, American inventor: b. Watertown, Conn., 1 Oct. 1826; d. Paris, France, 14 Feb. 1885. He was in early life a machinist and turned his attention to the invention of deadly weapons, among them the Hotchkiss magazine gun and the Hotchkiss machine gun, adapted for use in the fighting-tops of warships. In 1870 he established a factory at Paris. His guns were widely used by navies and armies until supplanted by other devices. He also improved heavy ordnance and projectiles.

Hotchkiss Gun. See MACHINE-GUN; ORDNANCE.

Hotel, or Hostelry, an inn or public tavern. The palatial hotels that have sprung up since the introduction of railways are too well known to require notice. One point of difference between the European and the American systems is that under the former, except in the case of a *table d'hôte*, the charge is for each dish ordered, while under the American plan a fixed price is charged for every meal. The modern French word is still used for the house of a rich or distinguished man, or for a public building, such as the *Hôtel de Ville*. See HOTELS IN AMERICA.

Hotels in America. The public house, or hotel, was established in the early days of the colonies to afford accommodation for those who might be compelled to journey from one place to another. As roads were poor, in those days, and stage transportation was slow, many of these houses were opened along the principal roads, or turnpikes, and the majority of these so-called inns bore such names as "King's," "Queens," "The Red Lion," etc. As public opinion changed, however, and the colonies inaugurated their revolt against the Crown, there was a corresponding change in the names of these hotels which brought them into closer harmony with the spirit of the times. From being mere public houses, wherein beds and food might be obtained by travelers, they became the meeting places of patriots, so it was but natural that the portrait of Washington, or of some other great American, should have taken the place of that of George III., and other royal personages, on the swinging signs before these doors. As time passed and the patriotic spirit rose to greater heights, these inns became the scenes of many events that brought them into the closest relation with the progress of the Revolutionary period and with the formative days which followed the declaration of peace. There was, for example, the City Tavern, in Philadelphia (1775), at which General Washington was frequently a guest; the Bunch of Grapes Tavern, Boston, where he enjoyed that "elegant dinner provided at public expense, while joy and gratitude sat on every countenance and smiled in every eye" (28 March 1776); the True American Inn, at Trenton (1777); Arnold's Tavern, Morristown; Sufferin's Tavern, Smith's Clove, N. Y.; the Buck Tavern, near Philadelphia; Smith's Tavern, Smith's Clove, N. Y. (1779); the tavern at East Chester, N. Y., where he was ill (1780); the Fountain Inn, Baltimore (1781); Day's Tavern, Harlem, where he stopped with Governor Clinton (1783); Fraunces Tavern, New York, where, in the assembly-room, he bade farewell to the men who had followed his fortunes so faithfully; Mann's Hotel, Annapolis, from which he proceeded to Congress on the day when he resigned his commission, and the City Hotel, Alexandria, where he was afterward entertained by the Alexandria Lodge, of which he was a member. The tavern at East Chester, where Washington stayed, during his illness, was erected soon after the beginning of the 17th century. At one time Lafayette was entertained in the house, and, for a season, it was practically the seat of the national government, President John Adams having taken refuge at East Chester during the yellow fever epidemic at Philadelphia, then the federal capital. This tavern now stands within the New York city limits, and the rooms which have the greatest historic interest still preserve the same appearance which they had in those old days.

Among the other taverns of the country which are rich in historic memories, but which were not directly associated with the career of the first President, were the Catamount Tavern, at Bennington, Vt.; George Burn's Coffee-House, in New York, long the lounging place of the British officers, although privately frequented by the Sons of Liberty during the occupation of the city by the British; the Tun Tavern, Philadelphia, the house in which the first Masonic lodge in America was organized; the City Tavern and the Bird in Hand, at Richmond, Va., and the Rose Tree Inn, at Media, Pa.

The first hotels in this country were conducted on the so-called American plan, which provided a fixed price for a day and for each fraction of a day. In those times $1 a day was considered a "good round price," and taverns were ordinarily so small that one which was provided with 20 rooms was regarded as a most commodious house. The rooms were usually comfortable, however, and were neatly, if plainly furnished with strongly-made furniture. Carpets were rarely found, although hand-woven rag-rugs frequently appeared on the floors. Meals, which were served at fixed hours only, were announced by the ringing of a bell or gong, and all guests were expected to respond as quickly as possible. The table was abundantly supplied with dishes that were both substantial and palatable, the cooking being done by the wife of the landlord, with such assistants as the patronage of the inn might authorize, and while meat dishes predominated, game was so plentiful that its appearance attracted no comment.

At this time in the history of the American public house there were comparatively few inns that made an extra charge for wines. Instead decanters of liquors and of some favorite wine, like Madeira, port, or sherry, frequently stood upon the tables, and from these the guests served themselves freely. There were no printed bills of fare in these days, but practically all the food to be served was placed on the table at one time. Guests helped themselves, some slight assistance being given by the waiter who stood at hand. When Congress met in New York, in 1789, the members found accommodations chiefly in the boarding-houses which abounded in the neighborhood of the Battery — on lower Broadway, in Cedar street, and in Maiden Lane. It is rather amusing to note that people from other parts of the country complained about the "high prices" that were charged at the taverns and boarding-houses in New York, for that was the time when the "board of the Congressmen was paid out of the common treasury, to which every citizen of the United States contributed his share." In reply to this charge of exorbitant prices it was stated that board in New York "ranges from $3 to $7 per week," and one house was cited as furnishing "from 7 to 9 dishes a day, with 4 sorts of liquor."

The most important American taverns in 1795 were located in New York, Philadelphia, Baltimore, and Boston. The best New York taverns were Fraunces', opened in 1762, and formerly known as the Queen Catherine, one of the largest inns during the Revolutionary period, as it contained some 30 rooms; the City Hotel, which was erected on the site of the George Burns' Coffee House, in 1793, and which was not only the meeting place of the fashionable City Assembly, but was patronized by the so-called "Three Hundred" of that day; Bunker's, the Washington Tavern, and the Tontine Coffee House, on Wall street.

The National Hotel, in Washington, which was for many years the home of the most eminent public men of the nation, was opened in 1827. In 1829, the Tremont House was opened in Boston, and for years it was noted as being the grandest hotel in the land, if not the most elegant public house in the world. Prior to that time the principal hotels in Boston had been the Eastern Stage House, Doolittle's City Tavern, and the Lamb Tavern.

It was about that time, or, to be exact, in 1830, that Delmonico opened the first high-class restaurant in New York. High as his prices were, when compared to those which prevailed elsewhere, epicures and persons of fashion flocked to his support and the enterprise prospered from the day of its inception. In 1833, the United States Hotel, in New York was opened; in 1834, the Louisville Hotel, and, in 1835, the Galt House, also at Louisville, all of which immediately became noted as fine houses. The United States Hotel, at Boston, which has since been greatly enlarged and is still standing, was opened in 1835, while, about this time, the old Washington Hotel, at Portland, Me., which had been established since 1823, also took the name of the United States. The Rockingham, at Portsmouth, N. H., once the home of Governor Langdon, was opened in 1834, but, like other hotels of that time it was not particularly commodious in the modern sense of the word. In fact, up to 1836, there were comparatively few hotels in the United States that were capable of accommodating as many as 200 persons. In 1836, the Astor House, in New York, was opened. Built of massive granite, and furnished with all the conveniences of that day, it was a fitting rival to Boston's Tremont House. Barnum's Hotel, at Baltimore, which was opened at about this time, eclipsed the best houses which had hitherto been built in that city, while the opening of the St. Charles Hotel, at New Orleans, in the same year, was an event which was heralded from one end of the land to the other. Situated in the centre of the "American" portion of the city, its stately portico built in the style of a Corinthian temple, made it, next to the Capitol, at Washington, the most imposing structure in the land. It was also one of the best appointed and most commodious houses in America, having accommodations for more than 700 persons. The original buildings were burned in 1851, but it was almost immediately rebuilt, and it continued to enjoy its position as the centre of southern hotel life, until the outbreak of the Civil War. In 1894, the structure was once more burned, but it has since been rebuilt, and still ranks as one of the best hotels in America.

The Charleston Hotel, at Charleston, had the distinction of being the only hotel in the country that had been burned to the ground on the same day on which it was opened. This was in 1839, but as it was rebuilt at once, it was again opened in 1840, and afterward becoming the favorite resort of Calhoun and other great southern statesmen. When the Planter's House, at St. Louis, was opened in 1841, it justly prided itself upon being "the largest hotel west of the mountains." It had 215 well-furnished rooms, a classic ball-room with a floor-space "8,911 square feet more than the celebrated Tremont House, in Boston," while the china and cutlery, all of which was made in England, bore the name of the house. Charles Dickens, who stopped there in 1842, spoke favorably of the hospitality of this hotel in his "American Notes." The Massassoit House, at Springfield, Mass., one of the celebrated New England hotels, and the New York Hotel, were both opened in 1848. The Delevan House, at Albany, was opened in 1845. The year 1847 will always be a memorable one in the history of the American hotel, for it marks the date of the opening of the Revere House, Boston, a house which, under the management of Paran Stevens, soon became the pattern which all other hotels in this country sought to imitate.

Up to 1855, the principal hotels in Philadelphia were the Mansion House, the United States, the Washington City, and the Girard House, and it was in that year that the Burnett House, at Cincinnati, was opened with 250 bed-rooms, besides many drawing-rooms, and especially spacious corridors. The Eagle Hotel, at Richmond, where Lafayette had stopped in 1824, was burned in 1840, and the Exchange and Ballard's were afterward opened. The Clarendon and the Irving House, in New York, were opened about 1850. The first Tremont House, at Chicago, which for some time was the leading hotel in that city, was opened about this time, while the Battle House, at Mobile, the St. Louis Hotel, at New Orleans, and the St. Nicholas and the Metropolitan, in New York, were opened about 1852. All were large houses, and were conducted upon an expensive scale, while the two New York houses were particularly conspicuous in having introduced "bridal chambers" and other novelties.

In 1854, the Brevoort and the Everett were opened, on the European plan, in New York; the famous Parker House, in Boston, also on the European plan, was opened in 1855, while the Fifth Avenue Hotel, in New York was finished in 1859. It was the first hotel to introduce a passenger elevator.

Willard's Hotel, at Washington, was the focus of many thrilling scenes and events during the Civil War, and among the houses that were opened during the next few years were the Lindell and Southern hotels, at St. Louis; the Albemarle, Hoffman, St. James, and Grand, in New York, and the Arlington, at Washington. The Gilsey House, which was opened in 1871, in New York, at once took rank as one of the best European-plan hotels, while the Windsor House, in New York, began the successful career that ended so disastrously in the fire of 1899, in 1873. The Brunswick, in Boston, and the Palmer and Grand Pacific, both in Chicago, were opened about this time, while the Palace Hotel, at San Francisco, one of the most famous and palatial houses in the far west, began to receive guests in 1875.

The last two decades of the 19th century were conspicuous, not only for the sudden increase of new and more splendid hotels, but also for the enlargement and improvement of those already built, in every part of the country, while, in such a brief review of the hotel business, it is impossible to name all the hotels worthy of mention that have been built during the past 25 or 30 years, it may justly be said that the revival of interest in the making of new and better houses extended from the Atlantic to the Pacific, and from our northernmost boundary to the Gulf. Beginning with the Vendome and Young's, at Boston, the list would include the Narragansett, at Providence; the Grand Union, Park Avenue, and Murray Hill, in New York; the Lafayette and Stratford, at Philadelphia; the Rennet, at Baltimore; the De Soto, at Savannah; the Kimball, at Atlanta; the Iroquois, at Buffalo; the Hollenden, at Cleveland; the Grand, at Cincinnati, and the Cadillac and Russell, at Detroit. Later came the Auditorium, at Chicago; the Plankinton, at Milwaukee; the Ryan, at St. Paul; the West, at Minneapolis; the Coates House, at Kansas City; Brown Palace Hotel, at Denver; the Portland, at Portland, Oregon, and the Tacoma, at Tacoma. The impetus to the hotel business, which began some 30 years ago, however, has continued up to the present time for the last few years have witnessed the construction of many new and finer hotels than any that had hitherto been built, among them being the Imperial, the Savoy, the Holland, the Waldorf, the New Astor, and the St. Regis, while one of the most unique experiments in the hotel line was the establishment of the Martha Washington, a hotel exclusively for women, which is now being successfully operated, also in New York.

The watering-place and summer-resort hotels also represent an important and rapidly increasing branch of the business. At the beginning of the 19th century there were a few inns at places like Saratoga, while a tavern at the White Mountains was built by Crawford in 1803. In 1822, the Catskill Mountain House was opened, and, by 1840, there were good houses at Trenton Falls and Delaware Water Gap. Twenty years later, Newport, Nahant, the White Mountains, Lake George, Saratoga, Niagara, Cape May, Old Point Comfort, and the Virginia springs, all had good hotel accommodations, but, since that time this branch of the business has grown to such an extent that splendid hotels are now located on almost every available spot on the coast from Maine to Florida, while the Adirondacks, the Catskills, and many interior resorts have accommodations for guests that can compare favorably with the best hotels in the country. At such hotels the American plan usually prevails, as it does to a considerable extent throughout the smaller cities and towns. In the large cities, however, the European plan, which fixes a price for the room, and which charges for extra service and for each item on the bill of fare, has become more popular, for while, in some instances, the two plans are combined, it is the European plan that is generally followed by the large hotels. Moreover the charges at the best hotels are about twice as great as they were in 1850.

When compared with the palatial hotels of to-day even the fine houses like the Tremont and the Astor House were primitive in their construction and management. The modern hotel is equipped with running water and set basins in every room; many rooms also have water-closets and baths with exposed plumbing; everywhere there are open grates and steam heat, improved ventilation, elevators for both passengers and baggage, electric bells, telephones, and every possible device to prevent fire, or to assure the safe escape of guests in case of a conflagration. Utensils and machinery have also multiplied greatly during the past few years, for the best hotels now run a thoroughly up-to-date laundry, an electric lighting plant, apparatus for the distilling of water, and the most elaborate cold-storage conveniences, often including an individual ice-making plant, while, among the other necessary conveniences of every well-equipped hotel one may mention the reading, writing, and music rooms; the coat, package, and baggage rooms; the barber shop, with its manicuring, boot-blacking, and other accessories; the billiard-room; telephone, telegraph, and ticket offices; the book and news-stand; the stenographers and typewriters, and the carriage and messenger services, not to mention a score of other details that are just as imperative a necessity. It is no uncommon thing to-day to find single hotel structures valued at $3,000,000 or $4,000,000, equipped with furnishings costing many hundred thousand dollars.

A conservative estimate of the number of hotels in the United States, in 1905, exclusive of those in process of erection, places the number at 44,250. Of these about 3,750 are summer or winter resort hotels, 3,000 are family, or private hotels, while the balance are commercial houses. These hotels now give employment to no less than 3,250,000 persons, and the amount of capital invested in the business is undoubtedly in excess of $6,000,000,000.

Hottentots, hŏt'ĕn-tots, an African race, the aboriginal occupants of the south end of that continent, near the Cape of Good Hope. The name now given to the whole race was that of the tribe in the immediate vicinity of the Cape of Good Hope, with which the Dutch settlers first became acquainted. The origin of the name is unknown. They are, when young, of remarkable symmetry; but their faces are ugly, and this ugliness increases with age. The complexion is a pale olive, the cheek-bones project, the chin is narrow and pointed, and the face consequently is triangular. The lips are thick, the nose flat, the nostrils wide, the ears large and lobeless, the hair woolly, and the beard scanty. The women in early life are often models of proportion, and their gait by no means deficient in grace. Their bloom, however, is transient, for, marrying at twelve or thirteen, after the first child they lose their grace and proportion, and soon become hideous. Both sexes are distinguished by excessive incurvation of the spine. When the Dutch first settled at the Cape the Hottentots were a numerous nation, and occupied a territory of 100,000 square miles. They had abundance of horned cattle and sheep; and it is supposed that the seven tribes into which they were divided made up together a population of at least 200,000. At the present day this race is nearly extinct within the wide territory which formerly belonged to it. They may amount to about 20,000. The Koras or Korannas (shoe-wearers), south of the Kalahari Desert, still remain a favorable specimen of the Hottentot race. They are taller, stronger, and more cleanly than some of the other tribes. Most of them possess cattle; those who do not, soon degenerate into Bushmen. On the eastern frontier of the colony are still some remnants of the Gona or Gonaqua tribe; but they have nowhere preserved their ancient usages and purity of blood, but are much mixed with the Amakosa Kafirs. The Namas, who are the purest type of Hottentots now existing, dwell in Namaqualand, in German Southwest Africa. The Namas are a pastoral people almost exclusively. Their dwellings are low, rude huts, surrounded by fences. Many of them have been Christianized. The Hottentots generally are very indolent and lethargic.

Hottentot's-bread. See ELEPHANT'S-FOOT.

Houdon, Jean Antoine, zhŏn äṅ-twän oo-dŏṅ, French sculptor: b. Versailles 20 March 1741; d. Paris 15 July 1828. Having gained the first prize for sculpture in the royal academy at Paris, he visited Italy, passed 10 years in Rome in the study of the antique, and finished, among other works, the statue of St. Bruno in the church of St. Maria degli Angeli. Returning to Paris, he executed admirable busts of Rousseau, Diderot, D'Alembert, Franklin, Turgot, Mirabeau, Gluck, and many other distinguished men; statues of Voltaire and Tourville; the celebrated 'Diana' for the empress of Russia; and other works, which placed him in the first rank of French sculptors. In 1785 he accompanied Franklin to the United States, to prepare the model for the statue of Washington ordered by the State of Virginia, and passed two weeks at Washington's residence at Mt. Vernon for that purpose. The statue, bearing the sculptor's legend, "*Fait par Houdon, citoyen Francais*, 1788," now stands in the hall of the capitol of Virginia at Richmond. Among Houdon's later works is the celebrated statue of Cicero in the palace of the Luxembourg.

Hough, hŭf, **Emerson,** American author: b. Newton, Ia., 28 June 1857. He was graduated from the State University of Iowa in 1880, traveled extensively in the wild portions of the West, was for several years a writer in Chicago, and there became in 1899 western manager of the New York periodical 'Forest and Stream.' His publications are: 'The Singing Mouse Stories' (1895); 'The Story of the Cowboy' (1895); 'The Girl at the Half-way House' (1900); and 'The Mississippi Bubble' (1902).

Hough, George Washington, American astronomer: b. Montgomery County, N. Y., 24 Oct. 1836. He was graduated at Union College in 1856; appointed astronomer at the Cincinnati Observatory in 1859, and the following year became astronomer and director of the Dudley Observatory, Albany, N. Y. In 1879 he became director of the Dearborn Observatory and professor of astronomy at the Chicago University; and later accepted a similar position at the Northwestern University. He has invented several astronomical instruments and has discovered more than 600 double stars. He has written 'Annals of the Dudley Observatory' (1866–71).

Hough, Walter, American ethnologist: b. Morgantown, W. Va., 23 April 1859. He was graduated from the West Virginia University in 1883 and since 1885 has been connected with the ethnological department of the United States National Museum, becoming in 1895 assistant curator. He has published several important professional monographs.

Hough, Warwick, American jurist: b. Loudoun County, Va., 26 Jan. 1836. He was graduated from the University of Missouri in 1854, subsequently studied law and was admitted to the bar in 1859. In January 1861 he was appointed adjutant-general of Missouri, as such issuing the general order under which the State military organizations went into camp on 3 May. He was for a short time secretary of state in Missouri, resigning in 1863 to enter the Confederate service, and serving on the staffs of General Polk and other Confederate commanders. For a few years after the war he practised law in Memphis, Tenn., but afterward returned to Missouri, establishing himself in Kansas City. He was a judge of the Missouri supreme court 1874–84, for two years of that period serving as chief justice of the State. In 1884 he removed to St. Louis, where he has continued in the active practice of his profession.

Houghton, hō'tŏn, **Henry Oscar,** American publisher: b. Sutton, Vt., 30 April 1823; d. North Andover, Mass., 25 Aug. 1895. He was apprenticed to a printer in Burlington, Vt., and later entered the University of Vermont, where he was graduated in 1846. Going soon after to Boston he became a member of the printing firm of Bolles & Houghton at Cambridge in 1849, and founded later the 'Riverside Press.' In 1864 he entered the book publishing firm of Hurd & Houghton, now the widely known house of Houghton, Mifflin & Co.

Houghton, how'tŏn, **Richard Monckton Milnes,** Baron, English poet: b. Fryston Hall, near Pontefract, Yorkshire, 19 June 1809; d. Vichy, France, 11 Aug. 1885. He was educated at Oxford and was long prominent in Parliament as a moderate Conservative. He was raised to the peerage in 1863. He was the author of several volumes of verse and prose, including a 'Life of Keats' (1848).

Houghton, hō'tŏn, Mich., a village and the county-seat of Houghton County, 94 miles northeast of Marquette: on the south bank of Portage Lake, and on the Copper Range, Mineral Range, and Duluth, S. S. & A. R.R.'s. Portage Lake is connected with Lake Superior at the south by the Portage River and at the north by a ship-canal by means of which steamers avoid the detour around Keweenaw Point.

Industries, etc.— Houghton is the centre of the rich mineral district in the peninsula of Keweenaw, the total output of which was in 1901 nearly 150,000,000 pounds. The larger part of the copper export of the region is shipped from this port. There is also considerable lumbering, manufacture, and commerce, and the shipping interests are important. The various industries have about 1,000 employees.

Public Institutions, Buildings, etc.— It is the seat of the Michigan College of Mines, which was founded in 1885 and occupies a fine structure. There are Episcopal, Methodist Episcopal, Catholic, and Presbyterian churches. Mention should also be made of the county court-house. The two banks have a combined capital of $250,000 and deposits of about $3,000,000.

History and Government.— Houghton was first settled in 1851. Its government is by a president and a council of six members elected biennially, three in each year. Pop. (1903) 4,000.

Horace J. Stevens,
Editor of the 'Copper Handbook.'

Houlton, hōl'tŏn, Maine, town, county-seat of Aroostook County, in the eastern part of the State; on the Canadian P. and the Bangor & A. R.R.'s; about 145 miles northwest of Eastport. It is the trade centre for a large lumbering region, and in the near vicinity there is quite an acreage of good agricultural lands. The chief manufactures are flour, butter, starch, foundry and machine-shop products, lumber, woolen goods, and furniture. It has a large slaughter-house and planing- and molding-mills. It is the seat of Ricker Classical Institute, a Baptist school. It has a town public library. Pop. (1900) 4,686.

Houma, hoo'ma, La., town, parish-seat of Terrebonne Parish; on the Bayou Terrebonne, and the Southern Pacific R.R.; about 72 miles southwest of New Orleans. It is situated in an agricultural region where the principal crops are rice, sugar-cane, and grain. The canning of oysters is one of the important industries; it has a large moss-factory and lumber yards. From 1890 to 1900 the increase in population was over 100 per cent. Pop. 4,686.

Hound, a dog that hunts by scent, a definition which excludes the greyhound (q.v.). It is difficult to determine from what stock the English hound has originally sprung, but the old "Southern hound" or talbot was most probably the source of the various hounds now known, among which the bloodhound, foxhound, beagle, harrier, dachshund, turnspit, otterhound and hoarhound (now known as Great Dane) are the principal varieties. The mastiff (q.v.) ought also to be included in this group. See Dog.

Hour-glass, a species of chronometer or instrument for measuring time. It consists usually of two hollow bulbs placed one above the other, and having a narrow neck of communication. Dry sand is introduced in quantity sufficient nearly to fill one of the bulbs and fine enough to pass freely through the orifice of the connecting neck. The quantity of sand is adjusted to the time which the glass has been constructed to indicate. In the case of an hour-glass the sand in the upper bulb takes an hour to pass into the lower bulb; and so on for any other definite division of time. This instrument is always subject to slight error in its indications of time, owing to the expansion and contraction of the glass by changes of temperature, and by the variations of dryness in the sand. The hour-glass was commonly used in churches during the 16th and 17th centuries to regulate the length of the sermon, and in some places it continued in use down to the beginning of the 19th century.

Houris, hoo'- or how'rĭz, the "black-eyed" nymphs of Paradise, whose company, according to the Koran, is to be one of the rewards of the faithful. They are described as most beautiful virgins endowed with perpetual youth. They dwell in beautiful gardens, by flowing streams, and the very meanest of the faithful will have at least 72 of them.

Housatonic, hoo-sa-tŏn'ĭk, a river which has its rise in the Berkshire Hills, in the western part of Massachusetts, and flows south, through Connecticut, into Long Island Sound. Its course of about 155 miles is through a hilly, mountainous country, noted for its scenic beauty.

House, a place of abode of a family or individual. The common expression, "a man's house is his castle," is in most instances true. Except in criminal cases a man can hold his house against all comers. No sheriff can break open his door to arrest him, or seize his goods for debt, except by a writ, affidavit, or search-warrant. But the house is no protection where there has been a criminal offence. Breaking into a house with the intent to rob is burglary, and to set fire to a house constitutes arson. A man may defend his house against trespassers and thieves attempting forcible entrance, even to the killing of the intruder, if it can be shown that he has used no greater force than was absolutely necessary.

House-boat, a combination of boat and house, used largely as pleasure craft on rivers, canals, and lakes, in Great Britain and the United States. The houseboat had its origin in England about 1860. Its growth there has been comparatively slow. It was transplanted to this country late in the 19th century, and at first found favor with only a select few; but as soon as its advantages became manifest it began to develop rapidly, and advanced to a most remarkable state of perfection. A "house-boat" is not a boat with two, three or four decks and a number of staterooms, but a commodious, comfortable craft arranged for the accommodation of a family party, a company of bachelors or any suggestible combination of people. It might be likened to a suite of apartments afloat.

The house-boat in England has been particularly a Thames attraction and is seen to the best advantage at Henley. In 1903 there were several hundred of these floating houses on the water of the Thames. The price of a house-boat ranges from $300 to $25,000. But a comfortable craft, containing saloon, kitchen and four bed-rooms, may be purchased for $2,000. The Thames season lasts from June to September, and is at its height in July and August. A large house-boat may be hired for the season, including Henley, for $1,000.

In the United States the house-boat is seen most frequently during the summer months on the Hudson River, the St. Lawrence River, and Long Island Sound. The American vessels are even larger than the English boats and more expensive. They are constructed on approved plans, and contain every possible comfort and convenience that may be found in the best equipped dwelling or suite of apartments ashore. There are spacious sleeping rooms, larger than the staterooms on ocean steamers, a cosy sitting-room, a parlor, a library, a reception room, all the necessary storerooms, a lavatory, a cook's galley and, in fact, everything that a well-ordered household might demand. The properly constructed houseboat has a promenade deck and a high rail encloses it so that children may play about the deck with the utmost freedom and safety. The more pretentious are lighted with gas supplied from a naphtha gas-making machine, or electric light, with the energy supplied by storage batteries.

The great charm of the house-boat is the power that its occupants possess to move it from one place to another. On dry land when a man or a family does not fancy a place he or they move away and leave the house behind. On the house-boat they take their house along with them, and they can go wherever navigable water exists. The boat can be anchored in midstream or moored to a pier. No persons can interfere with the privacy of those on board. It is their own floating castle. When they are tired of one place they can go to another, and they have the advantage over their land-living friends that they not only take their house along, but all their belongings, and without the aid of the baggage master.

A typical American house-boat is the Idler, owned by a New York gentleman and used about Alexandria Bay, in the St. Lawrence River. The cabin has a dozen or more windows of goodly size; there is a saloon and opening from it a dining-room. The kitchen, store-rooms and quarters for a servant or two are "aft." The promenade deck has hammocks, steamer chairs, camp stools, rugs, tables, books, work baskets, and flowers; here the family live, move, and have their being for three quarters of the time spent on the boat. Among the well known house-boats on the St. Lawrence, are the Nydia, Mavis, River God, Bohemia, Amaryllis, Merrivale, and Summerholme.

On the Mississippi River, Ohio River and other large streams in the Western States the house-boat is utilized for business as well as for pleasure, and floating grocery stores, photograph galleries, and dry goods and notion shops are not uncommon. There is on the Mississippi at least one floating theatre built on the house-boat plan, and hundreds of small families have adopted a rudely constructed inexpensive type of boat for permanent residences.

House-Boat on the Styx, A, a humorous book by John Kendrick Bangs (q.v.) published in 1895. It purports to be an account of the doings and conversations of a company of literary ghosts assembled in a house-boat managed by Charon. Among the ghostly personages represented are Shakespeare, Raleigh, Dr. Johnson, and many more of various degrees of renown.

House-cricket. See GRYLLIDÆ.

House-finch, A familiar garden finch (*Carpodacus frontalis*) of California, grayish, with the head, neck and breast scarlet-carmine. It represents a group of beautiful and interesting Pacific Coast and Mexican finches also known as linnets and burions.

House-fly. See FLIES.

House Industry, a modern system of labor in which the workmen carry to their homes raw materials and other goods to be manufactured within their own houses. In New York and other large cities this form of labor particularly applies to the Polish Jews, who are employed to the number of many thousands by the manufacturers of coats, cloaks, and other wearing apparel. The abuses of house industry have become notorious under the name of the sweatshop system, which will be found described more in detail in the article FACTORIES AND FACTORY INSPECTION.

House of Lords. See PARLIAMENT.

House of Representatives, the branch of most State legislatures, and of Congress, which has the more numerous members, elected from smaller districts, and in some cases for shorter terms. It is very commonly termed the "lower house" or "popular branch," implying a misunderstanding at once of its origin and functions. The House, for instance, is commonly supposed to be related to the Senate as the British House of Commons is to the House of Lords, and to have been modeled on that relation; the former is wholly untrue and the latter largely so. The House of Commons represents popular constituencies, the House of Lords represents only itself; the former is the less dignified theoretically, in practice it has not only more power but all the power; the individual members of the former have mostly less power than those of the latter, but as a body they are incomparably more powerful. None of these things is true about the House and Senate of Congress. Both represent constituencies and the public equally; both are not only theoretically but practically equal — the Senate's power of confirming appointments and treaties being fully balanced by the House's power of impeachment, of originating revenue bills, and electing a President if the electors fail of a choice. Nor are the members of either as individuals presumptively superior in power to those of the other. The actual superiority of the Senate is due to the longer terms, which give the older members a parliamentary experience before which the mass of raw members of the House bow; to the seats being the subject of eager competition among the ablest politicians, so that the average public position is higher: and to the lesser membership and smaller number of new bills, which enable it to preserve more independence of the chairman's tyranny than the House. Still, a certain glamour always surrounds the latter as the "popular branch"; partly due to the fact that, owing to its great number and short terms, popular movements are more quickly transformed into legislative action than in the Senate. In this respect alone the idea is correct: a party intrenched in the Senate has often boasted that no matter what the majority of the people wished it could not be dislodged for at least eight years, or the time of two presidential elections, in which anything might happen.

In its formation, the model in the State legislatures was simply to follow the old colonial form of council and assembly, itself not copied from Parliament but an independent development; and in Congress the model was partly those legislatures and doubtless partly Parliament — the political theory of "checks and balances" being more potent, however, in defining the distribution of powers than in creating the forms of the houses. The actual form of Congress was a compromise, without which the Union could not have been formed. The large States were averse to being outweighed by the small, and wished for a two-chambered body, with representation in each proportionate to population: the small ones were determined on a single-chambered one, with each State having one vote. The present arrangement was the suggestion of the Connecticut members; a final item of the compromise was that the senators should vote individually and not by States, so that a State should only have its power on condition of keeping its members in place. For the general functions of the House, and its relations present and prospective to the Senate, see CONGRESS.

The members of the House, according to the Constitution, must be 25 years of age, seven years citizens of the United States, and residents of the States which send them; by act of 25 June 1842 they must be chosen from districts formed of contiguous territory (but see GERRYMANDER for the observance of this). This put an end to electing on general ticket, but there is no provision that the representatives shall be residents of their districts, and the people have a perfect right to choose them in the British fashion, from any part of the State. What prevents this is not law, but the intense local particularism which, even in State senatorial districts made up of several towns, insists on passing the office around among the towns; at bottom, the American conviction that public office demands no training. The number of members is fixed by Congress after each new census.

A quorum of members is a majority of those actually chosen. The House organizes by having the clerk of the last House call the new members to order, and if a quorum is present he calls the roll for a vote on choice of Speaker. The members choose their seats in turn as their numbers are drawn by lot. The principal officers are the Speaker, clerk, sergeant-at-arms, doorkeeper, postmaster, and chaplain. (For the Speaker's powers, see CONGRESS.) The sergeant-at-arms is the constable. The symbol of his authority is the mace, made on the pattern ordered by the House 14 April 1789; a Roman device, ebony fasces, of which each rod ends in a spear-head, bound at the ends and in the middle with silver bands, and on the end a globe surmounted by an eagle with outspread wings. The House is governed by Jefferson's Manual of Parliamentary Practice, plus its standing rules and orders and the joint rules of the two houses.

House of the Seven Gables, The, a novel by Nathaniel Hawthorne (q.v.).

House Snake, or **Milk Snake**, a variety of *Lampropeltis doliatus*, the corn-snake (q.v.) of the South, found abundantly in most parts of the northern half of the United States westward to the Rocky Mountains. The dorsal scales are not at all keeled and the ventral plates often exceed 200 in number; the ground-color is gray with three series of rounded black-bordered brown blotches, and the belly checkered with black and white; a length of 4 feet is sometimes attained. This is a handsome and mild-tempered colubroid snake, very abundant in farming districts, where it frequently enters houses, but probably in search of mice rather than for the purpose of drinking milk, as is popularly believed. It is an expert climber, often ascending porches and vines attached to the walls of houses. As usual, the eggs are deposited in a hole dug in a sandy field.

House Sparrow. From the circumstances of the chief importations into this country having been from England this species, the *Passer domesticus* of ornithologists, is almost exclusively known in the United States as the English sparrow, although it is distributed quite as plentifully throughout most parts of Europe. The appearance and general habits of this familiar and ubiquitous bird require no description. The presence of the house-sparrow in America is a most noteworthy instance of the folly of disturbing the proper "balance of Nature" by the thoughtless introduction into new regions of vigorous species which are relieved from the restraining influences of those checks that usually operate in their original habitats. The motives which led to its importation seem to have been two-fold: the desire to combat the plague of measuring-worms (*geometridæ*), with which the parks of many of the eastern cities were affected, and the sentiment which moved many of our foreign born citizens to look with favor upon the introduction of a familiar bird of the fatherland. The importations began in 1850, when the directors of the Brooklyn Institute, led by the Hon. Nicolas Pike, liberated 8 pairs in that city, followed by larger numbers in 1852 and 1853. The following year saw their introduction into Portland, Me. Within the next 15 years direct importations were made to the eastern seaboard, the city of Philadelphia liberating 500 pairs in 1869 in her parks, which were carefully nurtured by a paid caretaker. During the next decade small lots were set free in nearly every State of the Union, including those on the Pacific coast. Thus, purposely distributed by man, carried in grain cars on the railroads and aided by its remarkable hardiness, fecundity, boldness and adaptability, the house-sparrow has in 50 years spread to practically all parts of this country, except a few remote and isolated regions, and to many parts of British America. It keeps close to the abodes of man and has become extraordinarily abundant in many large cities and towns, where it acts as a scavenger and befouls the buildings with its droppings and slovenly nests. Because of its presence and pugnacity many smaller native birds have withdrawn from the parks and open spaces, and it has in many other ways become a nuisance, though it does not altogether lack virtues. In its relation to agriculture little that is favorable can be said of the English sparrow. About three fourths of its food consists of grain, much of which is obtained by raids on the fields and store houses; serious injury is also done by its attacks on flower and leaf buds and on all kinds of fruits. On the credit side may be mentioned the relatively small quantity of insects and the considerable quantity of weed seeds devoured. Consult, Gentry, 'The House-Sparrow at Home and Abroad' (1878); Barrows, 'The English Sparrow in North America' (1889).

Housing Problem. See Tenement House, *Reform.*

Hous'man, Laurence, English author and illustrator: b. London 14 July 1867. He has illustrated 'The Goblin Market'; 'Weird Tales'; 'The Were Wolf'; 'Jump to Glory Jane'; and other books, his work being mostly engraved on wood by his sister Clemence. He is the author of 'The Writings of William Blake' (1858); 'A Farm in Fairyland' (1894); 'The House of Joy' (1895); 'Green Arras' (1896); 'All Fellows' (1896); 'Gods and Their Makers' (1897); 'The Field of Clover' (1898); 'The Little Land' (1899); 'Rue' (1899); 'The Seven Young Goslings' (1899); 'Bethlehem' (1902), and 'Love Letters of an Englishwoman' (1901), which appeared anonymously and was attributed to various writers of the day.

Houssa, how'sä, or **Haussa**, Central Soudan, a former important negro kingdom, north of the junction of the Benue and Niger rivers. After internecine divisions it was succeeded by a Mohammedan Fulah empire in 1802, and is now incorporated in Nigeria. The name is perpetuated by a negritic race and language distributed far beyond the ancient Houssa boundaries. The race is distinguished as able traders and craftsmen, and the language, for its euphony, simplicity and literary adaptability.

Houssaye, Henri, ŏñ-rē oo-sā, French historian: b. Paris 24 Feb. 1848. He was educated at the Lycée Napoléon, fought with distinction in the Franco-German war, became an editor of the 'Revue des Deux Mondes' and the 'Journal des Débats,' and was chosen president of the Société des Gens de Lettres. In 1864 he obtained election to the French Academy, which in 1873 awarded the Thiers prize to his 'Histoire d'Alcibiade.' He published in three parts — '1814,' and '1815' (2 vols.) — a study of Napoleon's downfall, which enjoyed wide sale in France, and is considered one of the best extant works on the subject.

Houston, hūs'tôn, **Sam**, American soldier and statesman: b. Lexington, Va., 2 March 1793; d. Huntsville, Tex., 25 July 1863. Leaving home when a boy he crossed the Tennessee River and took up his abode with the Indians, by whom he was kindly received, and with whom he lived after their own fashion for several years. Oolooteka, one of their chiefs, adopted him as his son. In 1811 he returned to his family, and to maintain himself opened a school. In 1813 he enlisted as a common soldier in the United States army, was promoted ensign, and fought under Gen. Jackson against the Indians at the battle of Tallapoosa, in March 1814. In November 1817 he was appointed a subordinate Indian agent to carry out the treaty with the Cherokees just ratified. In the following winter he conducted a delegation of Indians to Washington. On arriving he found that complaints had been made against him to the government on account of the zeal with which he had exerted himself to prevent the unlawful importation of African negroes through Florida, then a Spanish province, into the southern States. He was acquitted of all blame, but conceiving himself to be ill treated he resigned his commission in the army, and returning to Tennessee settled in Nashville and began the study of law. In 1819 he was elected district attorney, and in 1821 was chosen major-general of militia. Two years later he was elected to Congress; re-elected in 1825, and in 1827 was chosen governor of Tennessee.

In 1829, for reasons unknown, he resigned his office, separated from his family, and deserting civilization, went to Arkansas, where his former Indian friends, the Cherokees, had removed. He was kindly received and for years remained with the Indians. In 1832 he went to Texas and at the outbreak of the Mexican war was elected commander-in-chief of the Texan army.

After the massacre of the Alamo, the Mexican President-general Santa Anna was defeated by Houston at the battle of San Jacinto, 21 April 1836. Santa Anna was captured by the Texans and the independence of Texas was achieved. On 23 July a general election for president, vice-president, and members of Congress of the republic of Texas was ordered to take place on the first Monday of the following September. Houston was solicited to be a candidate, but declined; but as the day of election approached the popular feeling in his favor became so manifest that he had no alternative but to accept. He was elected by a large majority and was inaugurated 22 Oct. 1836. One of his first acts was to liberate Santa Anna, who had been kept in captivity, and to send him to Washington to confer with the president of the United States. He next opened negotiations with the United States government for the annexation of Texas to the Union, but the measure encountered such strong opposition in the United States that it did not succeed till several years later.

Texas became one of the United States in

1845, and Houston and Rusk were the first senators sent to Washington. Houston was re-elected at the end of his term in 1853, and remained in the Senate till March 1859. As a senator he was opposed to the Kansas and Nebraska bill, against which he made one of his most elaborate speeches, in which he declared that the repeal of the Missouri Compromise was a flagrant breach of faith, which would involve the country in interminable agitation and difficulty. He was prominently mentioned in 1854 as a presidential candidate of the 'Know-Nothing' party. He was elected governor of Texas 1 Aug. 1859, but was deposed for adherence to the Union in 1861. See Williams, 'Sam Houston and the War of Independence in Texas' (1893).

Houston, Texas, city and county-seat of Harris County, at the junction of White Oak and Buffalo bayous; the highest inland point in the State permanently accessible by water from the Gulf of Mexico. Buffalo Bayou, which furnishes an outlet to the sea, 50 miles distant, has been navigated from the earliest days of the city's history, and is being widened and deepened by the Federal government at a cost of $4,000,000 so as to admit of the passage of the largest ocean-going craft.

Houston was settled shortly after the battle of San Jacinto, which was fought on 21 April 1836, within a few miles of its location. The city was named after Gen. Sam Houston (q.v.). It was made the seat of government for the Republic of Texas, and so remained until 1840.

Government.— Houston was first incorporated under an act of the Texas Congress passed 29 Dec. 1837. It now has a charter granted by special act of the legislature in 1903. Under the charter a mayor is its chief executive officer, and 12 aldermen (two for each of the six wards into which the city is divided) constitute the legislative division of its government. The mayor and the aldermen are elected for two years as are also the city treasurer, the city tax assessor and collector, the city attorney, the city health officer, the street commissioner, the chief of police and the judge of the corporation court, which has jurisdiction of police cases. The cost of Houston's city government, including the amount appropriated out of the general revenue fund for the public schools, ranges between $600,000 and $650,000 per annum. The city owns a sewer system with 37½ miles of conduits. The city has about 30 miles of paved and otherwise improved streets. The city maintains a paid fire department at a cost on an average of $60,000 per annum. The cost of police protection averages about the same.

Public Buildings.— Houston's chief buildings are the city-hall and market-house, the Central fire station, the Binz office building, the Commercial National Bank building, the Stowers building, the Houston Post building, the High School building, the Mason building, the Carnegie Library building, the First Presbyterian Church house, the Christ Episcopal Church house, the Waddell building, the Kiam building, and a provided-for Federal building to cost $500,000 and the Rice Institute building for the erection and maintenance of which an endowment of between $4,000,000 and $5,000,000 has been left. The William M. Rice Institute was founded in the year 1892 by the late William Marsh Rice, of New York. This institute contemplates the establishment and maintenance of an industrial or polytechnic school for males and females, designed to give instruction on the application of science and art to the useful occupations of life. It establishes and maintains a free library and reading rooms, and galleries of art.

Education.— The city has 20 public schools (including a high school for whites and one for negroes), and 26 private schools — and one Carnegie library building. The city's school affairs are managed by a board of seven trustees appointed by the mayor with the approval of the city council. The schools are maintained by direct appropriation from the general revenue fund and get from $80,000 to $1,000,000 from that source annually. In addition they receive each year from the State a per capita apportionment of the State school fund which runs from $4.50 to $5.00 for each pupil between the ages of 7 and 17.

There are 5 Baptist, 5 Catholic, 3 Christian, 2 Christian Science, 3 Episcopalian, 2 German Methodist (North), 5 Methodist (South), 1 Methodist (North), 1 Cumberland Presbyterian, 5 Presbyterian and 2 non-denominational churches for whites, besides one Episcopalian chapel and two missions, a Salvation Army barrack and a Spiritualist association. The negroes have 29 churches of all denominations. The city's eleemosynary institutions consist of the Bayland Orphans' Home, the De Pelchin Faith Home, the Florence Crittenton Rescue Home, the Sheltering Arms Home of Christ's Episcopalian Church and an Infants' Home for foundlings. The city has one public park and zoological garden valued at $80,000.

The city has six national banks with a combined capital stock of $1,450,000; an average surplus of $900,000 and average undivided profits of $500,000. Their deposits range around $11,000,000 in amount and their loans around $7,000,000. In addition there are three private banks with combined resources of $3,000,000. Bank clearings in excess of $600,000,000 are annually effected through the city's clearing house.

Trade and Commerce.— In point of trade and commerce Houston distributes more groceries, hardware and machinery than any other city in the State. It is the most important spot cotton market in the world, barring Liverpool, 1,927,007 bales, or a little less than 19 per cent of the entire crop of the United States, constituting the volume of its transactions in the staple for the year 1903, said transactions involving an approximate outlay of $86,742,315. Houston is also the principal lumber market of the Southwest. In sugar Houston is second to New Orleans only, while in rice, a comparatively new industry in Texas, it ranks as one of the four principal markets west of the Mississippi.

More produce, fruit and feed stuff is consumed and distributed in Houston than in any other city in the Southwest.

Transportation.— Houston's pre-eminence as a commercial centre is due to its supply of transportation facilities. In 1856 these consisted, aside from a navigable outlet to the sea, of 56 miles of railroad. In 1861 its rail lines extended a distance of 357 miles, there being but 402 miles of railroad in the entire State at that time. And this ratio has been pretty well preserved until 1903 when 6,500 miles of rail-

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road, or more than one half the State's mileage were operated by 14 lines for which Houston is an initial point and which during that year moved 16,000,000 tons of freight, or about three fifths of the tonnage which went toward making up the total of the State's railroad business. These 14 lines with their immediate system connections give Houston 30,000 miles of direct rail facilities. In addition to this Houston enjoys direct rail and barge connection with a second steamship line to New York which has tri-weekly sailings from Galveston. By reason of its location at the head of ocean navigation on Buffalo Bayou, Houston enjoys water rates on freight from defined territories as well as from the Atlantic seaboard and finds itself in a most advantageous position for the distribution of merchandise of all classes. Freight to the value of $25,000,000 is annually exported and imported on barges and other craft navigating Buffalo Bayou and plying between Houston and Galveston.

Manufactures.— Houston has 507 industrial plants in operation in the city, an increase of 141 per cent during the last decade. There are $8,000,000 invested in manufacturing enterprises with products to the value of $12,000,000 in 1903. Manufacturing has been stimulated to a great extent by the discoveries of petroleum and the development of the rice industry. The rapid growth of the sawmill and lumber products business — the most important in the State — 85 per cent of which is carried on within easy reach of Houston and in a section for which the city is the natural market has also contributed to the same end. Chief among Houston's manufacturing concerns are the cotton oil refineries of which there are five. These represent an investment of $1,250,000 and annually, on an average, convert 144,000 tons of cotton seed into products bringing $3,168,000 in the markets of the world, in the aggregate. Here are also the general car shops of the Atlantic division of the Southern Pacific and allied lines and the division car shops of three other railroad companies. The city has 35 miles of electric street car lines.

Population.— (1890) 27,557; (1900) 44,663; (1903) 65,000.

R. M. Johnston,
Houston Daily Post.

Hovey, Alvin Peterson, American soldier: b. Mount Vernon, Ind., 1821; d. Indianapolis 23 Nov. 1891. He studied law, and was admitted to the bar in 1843; was appointed successively circuit judge, judge of the supreme court, and United States district attorney. He was a major of Indiana volunteers, and afterward major-general during the Civil War. In 1866 he was made minister to Peru; was elected to Congress in 1886, and became governor of Indiana in 1888.

Hovey, Charles Mason, American horticulturist: b. Cambridge, Mass., 26 Oct. 1810; d. Boston 2 Sept. 1887. He was the first to introduce a pistillate strawberry, known as "The Hovey," a variety that marks the beginning of strawberry culture in the United States. He edited the 'Magazine of Horticulture' for many years, and was the author of 'Fruits of America' (1880).

Hovey, Richard, American poet: b. Normal, Ill., 4 May 1864; d. New York 24 March 1900. He was graduated at Dartmouth 1885, went abroad and led a bohemian life, being in turn actor, journalist, dramatist and poet, and finally lecturer on English literature in Barnard College, New York. His verse was of the idealistic school and marked with the influence of Ibsen and Maeterlinck. His works are: 'Launcelot and Guenevere' (1880); 'Taliesin: a Masque' (1900); 'Seaward: an Elegy' (1893); 'The Laurel' (1897); 'Along the Trail' (1898); and with Bliss Carman (q.v.) wrote 'Songs from Vagabondia' (1893); and 'More Songs from Vagabondia' (1896).

Howard, Blanche Willis. See Teuffel, Blanche Willis Howard, Baroness Von.

Howard, Bronson, American playwright: b. Detroit, Mich., 7 Oct. 1842. Preparing for college he turned to journalism instead of entering Yale, and from 1867 to 1872, was employed on the New York *Tribune, Evening Mail* and other newspapers. In 1864 he had written a dramatic piece called 'Fantine,' which was produced in Detroit, but his first important play was 'Saratoga,' produced by Augustin Daly in 1870, and the first of a long list of successes, which gave him a foremost position among American playwrights. Among his plays are: 'The Banker's Daughter' (1878); 'Young Mrs. Winthrop' (1882); 'The Henrietta' and 'Met by Chance' (1887); 'Shenandoah' (1889); 'Aristocracy' (1892); 'Peter Stuyvesant' (with Brander Matthews); etc.

Howard, Catharine, fifth queen of Henry VIII.: b. about 1520; d. 13 Feb. 1542. She was a granddaughter of the second duke of Norfolk.

Howard, Guy, American soldier: b. Augusta, Maine, 16 Dec. 1855; d. 21 Oct. 1899. He was a son of Gen. O. O. Howard (q.v.) and entered the United States army in 1876 as a second lieutenant. He was promoted chief quarter-master, with rank of lieutenant-colonel 11 Aug. 1898; was assigned to duty in Manila under Gen. Lawton; and had charge of the transportation for Lawton's advance movement. While on the gunboat Oceania he was attacked by Filipino insurgents, and fatally shot.

Howard, John, English philanthropist: b. probably Hackney 2 Sept. 1726; d. Kherson, Russia, 20 Jan. 1790. In 1773 he was appointed high sheriff of Bedfordshire, when the subject of prison discipline came under his notice; and finding many abuses in the management of jails, he resolved to devote his time to investigation of the means of correcting them. With this view he visited most of the English county jails and houses of correction, and in March 1774 laid the result of his inquiries before the House of Commons. In 1781 and 1782 he made a tour through the northern parts of Europe, including Denmark, Sweden, Russia, and Poland. In 1783 he visited Spain and Portugal, and again surveyed the prisons of his own country. At the same time was published a complete edition of his 'State of the Prisons,' with all the supplementary matter. A new subject now engaged his attention, namely, the management of lazarettos, and the means of preventing the communication of the plague and other contagious diseases. In 1789 he published 'Account of the Principal Lazarettos in Europe.' In 1789 he proceeded through

Germany to St. Petersburg and Moscow. Prisons and hospitals were everywhere thrown open for his inspection as a friendly monitor and public benefactor. Consult: Howard's 'Correspondence' (1855); and 'Lives' by Dixon (1849); Stoughton (1853).

Howard, John Eager, American soldier: b. Baltimore County, Md., 4 June 1752; d. 12 Oct. 1827. He joined the army under Washington at Middlebrook, N. J., in the spring of 1777, and subsequently fought at Germantown and Monmouth. In 1780 he joined the army under Greene, and in the battle of Cowpens (1781) he displayed great gallantry, and the bayonet charge of the Maryland troops under his command, whereby the enemy were thrown into confusion, turned the fortune of the day and secured victory to the Americans. For his services in this battle he received from Congress a silver medal. In 1788 was elected governor of Maryland, a position which he filled for three years. From 1796 to 1803 he represented Maryland in the United States Senate. He was a candidate for the Vice-Presidency in 1816.

Howard, Oliver Otis, American general: b. Leeds, Maine, 8 Nov. 1830. He was graduated from Bowdoin in 1850, and from West Point in 1854. He was then assigned to the ordnance department of the regular army, served in Florida against the Seminoles, and was professor of mathematics at West Point 1857–61. At the outbreak of the Civil War he entered the volunteer service as colonel of the 3d Maine regiment. He was in over 20 important battles; in 1861 he was at the battle of Bull Run, and was afterward made brigadier-general of volunteers; in 1862 he served in the Virginia campaign, and at the battle of Fair Oaks lost his right arm. He commanded at the battles of Antietam and Fredricksburg; in 1863 was appointed to the command of the 11th Army Corps and led them at the battles of Chancellorsville and Gettysburg. When the 11th Corps was united with the 12th he was given command of the 4th Corps of the Army of the Cumberland, but was shortly afterward transferred to the command of the Army of the Tennessee, which was the right wing of Sherman's army on his "march to the sea." In 1864 he was appointed brigadier-general in the regular army, and in 1865 made commissioner of the Freedmen's Bureau, which he conducted very efficiently; 1869–73 he was president of Howard University (q.v.), established in Washington for the higher education of the negro. In 1874 he was placed in command of the Department of the Columbia, and there conducted four campaigns against the Indians, including that against the Nez Percés tribe. In 1881 he was superintendent at West Point, and subsequently in command of the Departments of the Platte and of California; in 1886 he was promoted to the rank of major-general, and assigned to the Department of the East, where he remained until his retirement in 1894. In 1895 he founded the Lincoln Memorial University, Cumberland Gap, Tenn. He has written: 'Donald's School Days' (1879); 'Chief Joseph, or the Nez Percés in Peace and War' (1881); 'General Zachary Taylor' (1892); 'Isabella of Castile' (1894); 'Fighting for Humanity'; and 'Henry in the War.' Consult: L. C. Holloway, 'Life of General Howard.'

Howard Memorial Library, established in 1889 in New Orleans, La., is one of the few complete reference libraries in the United States. It was founded by Annie Turner Howard, whose gift of site, building, and endowment amounted to nearly $350,000. The plans for the building were made by Henry Hobson Richardson (q.v.). In addition to the 45,000 volumes of the best books on all subjects, it contains special and nearly complete collections on the history, description, and literature of Louisiana and the Gulf States. It has a dictionary card catalogue.

In the spacious and handsome reading-room are many fine bronzes, including the Houdon bust of Washington, from a life mask. This bronze is on a pedestal which brings the face to the correct height. This library is of great service to students of all the educational institutions of the Southern States, and also to writers on special subjects pertaining to the Gulf States.

William Beer,
Librarian of Howard Memorial Library.

Howard University, a coeducational institution, situated in Washington, D. C., established by the United States government in 1867. It was named for Gen. O. O. Howard, who was head of the Freedmen's Bureau, and had much to do with the foundation of the school. The university is supported by Congressional appropriation, except the medical department, which is maintained by tuition fees, and this is the only department in which tuition is charged. The departments are preparatory, collegiate, medical, agricultural, dentistry, pharmacy, pedagogy, theology, law, music, and agriculture. An industrial department provides instruction in trades for students in the preparatory and English courses. The pupils in this department have practice under competent workmen, in printing, carpentry, bookbinding, and tinsmithing. The university is well known for its work in the higher education of the negroes of the United States. The school has property valued at about $1,000,000, and a general endowment fund of $175,000.

Howe, Andrew Jackson, American eclectic surgeon and author: b. Paxton, Mass., 14 April 1825; d. Cincinnati, Ohio, 16 Jan 1892. Educated in Leicester Academy and Harvard College, from which he graduated in 1853. Attended medical lectures at Jefferson Medical College, Philadelphia; College of Physicians and Surgeons, and the New York Medical College of New York city, and Worcester Medical Institute, graduating from the latter in 1855. He was demonstrator of anatomy in his alma mater in 1855–6; professor of surgery in Cincinnati College of Eclectic Medicine and Surgery, 1856–9; demonstrator and professor of anatomy in Eclectic Medical Institute of Cincinnati, 1859–61; professor in same of surgery, from 1861 to 1892. He wrote 'A Treatise on Fractures and Dislocations' (1873); 'Manual of Eye Surgery' (1874); 'Art and Science of Surgery' (1876); 'Operative Gynæcology' (1890); 'Conversations on Animal Life,' and 'Miscellaneous Papers,' published in 1894, after his death. He was president of the National Eclectic Medical Association in 1882–3.

ELIAS HOWE,

INVENTOR OF THE SEWING MACHINE.

Howe, Edgar Watson, American novelist and editor: b. Treaty, Ind., 3 May 1854. At the age of 12 he entered a printing office, and when only 19 was publisher of the 'Golden Globe' in Golden, Col. Ten years later he became proprietor and editor of the Atchison (Kan.) *Daily Globe.* He has written: 'The Story of a Country Town' (1883), which attracted considerable attention; 'The Mystery of the Locks' (1883); 'A Moonlight Boy' (1887); 'A Man Story' (1888); 'An Ante-Mortem Statement'; 'The Confession of John Whitlock'; etc.

Howe, Elias, American inventor: b. Spencer, Mass., 9 July 1819; d. Brooklyn, N. Y., 3 Oct. 1867. He lived with his father, who was both farmer and miller, till 1836, working upon the farm and in the mill and attending the district school during the winters. He then learned the trade of a machinist, and experimented in inventing a sewing-machine. The model was completed and the patent issued 10 Sept. 1846. A patent was also taken out in England, but from this the inventor realized nothing. After constructing four machines in the United States, he visited England in 1847, remaining two years. He returned to Boston entirely destitute, and resumed his trade for the support of his family. From this period until 1854 he was involved in expensive lawsuits, when the principal infringers of his patents acknowledged his rights, and arranged to manufacture sewing-machines under licenses from him. He served as a private in the 17th Connecticut volunteers during the Civil War. He was the recipient of the Legion of Honor cross and many medals.

Howe, Henry, American publisher and historian: b. New Haven, Conn., 16 Oct. 1816; d. 1893. He entered the publishing business in 1839, and while conducting this business began historical researches in New Jersey and New York. He later moved to Ohio, where he continued his historical studies, and published subscription books. His writings include: 'Memoir of Eminent Mechanics' (1839); 'The Great West' (1851); 'Travels and Adventures of Celebrated Travelers' (1853); 'Adventures and Achievement of Americans' (1858); 'Our Whole Country' (1861); 'Over the World' (1883); and 'Historical Collections' of three States, New Jersey, New York and Ohio.

Howe, John, English Puritan divine: b. Loughborough, Leicestershire, 17 May 1630; d. London 2 April 1705. He was frequently styled "The Platonic Puritan" and is ranked as the greatest of the Puritan clergymen. He was an eloquent preacher and a powerful controversialist, but fortunately free from animosity or theological bitterness. Among his works, 'The Living Temple'; 'The Blessedness of the Righteous'; and 'The Oracles of God' have been especially valued. See 'Life' by Rogers (1836).

Howe, John Ireland, American inventor: b. Ridgefield, Conn., 20 July 1793; d. Birmingham, Conn., 10 Sept. 1876; was at first a physician, but in 1830 invented a pin-making machine. This he perfected later and it was the means of revolutionizing the pin manufacture.

Howe, Joseph, Canadian statesman: b. near Halifax, Nova Scotia, 13 Dec. 1804; d. Halifax, 1 June 1873. He learned printing and in 1827 became connected with the 'Acadian' and in 1828 editor and proprietor of the 'Nova Scotian.' He contributed several remarkable articles to this paper, called "Western and Eastern Rambles" and the papers "Legislative Reviews." He was elected to the Provincial Parliament in 1836. He favored free common schools, one Provincial University and complete, responsible government and it was mainly due to his efforts that Nova Scotia finally received such government. He was a member of the Executive Council in 1840 and Speaker of the Assembly the same year. In 1846 he succeeded in making himself a popular power in the province and turned it over to the Liberals. Howe opposed confederation in the old assembly and even went to London to lay a petition before the throne against "the assertion of Federal supremacy," but lost his fight. He served as secretary of state for the provinces in the Dominion cabinet and superintendent of Indian affairs (1869–72), and later was a member of the Dominion Parliament for Hants County, Nova Scotia. He returned to Halifax in 1873 as lieutenant-governor, but only lived a few months to enjoy it.

Howe, Julia Ward, American author and philanthropist: b. New York 27 May 1819. In 1843 she married S. G. Howe (q.v.) of Boston, and immediately became active in philanthropical work. With her husband she edited the 'Boston Commonwealth,' one of the ablest anti-slavery papers, to which she contributed leading articles, essays, poems, letters, and witty comments. At the same time she also wrote for the New York *Tribune,* and the 'Anti-Slavery Standard.' Since the Civil War she has been active as writer and speaker in other social and philanthropic work, particularly in the agitation for woman's suffrage and for prison reform. She was one of the founders of the New England Women's Club, the first organization of its kind in America; she was delegate to the World's Prison Reform Congress in London (1872); and was president of the women's branch of the New Orleans Exposition (1884). She has also preached occasionally in Unitarian pulpits. She has been president of the Boston Authors Club from its foundation in 1899. Her writings include: 'Passion Flowers' (1854); 'Words for the Hour' (1856); 'Later Lyrics' (1866); 'A Trip to Cuba,' and 'From the Oak to the Olive,' two books of travel; 'The World's Own' (1855), a drama; 'Sex and Education' (1874); 'Modern Society' (1881); 'Is Polite Society Polite?'; 'Life of Margaret Fuller' (1883); and 'Reminiscences' (1899). Her best known poem is 'The Battle Hymn of the Republic' (in 'Later Lyrics'), written early in the Civil War, while she was visiting the camps around Washington. It was set to the music of 'John Brown's Body,' and immediately became popular with the soldiers.

Howe, Mark Antony de Wolfe, American editor and author: b. Bristol, R. I., 28 Aug. 1864. He was educated at Lehigh and Harvard universities, and on leaving college entered the editorial office of 'The Youth's Companion,' Boston. In 1893–5 he was assistant editor of the 'Atlantic Monthly,' and since 1899 has been corresponding editor of 'The Youth's Companion.' He has published: 'Shadows,' verse (1897); 'American Bookmen' (1898); 'The Memory of

Lincoln' (edited) (1899): 'Phillips Brooks' (1899); 'Boston: the Place and the People' (1903). He has edited the series of 'Beacon Biographies' from 1899.

Howe, Richard, Earl, English admiral: b. London 8 March 1726; d. 5 Aug. 1799. At 14 he shipped as a midshipman on board the Severn in which he sailed with Anson for the Pacific, and passed through the usual gradations of the service under that admiral till 1745, when he obtained the command of the Baltimore sloop-of-war, in which he took part in the siege of Fort William, during the last Jacobite rebellion. In 1756 he served in the Channel fleet; in 1758 reduced Cherbourg. In 1759 he defeated a French squadron under De Conflans, and for two years (1763–5) occupied a seat in the board of admiralty. In 1776, as commander-in-chief in North America, he acted against the American forces and against D'Estaing, who commanded a superior French fleet. He sailed to the relief of Gibraltar in 1782 and was successful in spite of the combined fleets of France and Spain. On the outbreak of war with France in 1793 he took the command of the British fleet, and on 1 June 1794, obtained a decisive victory off Ushant for which he received the thanks of Parliament. He was made admiral of the fleet in 1796. His name is one of the highest among those of the famous naval commanders of Great Britain. He greatly improved the service by the introduction of a new system of tactics.

Howe, Robert, American colonial soldier: b. Brunswick County, N. C., 1732; d. there 12 Nov. 1785. He was a member of the assembly and of two provincial congresses, and took a prominent part in the preparation for the Revolution. At the outbreak of the war he was given a command and aided in driving the British out of Virginia; was promoted to the rank of major-general and commanded in the South. In 1778 he was repulsed by the British and compelled to evacuate Savannah; though then deprived of command he was afterward acquitted by the court-martial by which he was tried for the loss of the city. In 1780 he commanded at Charleston; in 1783 assisted Washington in putting down a mutiny; and in 1785 was elected to the North Carolina legislature, but died before he took his seat.

Howe, Samuel Gridley, American philanthropist: b. Boston 10 Nov. 1801; d. there 9 Jan. 1876. He was graduated from Brown University in 1821, and from the Harvard Medical School in 1824. Immediately after completing his studies he joined the Greek army at the time of the war for independence; he created an excellent surgical corps for the Greeks, and was also distinguished as a brave commander in battle; at the declaration of peace he established an industrial colony of Greeks on the Isthmus of Corinth. He returned to the United States for a short time, but becoming interested in the work for the blind, went back to Europe in order to study the schools for the blind there; while in Paris he was chairman of the committee for the relief of the Poles in the time of the Polish uprising; he went to Prussia to distribute the funds collected, and was imprisoned by the Prussian authorities. In 1832 he returned to Boston, and founded the Perkins Institution for the Blind, of which he became superintendent; in this position he did much to improve the methods in the instruction of the blind, and to found similar schools throughout the United States. His greatest success was in the training of Laura Bridgman. (See Defectives, Education of.) He also assisted in organizing the Massachusetts School for Idiots. He was active in the anti-slavery cause; was candidate of the Conscience Whig Party for Congress, but was defeated; and was editor of the anti-slavery paper, the 'Boston Commonwealth,' assisted by his wife, Julia Ward Howe (q.v.). At the close of the Civil War he joined in the work of the Freedmen's Bureau (q.v.). He was always active in many lines of philanthropic work, organized the Massachusetts State Board of Charities and went to Greece in 1867 with supplies for the Cretans. In 1870 he was one of the commission appointed by President Grant to visit Santo Domingo and report upon the advisability of its annexation. He wrote: 'Historical Sketches of the Greek Revolution' (1828); 'Reader for the Blind' (1839). Consult: The 'Life,' by Julia Ward Howe, and Sanborn, 'S. G. Howe, the Philanthropist.'

Howe, Timothy Otis, American statesman: b. Livermore, Maine, 24 Feb. 1816; d. Kenosha, Wis., 25 March 1883. He received a common school education, studied law, was admitted to the bar, and sat in the Maine legislature in 1845. He removed in that year to Wisconsin, entered politics, and in 1861 was chosen United States Senator, serving till 1879. He declined a Supreme Court judgeship on the death of Salmon Chase, but in 1881 became postmaster-general in President Arthur's cabinet.

Howe, Sir William, English general: b. 10 Aug. 1729; d. 12 July 1814. He was a brother of Admiral Richard Howe (q.v.) and was the successor of Gen. Gage in command of the British forces in America. He had previously served under Wolfe at the battle of Quebec. He commanded at the battle of Bunker Hill (1775), in which he lost one third of his men present in the action, and in August 1776, gained the battle of Long Island and took New York city. He won the battle of Brandywine in September 1777, in consequence of which Philadelphia was occupied by his army. At his own request he was recalled in 1778, and was succeeded by Sir Henry Clinton, who repulsed Washington at Germantown in the October following. He succeeded to the Irish peerage as viscount in 1799.

How'ell, Clark, American journalist and politician: b. Barnwell County, S. C., 21 Sept. 1863. He was graduated from the University of Georgia in 1883, entered journalism, became managing editor in 1889 of the Atlanta *Constitution*, and editor-in-chief 1897. He was a member of the Georgia House of Representatives 1890–1 and has been a member of the Georgia Senate from 1900.

Howell, Mich., village, county-seat of Livingston County; on the Pere M. and the Ann A. R.R.'s; about 50 miles northwest of Detroit. It is located in a rich agricultural section of the State. The chief manufactures are flour and condensed milk; and it has a large sash, door,

Photograph copyright, 1902, by Purdy, Boston.

JULIA WARD HOWE.

and blind factory, and a planing-mill. Pop. (1900) 2,518.

Howells, William Dean, American novelist, poet and critic: b. Martin's Ferry, Ohio, 1 March 1837. During his boyhood his father owned and published daily papers in Hamilton and Dayton, Ohio, successively, and he learned the printer's trade and gradually the whole business of conducting a newspaper. In 1851 he was working in Columbus as a compositor; in 1856 he became Columbus correspondent of the Cincinnati *Gazette;* and in 1859 was appointed news editor of the *Ohio State Journal.* At this time he published a small volume of poems, and also some poems in the 'Atlantic Monthly.' In 1860, when Lincoln was nominated, Howells wrote his life, and in 1861 was appointed United States consul at Venice, where he remained till 1865. The impressions of his stay there were embodied in 'Venetian Life' (1866), and 'Italian Journeys' (1867). On his return to the United States, he was for a time connected with the staff of the New York *Tribune,* the *Times,* and the 'Nation.' In 1866 he became assistant editor of the 'Atlantic Monthly,' and editor-in-chief in 1872. In 1886–92 he conducted the critical department of 'Harper's Monthly' called «The Editor's Study»; and in 1892 was editor of the 'Cosmopolitan' for a short time.

His first novel 'Their Wedding Journey,' was published in 1871; his other novels include: 'A Chance Acquaintance' (1874); 'A Foregone Conclusion' (1875); 'The Lady of the Aroostook' (1879); 'The Undiscovered Country' (1880); 'Doctor Breen's Practice' (1882); 'A Modern Instance' (1882); 'A Woman's Reason' (1883); 'The Rise of Silas Lapham' (1885); 'Indian Summer' (1886); 'The Minister's Charge' (1886); 'April Hopes' (1887); 'A Hazard of New Fortunes' (1889); 'The Shadow of a Dream' (1890); 'An Imperative Duty' (1892); 'The Quality of Mercy' (1892); 'The World of Chance' (1893); 'The Coast of Bohemia' (1893); 'A Traveller from Altruria' (1894); 'The Landlord at Lion's Head' (1897); 'An Open-Eyed Conspiracy' (1898); 'The Story of a Play' (1898); 'Ragged Lady' (1899); and 'Their Silver Wedding Journey' (1900). Howells has also written farces and comedies, including: 'The Sleeping-Car' (1883); 'The Mouse-Trap' (1897); 'The Unexpected Guests' (1898); and 'The Albany Depot' (1898); etc., and the following volumes of verse: 'Poems of Two Friends' (1860), with J. J. Piatt; 'No Love Lost, a Romance of Travel' (1868); and 'Poems' (1873). His other works include: 'Tuscan Cities' (1885); 'Modern Italian Poets'; 'Essays and Versions' (1887); 'Criticism and Fiction' (1891); and 'Impressions and Experiences' (1896); 'Literary Friends and Acquaintances' (1899); and 'Heroines of Fiction.'

In American literature, Howells is the leader of the realistic school; his novels portray the average, everyday American life; he has a true and sympathetic understanding of the «common people» of the United States, and types of the American «self-made» man appear and reappear in his stories. His latest phase, that in which he seeks to understand and set forth the American social problems, — the meaning of socialism, the relations of labor and capital, and, more broadly, the mystery of poverty and of human suffering, — is typified in a book like 'A Hazard of New Fortunes'; and 'A Traveller from Altruria,' a picture of an ideal commonwealth. The absence of idealism in Howells' writings has been cited as their gravest defect; but it is by no means true that he entirely excludes the ideal sides of life from treatment. His work is marked by carefulness and thoughtfulness in style and construction, and by fidelity to a high ideal of artistic excellence. His essays, like his novels, have always that indefinable charm which is the enduring note in good literature, and to the charm are added the broad outlook and the deep ethical interest which are typical of the man.

How'ison, George Holmes, American philosopher: b. Montgomery County, Md., 29 Nov. 1834. He was graduated from Marietta College, Ohio, in 1852, and from Lane Theological seminary, Cincinnati, in 1855, and after holding various college professorships elsewhere became Mills professor of philosophy at the University of California in 1884. He has published 'Treatise on Analytic Geometry' (1869); 'Limits of Evolution' (1901); 'The Conception of God' (1897).

Howison, Henry Lycurgus, American rear-admiral: b. Washington 10 Oct. 1837. He was graduated from the United States Naval Academy in 1858. He served in various important engagements, becoming lieutenant-commander in 1865. In 1899 he became rear-admiral and was retired 19 Oct. 1899. In 1901 he was appointed a member of the Schley court of inquiry, but on being challenged, was relieved from service.

How'itt, William and **Mary**, English authors commonly named together. WILLIAM (b. Heanor, Derbyshire, 18 Dec. 1792; d. Rome, Italy, 3 March 1879), showed such a bias to literature that he published verses at 13. In 1821 he married MARY BOTHAM (b. Uttoxeter 12 March 1799; d. Rome 30 Jan. 1888), who wrote both by herself and with her husband. Their first joint work, a volume of poems, 'The Forest Minstrel,' was published in 1823, and in 1827 appeared 'The Desolation of Eyam.' The best lines in these are by Mrs. Howitt, Howitt himself having no great poetic gift. In 1871, however, he published a volume entitled 'The Mad War Planet and Other Poems.' William and Mary Howitt settled first in Staffordshire. In 1823 they removed to Nottingham, where they resided till 1837, and in 1840 visited Germany, where they resided for three years. Results of their residence in Germany appeared in 'Student Life of Germany' (1841) and 'Rural and Domestic Life of Germany' (1842), which, being translated into German, acquired flattering popularity. While at Heidelberg Mrs. Howitt set herself to translate the tales of Frederika Bremer into English, and later the works of Hans Andersen. Their most ambitious work is 'The Literature and Romance of the North' (1852). Howitt's best works are those in which English history and life are treated of in connection with English scenery. The earliest of these was the 'Book of the Seasons' (1831), which acquired great popularity; 'Rural Life in England' (1838) was also well received. Still others are: 'Visits to Remarkable Places' (1840); 'Homes and Haunts of the British Poets' (1847): 'The Year Book of the Country' (1850); and 'The Northern Heights of London' (1869). With his wife he published volumes on 'The Ruined Abbeys and Castles of Great Britain.' Mrs. Howitt's books for young people were long popular in the United States, and 'The Pet Lamb' and a few other unpretending verses of hers have become familiar to thousands of juvenile readers.

How'itzer. See ORDNANCE.

How'land, Alfred Cornelius, American painter: b. Walpole, N. H., 12 Feb. 1838. As an art student he began in the studios of Schultz and Eppindale at Boston, and subsequently went to Dusseldorf and Paris, in which latter place he painted under Lambinet. He excels in genre and landscape, and among his favorite works are 'Ford's Glen' (1878); 'Rendezvous of the Veterans' (1884); and 'The Coming Circus' (1886).

Howland, Gardiner Greene, American journalist: b. New York 1834; d. there 9 May 1903. He was the intimate and confidential friend of the elder James Gordon Bennett, held the same relations with the younger Bennett, was general manager of the *Herald* for more than twenty-five years, and one of the corporators named under the incorporation of the newspaper.

Howley, Michael Francis, Canadian ecclesiastic: b. 1843. In 1857 he entered Saint Bonaventure's College, and in 1863 went to Rome, entering Propaganda as an ecclesiastical student. In 1868 he was ordained a priest and went to Scotland as secretary to Most Rev. Dr. Ayre, but in 1870 returned to Rome with Dr. Ayre and was present on the occasion of the declaration of the dogma of papal infallibility by Pope Pius IX. He accompanied the Rt. Rev. Thomas J. Power to Newfoundland in 1870, and for over 30 years he has labored with great success for the spiritual and ecclesiastical advancement of Newfoundland. In 1886 he was made prefect apostolic of Saint Georges, in 1892 was consecrated bishop in Saint John's and made vicar apostolic of Saint Georges, in 1902 appointed bishop of Saint John's in succession to Rt. Rev. Dr. Power, and in 1904 he was named by the Holy See archbishop of the ecclesiastical province of Newfoundland. Archbishop Howley is not only distinguished as a theological scholar and thinker, a devoted missionary and able preacher, but also as a poet, lecturer, and antiquary. He has also contributed much to the historical study of Newfoundland (q.v.).

Howorth, how'ërth, **Henry Hoyle,** SIR, English author and politician: b. Lisbon, Portugal, 1 July 1842. He was a Conservative member of Parliament for South Salford 1886–1900. In recognition of his works on Eastern history and other subjects, he was created K. C. I. E. in 1892. Besides very many scientific memoirs, he has published: 'History of the Mongols'; 'The Mammoth and the Flood'; 'The Glacial Nightmare and the Flood'; 'Genghis Khan and his Ancestors.' etc.

Howrah, how'rä, India, an independent municipality, suburban to Calcutta (q.v.). Pop. (1901) 157,847.

Hox'ie, Vinnie Ream, American sculptor: b. Madison, Wis., 23 Sept. 1846. She was educated at Christian College, Columbia, Mo., and going to Washington, D. C., studied art, executed busts of Grant, Sherman and others, and a statue of Lincoln for the National Capitol. She then went abroad, where she designed medallions of Doré, Liszt, Buchanan, Read, and others. Among other works of hers are ideal statues of 'Sappho'; 'The Spirit of the Carnival'; and the statue of Admiral Farragut in Farragut Square, Washington. She was married to Major R. L. Hoxie of United States Engineers.

Hoyle, Edmond, English writer on games: b. 1672; d. London 29 Aug. 1769. It is said that he was educated for the law, but nothing definite is known of his career except that he was for many years in London a writer on and instructor in games. His 'Short Treatise on Whist' (1742), a compendium of the laws of the game and many rules for play, sold largely and has been the basis of all subsequent manuals of the kind. So generally has his authority been accepted in the game that "according to Hoyle" has attained a proverbial significance.

Hoyt, Charles Hale, American dramatist: b. Concord, N. H., 1860; d. 1900. He was at one time musical and dramatic critic of the *Post* of Boston. His works comprise 'A Midnight Bell' (1887), and a long series of farce-comedies, such as 'A Trip to Chinatown' (1890).

Hoyt, Henry Martyn, American lawyer and soldier: b. Kingston, Pa., 8 June 1830; d. Wilkesbarre, Pa., 1 Dec. 1892. He was graduated from Williams College in 1849, read law, was admitted to the bar in 1853, practised at Wilkesbarre, at the opening of the Civil War was appointed lieutenant-colonel of 52d Pennsylvania regiment, served during the Peninsular campaign in 1862, and was captured in a night attack on Fort Johnson during the siege of Morris Island. Mustered out with the grade of brevet brigadier-general; he practised his profession until 1867, and was then appointed additional law-judge of the Luzerne County courts. In 1879–83 he was Republican governor of Pennsylvania. His administration was particularly characterized by a wise financial policy, by means of which the State debt was reduced to $10,000,000 and refunded at three per cent. He published: 'The Controversy between Connecticut and Pennsylvania' (1879); 'Protection *v.* Free-Trade' (1885).

Hoyt, John Wesley, American educator: b. near Worthington, Ohio, 13 Oct. 1831. He was graduated at Ohio Wesleyan University in 1849, and later studied both medicine and law. He has had charge of educational exhibits in several international expositions, and was made chairman of the National Committee to Promote the Establishment of the University of the United States. He was the first president of the University of Wyoming, and was governor of Wyoming 1878–83. He has published 'Progress of University Education'; 'Studies in Civil Service'; etc.

Hoyt, Wayland, American Baptist clergyman and author: b. Cleveland, Ohio. He was educated at Brown University and studied for the Baptist ministry at the Rochester Theological Seminary. Since then he has held pastorates at Pittsfield, Mass., Cincinnati, Brooklyn, Minneapolis, and Philadelphia. Among his published works are 'Hints and Helps for the Christian Life' (1880); 'Gleams from Paul's Prison' (1882); 'Light on Life's Highway' (1890).

Huaina Capac, wä-ē'nā kä'päk, or **Huayna Capac**, 11th Peruvian Inca: b. Cuzco, Peru, about 1450; d. Tumibamba, Ecuador, November 1525. He began his reign in 1480, or, according to some authorities, 1491, and made many conquests, even subduing the country as far south as Chile. By his will he divided the empire between two of his sons, Huascar and Atahualpa (q.v.).

Huamanga, wä-män'gä, or **Guamanga**, gwä-män'gä, Peru, the former name of Ayacucho (q.v.).

Huanaco, hwä-nä'kō, the most numerous and widely distributed of the two species of the genus *Lama* (*L. guanaco*), of the camel family, resident in South America. It is somewhat like a large goat in form, but with a much longer neck, surmounted by a small camel-like head, and long, pointed, alert ears, but no weapons. A large male is about four feet tall at the withers, a female somewhat less. The coat is of long, woolly, reddish-gray hair, the improvement of which by selective breeding in domestication has formed the alpaca breed (see ALPACA). It roams the open plains of Argentina and Patagonia, serving as the principal game animal of that region, and furnishing the scattered natives with food, clothing, and shelter. In the autumn it gathers into large herds, and behaves in general like the antelopes of the similar arid plains of other parts of the world. Consult Darwin, Hudson, Spears, and other writers on Patagonia. See LLAMA.

Huascar, wäs'kär, Peruvian Inca, son of Huaina Capac (q.v.). See ATAHUALPA.

Hub'bard, hŭb'ard, **Elbert**, American author: b. Bloomington, Ill., 1859. After working on a farm as a boy, he went to Chicago, where he entered a printing-office, and later was employed in a soap factory. In the latter business he rose to be manager, and finally partner of the firm; selling out his interest, he devoted himself for a time to study and travel, and finally settled at East Aurora, where he established the Roycroft shop, devoted mainly to the artistic printing and binding of books. The organization of the shop is co-operative, and its ideal is for every worker to do that which best expresses his own individuality. Hubbard is editor of the 'Philistine,' a "magazine of protest," and has written 'Little Journeys' (biographical sketches); 'No Enemy but Himself'; 'Message to Garcia' (1898); and 'Time and Chance' (1901); 'The Man of Sorrows' (1904).

Hubbard, Joseph Stillman, American astronomer: b. New Haven, Conn., 7 Sept. 1823; d. there 16 Aug. 1863. He was graduated from Yale in 1843, and accompanied Frémont as observer of latitude and longitude in the latter's transcontinental journey. From 1845 until his death he was stationed at the Washington observatory as professor of mathematics in the United States navy. He made important investigations regarding comets, was at two different periods editor of the 'Astronomical Journal,' and was a member of the National Academy of Sciences.

Hubbard, Leonidas, Jr., American journalist, writer, and explorer: b. Waldron, Mich., 12 July 1872; d. Labrador 18 Oct. 1903. He was a teacher in the public school at Angola, Mich., while still in his teens, and early in life showed keen interest in writing, exploration, and athletics. Graduated from University of Michigan in 1897. He once began reportorial work in Ann Arbor, and later on the Detroit *Evening News*. He came to New York in the summer of 18[illegible] and attached himself to the staff of the *Daily News*, but early in 1902 became associate editor of 'Outing,' in which work he was much interested. He conceived the idea of exploring into the wilds of Labrador, and 20 June 1903, accompanied by Dillon Wallace, a New York lawyer, and George Elson, a Cree Indian guide, he left New York, going by steamer from Saint Johns, N. B., to Rigolette, a Hudson Bay trading post on the Grand River. From this point Hubbard and his friends traveled by canoe and on foot, mapping correctly for the first time Grand Lake; then penetrating the interior in a westerly and northwesterly direction, mapping the course of the Beaver River from its source to the point where it flows into the southeast bay of Lake Michikamau; and locating and mapping several large lakes in the interior. The party penetrated some 250 mile further into new territory than any previous expedition. Notes on the geology and general observation of the topography of the country were also made. Among Mr. Hubbard's most noted writings are: 'The Moonshiner at Home' (1902); 'Barataria' (1902); 'Children of the Bush' (1903); and 'Where Romance Lingers' (1904).

Hubbard, Oliver Payson, American physician: b. Pomfret, Conn., 31 March 1809; d. New York 9 March 1900. Graduated from Yale in 1828, he was assistant to Silliman the elder in the laboratory there in 1831–6, and aided Goodyear in experiments connected with the vulcanizing of India rubber. In 1836–60 he was professor of chemistry, pharmacy, mineralogy, and geology at Dartmouth, in 1866–71 lectured on those subjects, and from 1871 until his retirement as professor emeritus in 1883 was professor of chemistry and pharmacy. He was a founder of the American Association of Geologists and Naturalists in 1841, and its secretary in 1844. He contributed to the 'American Journal of Science,' and published 'A History of Dartmouth Medical College' (1880), etc.

Hubbard, Richard William, American artist: b. Middletown, Conn., 15 Oct. 1810. He was educated at Yale, set up his studio in New York, was elected to the National Academy in 1858, and painted numerous American landscrapes, such as: 'Mansfield Mountain at Sunset'; 'Showery Day, Lake George'; 'Glimpse of the Adirondacks'; and 'Lake Cazenovia.'

Hubbard, William, American colonial clergyman and historian: b. Tendring, Essex, England, 1621; d. Ipswich, Mass., 14 Sept. 1704. He was graduated at Harvard College in 1642, and was ordained about 1656 as minister at Ipswich, where he continued during the remainder of his life. He is the author of 'A narrative of the

Troubles with the Indians from 1607 to 1677, with a Discourse' (1677), the map accompanying which is supposed to be the first executed in America. He left in manuscript a 'General History of New England,' for which the colony paid him £50, and which has been consulted with advantage by Mather, Hutchinson, Holmes, and other American historians and annalists. It was published by the Massachusetts Historical Society in 1815.

Hubbardton, hŭb'ard-tŏn, Vt., town in Rutland County; 13 miles from Castleton, its nearest railroad station. It is in an agricultural region, and has but little manufacturing; its raw products are sent direct to the markets. On 7 July 1777 a battle took place here between the Americans under Colonels Francis and Warner, and a British and Hessian force under Generals Riedesel and Fraser, in which the British were successful. The Americans, the rear-guard of Gen. St. Clair's army, who were retreating from Ticonderoga, lost in killed, wounded, and prisoners 324 men; and the British loss was 183 men. A monument in memory of the American soldiers who were killed in this battle occupies a prominent position. Pop. 500.

Huber, Johannes, German philosopher and theologian: b. Munich 18 Aug. 1830; d. there 19 March 1879. He was educated at the University of Munich, became professor of philosophy there in 1859, and was one of the leaders of the Old Catholic party and an active opponent of the Ultramontanes. He vigorously attacked the definition of the dogma of papal infallibility. Among his works were 'Studies' (1867); 'Das Papsttum und der Staat' (1870); 'Der Jesuitenarden' (1873); and 'Zur Philosophie der Astronomie' (1877).

Huber, Victor Aimé, German publicist and author: b. Stuttgart 10 March 1800; d. Wernigerode 19 July 1869. Educated at Würzburg and Göttingen, he became professor of the history of literature and of modern history at Rostock in 1833, of the languages of western Europe at Marburg in 1836, and at Berlin in 1843. He retired in 1850. Huber was one of the most profound of German scholars in the Spanish language and literature. Among his publications were: 'Die Geschichte des Cid' (1829); 'Crónica del Cid' (1844); and 'Skizzen aus Spanien' (1825–35).

Hubert de Burgh, English statesman: d. London 12 May 1243. He held office under Richard Cœur de Lion, and was made castellan of Falaise by King John, with whom he sided in the struggle with the barons, though advising the granting of Magna Charta. In the year of Runnymede (1215) he was made justiciar (chief-justice) of England. On 24 Aug. 1217 he won a distinguished victory over a French fleet bringing reinforcements to the army besieging Dover Castle; the treaty of Lambeth was concluded (11 September) and the enemy evacuated England. After 1219 he was co-regent with Langton, archbishop of Canterbury, for Henry III. He vigorously opposed the foreigners who were endeavoring to obtain control of the government, and sought to end the exactions of the clergy. In 1232 he was dismissed, owing largely to his failures in the conflict with the Welsh, and thereafter he had no part in the government.

Hubert, hū'bėrt (Fr. ü-bār), Saint, apostle of Ardennes, the patron of huntsmen; d. about 727. Legend says that he was a keen hunter, and that being once engaged in the chase on Good Friday, in the forest of Ardennes, a stag appeared to him having a shining crucifix between its antlers, and he heard a warning voice. He was converted, entered the church, and became bishop of Maestricht and Liège. He worked many miracles, and his body, at first deposited in the church of St. Peter at Liège, was in 817 conveyed to the Benedictine convent of Andain, in the Ardennes, which received the name St. Hubert's of Ardennes. The day of the saint is 3 November, and was formerly celebrated at many courts by a solemn chase.

Hübner, Joseph Alexander, COUNT, Austrian diplomat: b. Vienna 26 Nov. 1811; d. there 30 July 1892. He was educated at Vienna, and, having entered the service of the government, became in 1849 minister at Paris, and in 1865–8 was ambassador at Rome. In 1879 he became a member of the clerical-conservative wing in the upper house of the Reichsrat. Among his published works are: 'Sixte-Quint-D'après des Correspondances Diplomatiques Inédites' (1870, new ed. 1883); 'Ein Spaziergang um die Welt' (1872, 7th ed. 1891); and 'Durch das Britische Reich' (1886, 2d ed. 1891).

Hübner, Julius, German painter: b. Oels, Silesia, 27 Jan. 1806; d. Loschwitz, Saxony, 7 Nov. 1882. He studied at the Berlin Academy and was also a pupil of Schadow at Berlin and Düsseldorf. In 1841 he became professor in the Dresden Academy of Arts. He was an historical painter of the Düsseldorf School, his works including 'Disputation between Luther and Eck' and 'Charles V. at Saint Just.'

Hübnerite, a native tungstate of manganese, $MnWO_4$. It always contains some ferrous iron and as its percentage increases it graduates toward wolframite (q.v.), which it often much resembles, but from which it is distinguished by its brown color and pleochroism. It occurs in monoclinic crystals, often bladed and deeply striated. It has easy pinacoidal cleavage, is brittle, has a hardness of 5 to 5.5 and is very heavy, its specific gravity being 7.2 to 7.5. Its lustre is sub-metallic or resinous, and its streak yellowish-brown or greenish-gray. It occurs in considerable quantities near Silverton, Colo., in New Mexico, Nevada, Arizona, and elsewhere.

Huck'leberry, a name of uncertain derivation applied to a variety of shrubs, especially to species of the genus *Gaylussacia*, and to those belonging to the order *Vacciniaceæ* and the genus *Vaccinium*. The principal species are found mainly in the northern hemisphere, throughout North America, Northern Britain, and Europe. The fruit of *Vaccinium* is a many-sided berry with four or five cells. *V. Pennsylvanicum* is a small plant about six inches in height. Other species range widely in size, *V. corymbosum* sometimes attaining a height of nearly 10 feet. In many places in the United States huckleberries are a valuable product, the fields in which they grow are preserved, and the berries are secured either for household use or for profitable marketing.

Huckleberry Finn, The Adventures of, a story by Samuel L. Clemens ("Mark Twain"), published in 1884. It is a sequel to, and follows the fortunes of, the leading characters of the same author's 'Tom Sawyer.' In this book the author not only preserves to us a valuable record of a rapidly disappearing social order, but throws light upon some questions of moment to the student of history.

Hudibras, hū'dĭ-brăs, Sir, the hero of a famous satirical poem by Samuel Butler (q.v.), published 1663–78.

Hud'son, H. Lindsay, "Harry Lindsay," English novelist: b. Belfast, Ireland, 10 April 1858. He has been a journalist and schoolmaster by turns, and among his writings published under the signature "Harry Lindsay" are 'Methodist Idylls' (1897); 'An Up-to-Date Parson' (1899); 'Judah Pyecroft: Puritan' (1902).

Hudson, Henry, English navigator. The time and place of his birth appear to be lost. We only know that he had earned, perhaps by the time he was 40, sufficient reputation as a bold and skilful navigator to be placed in command of the ship Half Moon of Amsterdam. Early in 1609 he made a contract with a party of Dutch merchants to act as captain of their private exploring expedition, and in the written agreement between them he was described as "Henry Hudson, Englishman." This settles the honor of his birth country, though nothing more. At that time the one great commercial demand was for a shorter and better, all-sea trade route to the Far East. It was known that there was land to the west of Europe and it was believed that a passage could be found through these lands directly westward to the East. It is clear that Hudson believed that the western route was the most promising and, no doubt, he suggested it to his employers, but they evidently had more faith in a sea passage north and then east, round Europe and Asia to China. Thus it happened this English sea captain sailed from the Dutch port of Amsterdam in the small ship "Half Moon bound for China by the way of the North Cape. The ship's company of Dutch and English was fortunate in having as mate one Robert Juet (perhaps also of England), and the mate could read and write. Juet kept the ship's log, and in this log book on the first page are these words: "On Saturday, the five and twentieth of March, 1609, after the old account (style), we set sayl from Amsterdam, and by the seven and twentieth day we were down at the Texel; and by twelve of the clock we were off the land, it being east of us two leages off."

Once "off the land" the ship was free to go where the captain pleased and it certainly did not please the crew to face the arctic cold of the attempted voyage round Europe. Solid pack ice and the open mutiny of the crew decided Hudson to turn back and he steered south — and west. It is evident that he felt free to carry out his own plans and reach China by another route. His owners' plans had failed and, while his plan might fail, his success would justify his action. Hudson's decision was almost as bold as that of Columbus for, while he had, no doubt, some knowledge of the lands to the west, he evidently had no conception of the shape or size of North America nor of the width of the Pacific.

The Half Moon was a slow sailer, and four months passed before she made the land along the eastern coast of what is now the United States. The log book described the land as "low white sandy ground" — exactly describing all the shore line south of Sandy Hook. The book might also have described parts of Long Island or Cape Cod and it is clear it did not describe the coast of Maine, and it is more than probable the first land mentioned in the book was south of Sandy Hook for, on reaching the land and finding no passage westward, Hudson steered "northeast by north" until, about two weeks later, he came to a great bay. The log book, which does not give the name of the month, and which must have been September, says, "And from that lake or bay the land lyeth north by east, and we had a great streame out of the bay." The Half Moon had found the "great stream" described by Verrazano, and with the flood tide sailed into New York Bay and headed for the Narrows and, as the log book says, "came to three great rivers." And it continues: "So wee stood along to the northmost, thinking to have gone into it." The Half Moon was off Manhattan. It was true Verrazano, in 1524, had entered New York Bay and left a record of a high hill and a great bay out of which flowed a large river, but Verrazano had not the courage to pass the Narrows, except in a small boat. Other explorers may have looked into the bay. The Half Moon was the first ship to pass up the "great stream" and to Hudson belonged the entire honor of discovering and exploring the river that now bears his name.

The pages of Juet's journal tell nothing of Hudson's own hopes, fears and anticipations. Yet, it is fair to think that Juet's enthusiasm over the beauty and value of the great valley was shared by his captain and that the ship's log was, in a sense, a reflex of Hudson's own views. There is no hint of Hudson's belief that he could reach China by this route, yet it is reasonable to suppose he entered New York Bay in the hope that the "great stream" would lead through the land to the Pacific. The great size of the bay and river and the fact that the tide flowed far into the land and that for the first few days' sail the water remained salt, no doubt encouraged him to keep on through this most promising opening in the land. Favored by "fairer weather" and a favorable breeze he steered northerly over the wide salt arm of the sea until the apparent strait became a river and the sea water became fresh. At the Highlands all hope of a road to China must have faded away. Still, he would sail on, push through the mountains and see what manner of country lay beyond.

The items of the log book plainly show that Hudson, after passing the Highlands, began to recognize the transcendent importance of his discovery. He had found a new land of surpassing beauty and fertility and everywhere clothed in splendid forests. Hudson clearly recognized the commercial value of his discovery, for the log book enumerates all the potential wealth of the river and valley in fish, game, lumber, fruits, vegetables, grains and peltry. It even mentions the fact that Hudson, while the ship was at anchor somewhere near the present city of Hudson, sent the ship's carpenter ashore to fashion a new forearm out of one of the primeval trees — the first bit of lumbering done by white men in the valley.

Hudson seems to have decided, after reaching the upper river and sailing to a point opposite the Catskills, that the best way to mollify his owners on his return would be to report as fully as possible the potential wealth he had discovered and he sent a boat up the river to explore the country. The boat party appears to have been absent several days, for they rowed up stream about nine leagues or perhaps beyond Albany where, as the log book says, the boat found "it bee at an end for shipping to goe in — with but seven foot water and unconstant soundings." Meanwhile Hudson evidently traded with the Indians for peltry, no doubt regarding the furs as something that would demonstrate to his merchant owners the value of his discovery.

Three weeks after the Half Moon entered "the great streame" she again passed Sandy Hook and steered away for Amsterdam. There is no record of the return voyage nor is there any record of Hudson's report to the merchants of Amsterdam, yet it is evident that his story and perhaps the exhibit of peltry created a tremendous sensation in the commercial cities of Holland. Hudson appears not to have cared much about this side of the affair. He seems to have considered his voyage a failure. He had tried to reach China and failed, and wished to sail again, but the merchants seem to have been wholly occupied in fitting out new ships under more commercial captains and would not listen to him. At last, after some delay, he did secure a second ship and set forth once more to find a sea path through America. He appears to have thought there might be a passage round by the north of America and he steered for Baffin's Bay. Once more he found a great passage leading westward into the land, once more a salt water strait seemed to promise success, but it only led to an inland sea. His miserable crew, ignorant, frightened at the arctic cold and gathering ice, rose in mutiny, and putting their great captain in an open boat, with his son, a boy of seven, and some invalid sailors, set them adrift in the vast waters of Hudson Bay and left them there to perish. CHARLES BARNARD,

Lecturer, Board of Education, New York.

Hudson, Henry Norman, American Shakespearian scholar and Episcopal clergyman: b. Cornwall, Vt., 28 Jan. 1814; d. Cambridge, Mass., 16 Jan. 1886. He served as chaplain in the Civil War, was professor of Shakespeare at Boston University, and for a time editor of the 'Churchman.' He published 'Lectures on Shakespeare' (1848); 'Campaign with General Butler' (1865); 'Shakespeare, his Life, Art, and Characters' (4th ed. 1883); 'Essays on Education' (1883). He edited the Harvard and the University edition of Shakespeare.

Hudson, Thomson Jay, American philosophical writer: b. Windham, Ohio, 22 Feb. 1834; d. Detroit, Mich., 1903. After studying law and being admitted to the bar in Cleveland, Ohio, in 1857, he practised three years, was engaged in journalism in Michigan 1860–76, and was principal examiner in the United States Patent Office 1880–93. He has published 'The Law of Psychic Phenomena' (1893); 'A Scientific Demonstration of the Future Life' (1895); 'The Divine Pedigree of Man' (1899); 'Law of Mental Medicine' (1903).

Hudson, William Henry, American educator and critic: b. London, England, 2 May 1863. He was five years private secretary to Herbert Spencer (q.v.) and coming to America was assistant librarian of Cornell University, 1890–2. He has been an assistant professor of English literature at Leland Stanford University from 1892, and has published 'The Church and the Stage' (1886); 'An Introduction to the Philosophy of Herbert Spencer' (1893); 'Studies in Interpretation' (1896); 'Idle Hours in a Library' (1897); 'The Study of English Literature' (1898); 'The Sphinx and Other Poems' (1900); 'The Meaning and Value of Poetry' (1901); 'Life of Sir Walter Scott' (1901); 'Famous Missions of California' (1901); etc.

Hudson or Hudson's Bay, Canada, an extensive bay or inland sea extending between lat. 51° and 64° N., and lon. 77° and 95° W. Its greatest length north to south is about 800 miles, greatest breadth, 600 miles. It is connected with the Atlantic Ocean by Hudson Strait and with the Arctic Ocean by Fox and other channels. Hudson Bay is navigable in summer from the middle of June to the end of October, being obstructed by drift-ice during the rest of the year. There are many islands, reefs and sand banks. The white whale is found in its waters, and there is a considerable summer fishery. Numerous rivers flow into the bay, the chief being the Nelson and Churchill on the east. The shores on the east are high and bold; those on the west are low and level, and much of the land is favorable for stock and dairy farming, while valuable deposits of iron ore, galena, and plumbago exist. With the exception of a few fur trading stations on the west and south coast, there are, however, no settlements.

Hudson, Mass., town, Middlesex County, on the Assabet River, and on the Boston & M. and the Fitchburg R.R.'s; about 17 miles northwest of Worcester. The town is situated in an agricultural region, but it is particularly noted for its manufactures, especially of articles made from leather and rubber. The chief manufactures from rubber are gossamer clothing, webbing, goring, and boots and shoes. Some of the other manufactures are paper and wooden boxes, leather, and leather boots and shoes. The town owns and operates the electric-light plant and the waterworks. Pop. (1900) 5,454.

Hudson, N. Y., city, port of entry, county-seat of Columbia County; on the Hudson River, and on the New York Central & H. R. and the Boston & A. R.R.'s; about 30 miles south of Albany. Area of the city, one square mile. Hudson was settled in 1783 and was called Claverack Landing; but the year following the name was changed to Hudson. In 1785 it was chartered as a city, and in 1790 it was made a port of entry. From the first it was a trading station of importance and a whaling port. After the Revolution a large foreign trade was established, but the commerce of the city was injured by the destruction of its shipping in the War of 1812. The surrounding country is devoted largely to agriculture, and the city has a number of manufacturing establishments. The chief manufactures are foundry products, machinery, knit goods, car-wheels, and creamery products. It has a large sash and blind factory and several small manufacturing establishments. Some of its prominent buildings are the State Volunteer Firemen's Home, the State House of Refuge for Women, an orphanage, hospital, and the city public buildings. The city owns and operates the waterworks. The government is vested in a mayor, who holds office two years, and a city council. Pop. (1900) 9,528.

Hudson, Ohio, town in Summit County, on the Pennsylvania railroad, 20 miles south of Cleveland. This was one of the earliest settled towns on the Ohio Western Reserve, and prior to the Civil War was an abolition stronghold. The Western Reserve College, before its removal to Cleveland, was located here. Pop. (1900) 2,240.

Hudson, Wis., city, county-seat of Saint Croix County; on Lake Saint Croix, an expansion of the Saint Croix River, and on the Chicago, St. P., M. & O. railroad; about 65 miles northwest of Eau Claire and 20 miles east of St. Paul, Minn. The chief manufactures are flour, finished lumber, furniture, railroad cars, machinery, beer, and brooms. The city has a large cold-storage plant and ample facilities for shipping butter, poultry, vegetables, and fruits. It has a large sanatorium. The electric-light plant and the waterworks are owned and operated by the city. Pop. 3,259.

Hudson, the largest river in the State of New York, has its head waters in Hamilton and Essex counties, and flows southwest into Saratoga County, then nearly directly east to Sandy Hill in Washington County, and from this point south through New York Bay into the Atlantic Ocean. It is fed by several of the Adirondack lakes, a number of small streams, and by Schroon River, Batten Kill, Hoosick, Wappingers and Croton from the east, and the Sacondaga, Mohawk, Wallkill, and Esopus Creek from the west. The Mohawk (q.v.), which flows into the Hudson at Cohoes, is the largest tributary; the Rondout enters the Wallkill near the Hudson. The head waters of the Hudson and the sources of several of the streams which flow into the Saint Lawrence are very near each other in the Adirondack Mountains. At Troy, three miles below the mouth of the Mohawk, the Hudson becomes a navigable tidal stream. There is a tidal rise of about one foot at Albany. Above Troy there are a number of rapids and long falls in the river; but below, the navigation is uninterrupted. At one time there were a few obstacles, the largest of which was "Overslaugh", or Castleton Bar, at Castleton. This hindrance to navigation has been almost wholly removed by the Federal and State government. The Catskill Mountains, on the west side, begin about 25 miles below Albany. Lower down are the Highlands, averaging about 1,100 feet in height, which extend along the shore for a distance of about 20 miles. The Highlands of the Hudson are noted for their beautiful scenery. On the west bank are the famous Palisades (q.v.) about 13 miles long, their southern extremity being near Fort Lee, in New Jersey, and the northern extremity near Piermont, New York. This remarkable arrangement of rock rises from near the water's edge, almost perpendicularly, from 350 to 550 feet. Below Verplanck and Stony Point is an expansion in the river the upper part of which is called Haverstraw Bay and the lower part Tappan Sea. Many small islands in the river serve as foundations for lighthouses, or for the erection of dredging platforms. Iona, on which there is now a naval station, Constitution, and Beeren Islands have all figured in history. Below Albany the Hudson is more an estuary or fiord than a river, which accounts for the great depth of water. The area drained by the Hudson above where the Mohawk enters is about 30,000 square miles. The river is noted for its beautiful scenery from the source to the mouth. Along the lower part of its course there are many fine residences, as a large part of the country on both banks from New York to Albany is now a residential section. The Hudson is fittingly called the "Rhine of America."

Hudson River was discovered by Verrazano, an Italian navigator, in 1524; but it was explored by Henry Hudson in 1609. The Indian name for the river was Shatemuc, and the first colonists called it North River, as the Delaware was then called South River. The part of the river west of New York city is still called North River; but it was given the name Hudson in honor of its first explorer. The history of the country since its discovery by Europeans occupies an important place in the history of the United States. The almost unbroken waterway from the Atlantic Ocean through what is now the State of New York, to the Saint Lawrence River, made this an important route for missionaries, traders, and for the armies in the various wars. From the mouth of Lake Champlain to Lake George, across the portage from Lake George to the Hudson, and the Hudson to the ocean, was all disputed territory, and the scene of many a contest of the Revolutionary War. What a change in the map of America if Burgoyne had succeeded in his plan of 1777 "to cut the nation in two" by getting possession of Lake Champlain and the Hudson. See CHAMPLAIN, LAKE; CROWN POINT; HAVERSTRAW; TICONDEROGA.

The river is navigable for ships of the first class for about 117 miles from the ocean. Its whole length is about 300 miles. Before the introduction of railroads, the navigable waters of the Hudson, connecting New York with a large section of country, gave the city great opportunities for development. A canal built along the Mohawk Valley, in 1817–25, connected the Hudson with Lake Erie, and the Champlain Canal completed the water route from the Hudson to Lake Champlain. Later the Erie and the Delaware and Hudson railroads brought the coal of Pennsylvania to the Hudson River for transportation by water to markets in the interior. The New York Central and Hudson River Railroad is on the east side of the river and the West Shore on the west side. In 1807 Robert Fulton made on this river the first successful experiment with steam navigation. The Hudson is now a thoroughfare for an immense amount of freight, and elegant passenger steamers ply daily between New York and Albany. The government has erected and maintains 21 lighthouses and lighted beacons. Navigation ceases in winter because the river is frozen nearly its whole length. The ice crop harvested each winter on that part of the river between Albany and the Highlands is shipped, when navigation opens, chiefly to New York city. Shad fishing is one of the important Hudson River industries. Many of the cities on the Hudson were at first only trading posts or ferry towns, but nearly all have kept pace in development with the rest of the State. The principal cities and towns on the river from north to south are Glens Falls, Sandy Hill, Fort Edward, Mechanicsville, Cohoes, Troy, Albany, Hudson, Catskill, Kingston, Poughkeepsie, Newburg, West Point, Peekskill, Haverstraw, Ossining, Nyack, Tarrytown, and Yonkers. At the mouth of the river are New York and Jersey City, with the suburbs, which are important shipping ports, Hoboken and Weehawken. The only bridge crossing the river between New York and Albany is the one which extends from Poughkeepsie on the east side to Highland on the west. There are 14 public ferries. The use of the water-power of the Hudson as an aid in developing electrical power for the mechanical arts is most important. From Mechanicsville the power of the Hudson is transmitted to the general electric shops of Schenectady. At Spiers Falls, at the foot of Mount McGregor, about forty miles above Albany, there has been constructed a dam, — a stone wall over 1,800 feet long, 100 feet high, and containing 1,800,000 cubic feet of masonry. The Hudson is raised 50 feet above its former river bed, then its waters fall 80 feet, and the power developed is (1904, 30,000 horse-power), transmitted for electrical machinery, to Schenectady, Albany, Troy, Amsterdam, and other places. The electric motors at Spiers Falls get some of their power from the older plant at Mechanicsville, about 20 miles distant. At other points storage plants will be constructed, more power will be developed, the current will be sent at a high pressure to sub-stations at Saratoga, Schenectady, Ballston, Glens Falls, Fort Edward, and Watervliet. This will mean running cars, lighting streets, driving machinery by power developed hundreds of miles away. This power development of the waters of the Hudson combined with development of like power of the waters of the Saint Lawrence at Massena (q.v.), keeps the two rivers, as in early years of our country, of vast importance to the State. Many industries are affected by this great new power, not the least of which are the coal-mining of Pennsylvania and the preservation of the Adirondack forests.

The Hudson occupies an important place in the historical, commercial, and mechanical development of the nation, also in its literary and artistic progress. Washington Irving who lived at "Sunny Side" and was laid to rest in Tarrytown, introduced to the world many of the places along the Hudson. Cro' Nest is associated with Joseph Rodman Drake and his poem, 'Culprit Fay'; West Park and the country around have been practice observation ground for the naturalists John Burroughs and Ernest Ingersoll; Cornwall-on-the-Hudson was the home of N. P. Willis and E. P. Roe. Artists who have received inspiration from Hudson's scenery and history have become sufficiently numerous and their works of importance enough to be called "The Hudson School of Painters." Consult Ingersoll, 'Guide to the Hudson River'; Cooper, article in 'Magazine of American History,' Vol. IV.

Hudson's Bay Company, incorporated 1670, the great fur-trading and later landholding and administrative company of Northwest Canada. It originated in the dissatisfaction of two French Protestant employees of the French fur-trading monopoly at Quebec, Groseilliers and Radisson, with its unwillingness to extend the trade to Hudson Bay, after vainly trying to induce Boston merchants and the French court to take up their scheme for so doing. They gained the ear of a company of London merchants and Prince Rupert, cousin of Charles II., brought a load of furs from the bay, and on 2 May 1670 Rupert and 17 associates received from Charles a charter for "The Governor and Company of Merchants-Adventurers trading into Hudson's Bay." It had the monopoly of the right to trade in the bay or on its coasts, and could expel any one entering the territory without its license; could build forts, send out ships of war and privateers, and declare war and make peace with any non-Christian people. Its capital was £10,500, divided into 34 shares with an extra one for Prince Rupert, and in 1676 it imported some £19,000 worth of furs, sending in return £650 worth of goods to the Indians. The profit was high on the petty capital paid in, but the gross amount was not large for a century. In 1748 the trade was carried on with four ships, and employed about 120 men in all, including the garrisons at its forts. The furs and other imports amounted to over £30,000, the exported goods to £5,000, and the costs of business over £17,000. The average profit was 40 per cent. on capital, but the sum was trivial. Moreover, the company had great losses and tribulations from the French rivalry and assaults, especially in the national wars. The French laid claim to the territory on the strength of a mythical expedition of Jean Bourdon in 1656, and in 1682 and 1686 captured several of the company's forts, the two countries' trading posts shared in the long war ended by the Peace of Ryswick in 1697, captured each others' forts, and the peace yielded Port Nelson to the French, to the great damage of the company. The War of the Spanish succession inflicted frightful hardships on both sides: the company claimed a loss of over £100,000, hundreds of trappers and employees starved to death, and the Indians turned cannibals. The Treaty of Utrecht in 1713 finally resigned all French claim to the Hudson's Bay territory, and thence till the cession of French Canada in 1763, the monopoly gave the company an easy life and good profits, though still on a small scale. But when that cession opened up access to Hudson's Bay from both land and sea, the possibilities of trade were incalculably enlarged. Despite the clandestine rivalry of Montreal traders who intercepted their boats, the gross volume increased manifold, and it was not crippled by the ravages of France in 1782, as part of the war begun in 1778, when they captured and partly ruined the massive stone Fort Prince of Wales at the mouth of Churchill River, and altogether destroyed property valued by the company at half a million pounds. But a much worse rivalry was at hand, organized and powerful: the Northwest Company (q.v.), started on a co-operative plan in 1784 by an association of Scotch merchants in Montreal. The Declaration of Rights having guaranteed free and open trade to all British subjects, this company invaded its rival's territory, and the trade competition for many years merged into actual war. In 1821 they had done each other so much harm that they consolidated, and Parliament in view of the evils of competi-

HUDSON RIVER FROM WEST POINT.

1. Looking eastward, showing the Dade monument.
2. Looking northward from the battery.

tion empowered the crown to issue licenses for the "Indian territories," which was exercised in favor of the new company. Meantime exploration had been steadily enlarging the territory: Samuel Hearne for the old company had reached the Arctic in 1771, Alexander Mackenzie for the new one reached the Pacific in 1793. With the United States, its rivalry for the far Northwest was strenuous and persistent: it planted posts in the Oregon district, repelled settlers, and there was much danger of war till the boundary settlement of 1846 quieted the dispute. In 1849 it secured a grant of Vancouver Island. This was the time of its palmiest growth. In 1846 it had 513 employees and 35 officers, in 1856 it had over 3,000 employees and officers together, with 152 posts. Its trade monopoly expired by limitation in 1859, but there was also a great desire to settle the Northwest Territories, with which the fur-trade and administrative rights of the company were incompatible. The company, liable to be dispossessed by force if it refused to come to terms, agreed in 1869 to transfer its territorial rights to the Dominion of Canada for £300,000 and one twentieth of the lands set out for settlement by the government for the next 50 years. It retained its posts and its rights of trade. The transfer to Canada, and the survey of lands for settlement, was immediately followed by the Riel rebellion (q.v.). The company, despite its lapse of administrative powers, remains the most potent influence for law and order in the unsettled parts, through its relations with the Indians. Consult Bryce, 'History of the Hudson's Bay Company' (1900); Willson, 'The Great Company' (1900); Cawston and Keane, 'Early Chartered Companies' (1896). For the Northwest Company, see also Irving, 'Astoria.'

Hué, hoo-ā', the capital of Anam, on the river Truong, 10 miles from its mouth in the Gulf of Tonking. It is surrounded by Vaubanian fortified walls, five miles in circumference, the internal city being built on a rectangular plan with wide and straight streets. The chief building is the royal palace. Hué is the seat of a French political resident, and at Thuan-an, the port at the river mouth, there is a French garrison. Pop. estimated at 100,000, of whom less than 400 are Europeans.

Huelen, wā'lān, Chilean hero: b. about 1540; d. 1603. He attained the command of the native forces in Araucania, and was for a time successful in repelling the invading Spaniards, whose methods of warfare he copied. He defeated the enemy at Valdivia, near Concepción, and near Bio-Bio, but died at the siege of Osorno.

Hueppe, hüp'pė, **Ferdinand**, German hygienist: b. Heddesdorf, Rhine Province, 24 Aug. 1852. He studied at the Friedrich Wilhelms Institut of Berlin, and in 1890 became professor of hygiene in Prague University (German). His researches in bacteriology and disinfection have been extensive and important. He wrote 'Die Methoden der Bakterienforschung' (1885); 'Naturwissenschaftliche Einführung in die Bakteriologie' (1896); 'Handbuch der Hygiene' (1899), and other works.

Huger, ū-jē', **Benjamin**, American soldier: b. Santee, S. C., 22 Nov. 1805; d. Charleston, S. C., 7 Dec. 1877. He was graduated from West Point, served in the United States army during the Civil War and was brevetted colonel. He resigned his commission in 1861 and entering the Confederate army became a major-general.

Huger, Francis Kinloch, American soldier: b. Charleston, S. C., September 1773; d. there 14 Feb. 1855. He was a nephew of I. Huger (q.v.). His father, Major Benjamin Huger, was killed before the lines of Charleston in 1780. He joined with Dr. Eric Bollman of Philadelphia in a visit to Europe for the purpose of attempting the rescue of Lafayette from the dungeons of Olmütz, his father having been the first to receive that general on his arrival in Georgetown in 1777. The enterprise resulted in their imprisonment for eight months. Huger became a captain in the United States army in 1798, was a colonel in the war of 1812, and served in both branches of the legislature of his State.

Huger, Isaac, American general: b. Limerick Plantation, S. C., 19 March 1742; d. 17 Oct. 1797. He was one of five patriot brothers active in the revolution. Promoted to the rank of brigadier-general in 1777, he took a conspicuous part in the engagements connected with the siege of Savannah in 1778, commanded a force of cavalry at the siege of Charleston in 1780 which was surprised and dispersed by Tarleton, and commanded the Virginia brigade which formed the right wing in the battles of Guilford Court-House, and Hobkirk's Hill.

Huggins, hŭg'ĭnz, Sir **William**, English astronomer: b. London 7 Feb. 1824. In 1852 he was elected a member of the Microscopical Society, and in 1856 erected an observatory at Tulse Hill, in northeastern Surrey. When in 1859 Professor Kirchoff of the University of Heidelberg announced the true interpretation of the dark Fraunhofer lines in the solar spectrum, Huggins at once saw the possibility of using his practical knowledge of chemistry and physics in the service of astronomy. With W. A. Miller, professor of chemistry at King's College, London, he at once set about the task of constructing a star-spectroscope. The two then began the observation of stellar spectra. A full statement of their results was read before the Royal Society in 1864, the essence of the statement being, in Huggins' own words, that the chemistry of the solar system prevails, essentially at least, wherever a star twinkles. In August 1864 Huggins directed his star-spectroscope toward a planetary nebula in Draco, and found its spectrum to be a monochromatic one, thus proving that the nebula consists of a luminous gas. In 1868 he was able to announce to the Royal Society the results of his first measurements of the motion of stars in the line of sight. He began his observations of comet spectra with that of Winnecke's comet in 1868, and in 1868–9 made spectroscopic observations of the solar prominences. About 1876 he resumed his abandoned efforts to photograph stellar spectra, using the gelatine dry plate process then recently introduced, and this time he was completely successful. His photographs of the invisible ultra-violet portions of stellar spectra have proved extremely valuable, providing, for example, the only reliable data for determining the relative ages of the stars. He was elected a fellow of the Royal Society in 1865, and awarded by that body a Royal Medal (1866), the Rumford Medal (1880), and the Copley Medal. He was president of the Royal Astronomical Society in 1876–8. With Lady Huggins he published in 1900 a valuable 'Atlas of Representative Stellar Spectra.'

Hugh Capet, king of France, founder of the Capetian dynasty. See CAPET.

Hughes, hūz, **Ball**, American sculptor: b. London 19 Jan. 1806; d. Boston, Mass., 5 March 1868. He early exhibited a decided taste for modeling, and at 12 years of age made out of wax candle ends a bas-relief copy of a picture representing the wisdom of Solomon, which was afterward cast in silver. He was then placed in the studio of Edward Hodges Bailey, where he remained seven years. At this time he successfully competed for the prize awarded by the Royal Academy, winning the large silver medal for the best copy in bas-relief of the Apollo Belvidere; also the silver medal from the Society of Arts and Sciences for a copy of the Barberini faun, the large silver medal for the best original model from life, and a gold medal for an original composition, "Pandora brought by Mercury to Epimetheus." He emigrated in 1829 to New York, where his first work of importance was a marble statue of Hamilton, for the Merchants Exchange, which was destroyed by fire in 1835. He subsequently removed to Boston, Mass. Among later works of his are the bronze statue of Bowditch at Mount Auburn Cemetery, a bust of Washington Irving, and a statuette of General Warren at Bunker Hill.

Hughes, David Edward, English-American inventor: b. London 16 May 1831; d. there 22 Jan. 1900. When very young came with his parents to the United States. He was educated at Bardstown College, Kentucky, where he was appointed professor of music (1850), and later of natural philosophy. In 1855 he patented his first important invention, that of the well-known printing telegraph which bears his name. It was at once adopted in America, and by 1876 by practically every European country. In 1878 Hughes announced to the Royal Society his invention of the microphone, an ingenious instrument which not only transmits sound, but so magnifies faint sounds as to make them distinctly audible. The microphone is now in universal use in the telephone. Another important invention, that of the induction balance, was completed by Hughes in 1879, and in 1880 he was elected a fellow of the Royal Society.

Hughes, Hugh Price, English Wesleyan clergyman: b. Caermarthen 1847; d. London 17 Nov. 1902. He was educated at University College, London, and the Wesleyan Theological College, Richmond, was appointed to Dover in 1869, and was afterward at Brighton; Stoke-Newington; Mostyn Road, London; Oxford; Brixton Hill; and the West London Mission. From 1885 he was editor of the Methodist 'Times,' and he was also at one time president of the national council of Evangelical free churches. He was prominently identified with reform work in London, and with the Anti-gambling League. Among his writings are: 'Social Christianity' (1889); 'The Atheist Shoemaker' (1889); 'The Philanthropy of God' (1890); and 'Ethical Christianity' (1892).

Hughes, John, American Roman Catholic prelate: b. Annaloghan, County Tyrone, Ireland, 24 June 1797; d. New York 3 Jan. 1864. His parents were poor but made sacrifices to give him the opportunity of acquiring an elementary education; and by his own efforts he continued his studies so that when he came with his parents to America in 1817 he was prepared for college. However, for lack of means he had to defer entering any school, and instead began work as a day laborer, in which occupation he continued for three years, but at 23 entered the Roman Catholic theological seminary, Mount Saint Mary's, Emmittsburg, Md. As a student, his remarkable power of reasoning and his ability in argument attracted attention. He was ordained priest in 1826, and for a time was stationed at Bedford, Pa., from which he was transferred to Philadelphia. Here he had charge of Saint Joseph's parish and later Saint Mary's parish. In 1838 he was consecrated titular bishop of Basileopolis and appointed coadjutor to the bishop of New York. In 1842, after the death of Bishop Du Bois, he was made bishop of New York. In 1850 the diocese of New York became an archdiocese, and on 19 July 1850 he was raised to the dignity of first archbishop of New York, which office he held until his death.

He was an active and effective worker. As a speaker or writer he was ever ready to defend the Church which he represented. When a student at Mount Saint Mary's, he wrote the pamphlet, 'An Answer to Nine Objections against the Catholic Church.' When in Philadelphia, he wrote the replies to Dr. Breckenridge, a Presbyterian clergyman. The articles on both sides are issued in book form, 'Hughes and Breckenridge.' Before asking his priests to collect money to build schools and churches, he had set the example. He collected money for the rebuilding of Mount Saint Mary's after it had been burned. He established St. John's orphan asylum in Philadelphia, and a number of charitable institutions in New York. He settled decisively the "trustee system" question which was agitating New York when he came there; and he defended the Church property against the attacks of the "Knownothing" element. The "school question" was to him all important. One of his first undertakings was to establish a theological seminary at La Fargeville in Jefferson County, N. Y.; the distance from New York caused the abandonment of this plan, and Saint John's College (q.v.) was founded at Fordham instead. In 1858 he laid the corner stone of Saint Patrick's Cathedral. In 1861, during the Civil War, he was sent by the United States government to Europe, to present the cause of the Union, and counteract any adverse sentiment which might exist against the attitude of the North. His diplomatic mission was most successful in France, Italy, and Ireland. Consult: Brann, 'John Hughes,' in the 'Makers of America Series'; Hassard, 'Life of John Hughes'; Sadlier, 'Archbishop Hughes,' in the 'Ave Maria' magazine.

Hughes, Rupert, American author: b. Lancaster, Mo., 31 Jan. 1872. He was graduated from Adelbert College of the Western Reserve University in 1892, was for a time assistant editor of the New York 'Criterion,' and in 1900 entered editorial work in London. In addition to many contributions to periodicals, he wrote: 'The Lakerim Athletic Club' (1898); 'One Dozen from Lakerim' (1899); 'American Composers' (1900); 'Guide-Book to the World of Music' (1901); and, in verse, 'Gyges' Ring' (1901).

Hughes, Thomas, English author: b. Uffington, Berkshire, 20 Oct. 1823; d. Brighton, Sussex, 22 March 1896. He was educated at Rugby and Oxford, later studied law at Lincoln's Inn, was called to the bar of the Inner Temple in 1848, and began practice at once. In 1869 he was appointed queen's counsel, in 1882 county court judge. Throughout his long public career, as advanced Liberal in Parliament (1865–74), as founder with Canon Kingsley and Frederick Maurice of the Christian Socialists, as creator of Rugby, a socialistic community in the mountains of Tennessee (1880), he tried most earnestly to exercise a helpful influence upon English working-people. He early essayed journalism, writing many sketches for the London 'Spectator,'— chiefly accounts of traveling experiences. These sketches served as his apprenticeship in writing, and afterward were collected in book form with the title 'Vacation Rambles' (1895). But authorship was a secondary interest until 'Tom Brown's School Days,' first appearing in 1856, made him famous. This work is largely a presentation of the influence of Dr. Thomas Arnold (q.v.) in the great public school. 'The Scouring of the White Horse' (1858), a spirited account of a vacation trip, had a respectful although less cordial reception. The great success of the first story led him to continue his hero's career with 'Tom Brown at Oxford' (1861), first published serially in 'Macmillan's Magazine.' This second volume, which is much the longer, although often fine and spirited, sometimes waxes prolix, and has never been so popular as the earlier story. At the time of the American Civil War, Hughes was a decided abolitionist, and thus established a friendship with James Russell Lowell. Among other works of his are 'Alfred the Great' (1869); 'Life of Livingston'; 'Memoir of a Brother'; 'Life of Bishop Fraser' (1887).

Hughes, Thomas Patrick, American Protestant Episcopal clergyman: b. Ludlow, England, 26 March 1838. He was educated at Islington College, was ordained priest in 1864, in 1865–85 was missionary and chaplain at Peshawar, Afghanistan, in 1885–9 rector at Lebanon Springs, N. Y., and from 1889 of the Church of the Holy Sepulchre, New York. In 1875–85 he was also examiner in Oriental languages to the British government. Among his writings are: 'Notes on Mohammedanism'; 'The Poems of Abdur Rahman'; 'A Dictionary of Islam'; 'Heroic Lives in Foreign Fields.'

Hugo, hū'gō (Fr. ü'gō), **Victor Marie**, French poet and novelist: b. Besançon 26 Feb. 1802; d. Paris 22 May 1885. Major Hugo, his father, having entered the service of Joseph Bonaparte, king of Italy and afterward of Spain, Victor's earlier years were partly spent in these countries. At the age of 12 he was already writing verses, and in 1823 his first novel, 'Han d'Islande,' appeared, followed in 1825 by 'Bug Jargal.' In 1828 a complete edition of his 'Odes et Ballades' appeared. In these productions Hugo's anti-classical tendencies in style and treatment of his subject had been very visible, but the appearance of his drama, 'Cromwell' (1827), with its celebrated preface, gave the watchword to the anti-classical or romantic school. 'Cromwell' was too long for representation, and it was only in 1830 that 'Hernani,' over which the great contest between Classicists and Romanticists took place, was brought on the stage. Other dramas followed—'Marion Delorme' (1831); 'Le Roi s'amuse' (1832); 'Lucrèce Borgia' (1833); 'Marie Tudor' (1833); 'Angelo' (1835); 'Ruy Blas' (1838); 'Les Burgraves' (1843). During those years he had also published a novel, 'Notre Dame de Paris' (1830), and several volumes of poetry, 'Les Feuilles d'Automne' (1831); 'Les Chants du Crépuscule' (1835); 'Les Voix intérieures' (1837); 'Les Rayons et les Ombres' (1840). The poetry of this period has a melody and grace superior perhaps to any that he afterward wrote, but wants that deep and original sense of life characteristic of his later poems. During the same period he also wrote critical essays on Mirabeau, Voltaire, and a number of articles for the 'Revue de Paris.' In 1841, after having been four times previously rejected, he was elected a member of the French Academy; made shortly afterward a tour in the Rhineland, of which he wrote a brilliant and interesting account in 'Le Rhin' (1842). In 1845 he was made a peer of France by Louis Philippe. The revolution of 1848 threw Hugo into the thick of the political struggle. At first his votes were decidedly Conservative, but afterward whether from suspicion of Napoleon's designs or from other reasons, he became one of the chiefs of the democratic party. After the *coup d'état*, 2 Dec. 1851, he was one of those who kept up the struggle in the streets against Napoleon to the last. He then fled to Brussels, where he published the first of his bitter satires on the founder of the Second Empire, 'Napoléon le Petit.' In August 1852 he went to live in Jersey, and finally settled in Guernsey, where he bought an estate called Hauteville House. In the following year (1853) the famous volume 'Les Châtiments,' a wonderful mixture of satirical invective, lyrical passion, and pathos, appeared. It was in the comparative solitude and quietness of the Channel Islands that he wrote most of the great works of his later years. 'Les Contemplations' (1856); 'La Légende des Siècles,' 1st series (1859); 'Chansons des Rues et des Bois' (1865), and his celebrated series of social novels, 'Les Misérables' (1862); 'Les Travailleurs de la Mer' (1866); and 'L'Homme qui Rit' (1869). In 1870, after the fall of the Empire, Victor Hugo returned to Paris, where he spent his remaining years in occasional attendances at the senate, and in adding to the already long list of his literary works. Among these latest productions may be cited, 'Quatre-Vingt-Treize' (1873); 'L'Art d'être Grand-père' (1877); 'L'Histoire d'un Crime' (1877); 'Le Pape' (1878); 'La Pitié Suprême' (1879); 'Religions et Religion' (1880); 'Les Quatre Vents de l'Esprit' (1881); 'La Légende des Siècles' (last series, 1883); 'Torquemada' (1882). If not the greatest writer that France has produced, certainly he is her greatest poet. But he had grave defects and limitations, the chief being an entire want of humor, a too frequent straining after effect through the abnormal and bizarre, an overweening belief in his own infallibility, and an ever-present conviction that he was a sage, all of whose sayings might be regarded as priceless teachings, to be eagerly caught up by a listening world. An edition of his complete works in 40 vols. appeared at Paris in 1886. The house in which Victor Hugo lived, on the Place des Vosges, has recently been transferred to the city of Paris, and now forms a Victor Hugo Museum, full of interesting relics of the poet. Consult: Swinburne, 'Study of Victor Hugo' (1886); Barbou, 'Victor Hugo et son Temps' (1882); Mabilleau, 'Victor Hugo' (1893); Nichol, 'Victor Hugo, a Sketch of his Life and Work' (1894); Dupuy, 'Victor Hugo, l'Homme et le Poète' (1887); Bire, 'Victor Hugo après 1852' (1894).

Huguenots, hū'gē-nŏts, a term of unknown origin, believed to be derived from a personal name, applied to the Protestants of France during the religious struggles of the 16th and 17th centuries. During the early part of the 16th century the doctrines of Calvin, notwithstanding the opposition of Francis I., spread widely in France. Under his successor Henry II., 1547–59, the Protestant party grew strong, and under Francis II. became a political force headed by the Bourbon family, especially the King of Navarre and the Prince of Condé. At the head of the Catholic party stood the Guises. The contest between the two parties was as much political as religious. The result was that a Huguenot conspiracy headed by Prince Louis of Condé was formed for the purpose of compelling the king to dismiss the Guises and accept the Prince of Condé as regent of the realm. But the plot was betrayed, and many of the Huguenots were executed or imprisoned. In 1560 Francis died, and during the minority of the next king, Charles IX., it was the policy of the queen mother, Catharine de Medici, to encourage the Protestants in the free exercise of their religion in order to curb the Guises. In 1562 an accidental conflict between the followers of the Duke of Guise and some Protestants at a church meeting precipitated a series of religious wars which desolated France almost to the end of the century. Catharine, however, began to fear that Protestantism might become a permanent power in the country, and suddenly making an alliance with the Guises, with their help she projected and carried out the massacre of St. Bartholomew's (q.v.). The Protestants fled to their fortified towns and carried on a war with varying success. On the death of Charles IX., Henry III., a feeble sovereign, found himself compelled to unite with the King of Navarre, head of the house of Bourbon and heir-apparent of the French crown, against the ambitious Guises, who openly aimed at the throne, and had excited the people against him to such a degree that he was on the point of losing the crown. After the assassination of Henry III. the King of Navarre was obliged to maintain a severe struggle for the vacant throne; and not until he had, by the advice of Sully, embraced the Catholic religion (1593), did he enjoy quiet possession of the kingdom as Henry IV. Five years afterward he secured to the Huguenots their civil rights by the Edict of Nantes (q.v.) which confirmed to them the free exercise of their religion, and gave them equal claims with the Catholics to all offices and dignities. They were also left in possession of the fortresses which had been ceded to them for their security. This edict afforded them the means of forming a kind of republic within the kingdom, which Richelieu, who regarded it as a serious obstacle to the growth of the royal power, resolved to crush. The war raged from 1624 to 1629, when Rochelle, after an obstinate defense, fell before the royal troops; the Huguenots had to surrender all their strongholds, although they were still allowed freedom of conscience under the ministries of Richelieu and Mazarin. But under Louis XIV. a new persecution of the Protestants commenced. They were deprived of their civil rights, and bodies of dragoons were sent into the southern provinces to compel the Protestant inhabitants to abjure their faith. The Edict of Nantes was revoked in 1685, and by this act about 50,000 Protestant subjects were driven out of France to other countries. (See HUGUENOTS IN AMERICA.) In the reign of Louis XV. a new edict was issued repressive of Protestantism, but so many voices were raised in favor of toleration that it had to be revoked. The Code Napoléon and later enactments place Protestants in France on an equality with their Catholic compatriots.

Huguenots in America. The French Protestant settlements in the New World divide themselves into two classes: those of choice (or at least with time and opportunity to make choice) and those of necessity. The former extend from the middle of the 16th century down to the capture of New York by the English in 1664; the latter comprise all those dating from the increasing severity of repression that heralded the Dragonnades and the Revocation of the Edict of Nantes to the end. The former were deliberate organized colonizations, of the same stamp as the English and from the same motives; the latter were the desperate and generally hurried resource of crowds of ruined exiles. The former were complete failures, and were soon suppressed, absorbed, or exterminated; the latter sought only life and livelihood and welcomed absorption. The former include the abortive attempts in Brazil and Florida, the earliest settlements in Acadia and Canada, the first settlement of New York, and the settlement of some of the West Indies; the latter include the feeble attempts at settlements in New England, the flood of accessions to the French element in New York, the founding of New Rochelle, the migrations to Pennsylvania, Delaware, and Maryland, the promising but aborted attempt in Virginia and, greatest of all, the tide of immigrants that created South Carolina.

The first attempt at creating a New-World Huguenot asylum and magazine of supplies was undertaken in 1555: Nicholas Durand de Villegagnon (q.v.) pretended to undertake it for Coligny, and settled a colony in Rio Janeiro harbor. But it was half Catholics: Villegagnon was a scamp, persecuted and scattered the Protestants, and finally deserted the colony; and the Portuguese slaughtered it out in 1567. A more honest attempt was made by Jean de Ribault in 1562, at Port Royal, S. C., but failed. In 1564 René de Laudonnière founded a colony on the St. John's in Florida (q.v.), at Fort Caroline; but the next year Pedro Menendez de Avilés butchered the entire settlement. St. Bartholomew and the religious wars intervened; and no further efforts were made till after the accession of Henry of Navarre, who had imbibed the ardor for colonization from Coligny. In 1604, under his commission, Sieur de Monts planted a settlement to be on the basis of perfect religious equality, the first in the New World — at Port Royal, N. S.; French mercantile jealousy had the commission revoked, and it perished; but two years later it was refounded by Poutrincourt, and De Monts and Champlain founded Quebec. In 1613 Sir Samuel Argall (q.v.) destroyed Port Royal, but the French stayed and bands of Protestants came to reinforce them at intervals. A small settlement was made on Newfoundland, but was broken up by the government except for a few who would turn Catholics. The founding of New Amsterdam, usually supposed to be by the Dutch, was in fact by Huguenots under Dutch auspices. The Huguenots — largely French-speaking Walloons — who had crowded into the Netherlands to escape persecutions, had tried to gain permission to found settlements in the English colonies; rebuffed in this, they engaged with the Dutch, and the first shipload of emigrants that came to the future New York were entirely Huguenot, Peter Minuit himself being a Walloon. French families had been there already for years, the first white child born on Manhattan Island being French. For three generations the French element continued to be a highly important factor in the city, and composed much of the business aristocracy; even after the English occupation, all official documents were printed in both Dutch and French as well as English. Of the first shipload of emigrants, a number went up the Hudson and founded Fort Orange (Albany). In 1660 a number of Walloon and Vaudois exiles, who had taken refuge in the Lower Palatinate, settled near Kingston, N. Y.; later, the Vaudois founded New Paltz in the Wallkill Valley. In 1677 a French town was founded at Hackensack, but the fast-breeding Dutch soon swamped it. Small French groups settled in various parts of New Jersey.

Of the second class, the refugee emigration, too scattered and hurried in general to found separate French settlements, the first beginning from the north was at Boston. From 1660 on, small numbers had come from the Channel Islands and Rochelle, but after the Dragonnades 200 or 300 families came over, including some of the most notable names in Boston history. A settlement at Oxford, Mass., was made in 1687, primarily to convert the Nipmuck Indians, but that tribe joined hands with the Canadian tribes in league with the French, and inflicted such horrors on them — one whole summer besieging them in their blockhouse — that the settlement broke up in despair, many of them taking refuge in Milford, Conn. Many small groups settled in Rhode Island; the largest had a miserable history, being defrauded by a New England company organized expressly to sell to innocent foreigners a tract of land to which it had no title. In Connecticut Hartford and Milford received the greatest number. In New York the arrivals strengthened the French element, but soon melted into the general mass. In Pennsylvania, Delaware, and Maryland, many hundreds settled, but as scattered members of the population, and left no outward trace. In Virginia, whose southern climate was congenial to them, the Huguenots had settled in considerable numbers for many years, but in 1690 William III. sent over some 300 Huguenots who had followed him from Holland, and they made a settlement named Monacantown, from an extinct Indian tribe. In 1700, after long negotiations, four shiploads more came over under Marquis de La Muce; about half of them settled at Jamestown, Va., and in South and North Carolina, the rest at Monacantown. Several hundred more came over at different times, and the settlement seemed to have struck enduring roots; but furious religious dissensions broke it in two, and the pastor led part of them to the Trent in North Carolina, whence in fear of Indian massacre they finally went to South Carolina, the Canaan of the Huguenots, settling at Jamestown there. This South Carolina French immigration, due to the latitude and soil fitting their habits, began in 1670 in small numbers. In 1680 the city of Charleston was founded, largely under French auspices; the same year Charles II. sent over about 90 Huguenots to raise wine, oil, and silk. After the Revocation the great tide began to flow in; in 1687 there were four wholly or largely French settlements — Jamestown on the Santee, the "Orange Quarter" on the Cooper, St. John's Berkeley, and Charleston. In 1732 a band of 360 French-Swiss Protestants settled Purysburg on the Savannah; and in 1764 the last French colony was founded — New Bordeaux in Abbeville County. In the intervals there was a steady stream, very large for many years after 1685. Some of the greatest names in Southern history are French, and the entire character and action of the State have been deeply molded by this fiery, impulsive, gallant strain. It is pitiful to record that after all the sacrifice and courage of these exiles, religious persecution forced them to close their churches. All but members of the Church of England were disfranchised in 1706, and the Huguenots were bribed into submission by government support of the churches and having the liturgy translated into French.

The Huguenot settlements in the West Indies — St. Christopher, Martinique, Guadeloupe, and some smaller ones — belong in origin to the former group, that of voluntary colonization; their later history and the flight from them belongs to the latter. They were colonized by a trading company under Richelieu's patronage from 1626 on; there was nominal prohibition of public worship, but actually the law was a dead letter, as there would have been no trade but for the Huguenots; the Walloon Synod of Holland supplied ministers, and the life was one of prosperity and content. Then as the Revocation approached, atrocious penal laws were passed, but still not enforced. But the Revocation changed everything into a scene of misery. The first result was the using of the islands as a penal settlement for the Huguenots of France; the latter were sold into service, sometimes of the worst character, and the horrors of the passage rivaled the worst of the slave-trade. Then the governor-general was ordered to extirpate heresy at all hazard, and threatened a dragonnade if the inhabitants did not recant.

The effect was a general flight; next a stern order from the governor-general to stop or he would carry out the government orders in all their severity, which produced a still greater stampede, assisted by the Catholics themselves. In a few months the islands were half depopulated and their trade nearly ruined. The king then modified his orders; the flight ceased and a few returned; but most of the refugees remained in the English colonies or Bermuda. Several score at least removed to New York, and some of them founded New Rochelle; a few to New England, and the Southern colonies naturally received the largest quota. This immigration had an important effect on the United States trade with the West Indies, as the Huguenot merchants, from their familiarity with the region and their family ties, took the lead in and greatly developed it.

The "dead-line" of the French churches in America, the test of that element's separate existence, is about the middle of the 18th century; beyond that, according to Baird, few existed and fewer kept their language. French instinct was to blend, and of course it was much the best that it should do so. The element was absorbed soon and utterly, but its blood and its ideas have been very valuable to the United States. Consult Baird, 'History of the Huguenot Emigration to America' (1885).

Huichol (wē'chōl) **Indians.** See INDIANS, AMERICAN.

Hull, Edward, Irish geologist: b. Antrim 21 May 1829. As a member of the Geological Survey of Great Britain for 20 years, he geologically mapped a large portion of the central counties of England. In 1869 he became professor of geology at the Royal College of Science, Dublin; and in 1883 commanded an expedition under the auspices of the Palestine Exploration Society to Arabia Petræa and Palestine. Among his important works are: 'The Coal-Fields of Great Britain' (1865); 'Building and Ornamental Stones' (1872); 'A Text-Book of Physiography' (1888); 'Mount Seir, Sinai, and Southern Palestine' (1885); 'Volcanoes, Past and Present' (1892); 'Our Coal Resources at the Close of the 19th Century' (1897).

Hull, Isaac, American commodore: b. Derby, Conn., 9 March 1775; d. Philadelphia 13 Feb. 1843. He commenced his career in the merchant service, and was commissioned as lieutenant in the navy at the commencement of hostilities with France in 1798. In 1800 when first lieutenant of the Constitution, he cut out a French privateer from under a strong battery in the harbor of Port Platte, San Domingo. During the war with Tripoli (1802–5) Hull served with distinction in the squadrons of Commodores Preble and Barron, in command of the schooner Nautilus and brig Argus, participating in the several attacks on the city of Tripoli in July, August, and September 1804, and subsequently co-operating with Gen. Eaton in the capture of the city of Derne. In May 1804, he was promoted to the rank of master commandant, and in April 1806, to that of captain. At the opening of the War of 1812 between the United States and Great Britain he was in command of the frigate Constitution, and in July of that year, while cruising off New York, fell in with a British squadron, which chased the Constitution closely for nearly three days and nights. The wind was light and baffling, but Hull handled his vessel with superior seamanship, and finally escaped without injury; at one time he resorted to a novel and successful expedient; the boats were lowered, and all the spare rope on board was bent to a kedge anchor which was carried out nearly a mile ahead and let go. The ship was warped up to this kedge, which was weighed while another was carried out. In this way she left her pursuers before they discovered the manner in which it was done. After this remarkable escape, Hull went into Boston for a few days, whence he sailed 3 August, and 19 August met the English frigate Guerrière, which after a short conflict he reduced to a complete wreck, and forced the English to surrender. (See CONSTITUTION, THE.) As this was the first naval action of the war, it was regarded as a very important one; Capt. Hull was enthusiastically received, and Congress at its next session presented him with a gold medal. After the war his principal services were in command of the navy yards at Boston and Washington, of the squadrons in the Pacific and Mediterranean, and as a member of the board of navy commissioners.

Hull, William, American soldier: b. Derby, Conn., 24 June 1753; d. Newton, Mass., 29 Nov. 1825. He was graduated at Yale College in 1772, studied law at Litchfield, Conn., and was admitted to the bar in 1775. He entered the army of the Revolution at Cambridge in 1775 as captain of a Connecticut company of volunteers; was promoted to the rank of major in the 8th Massachusetts regiment in 1777, and to that of lieutenant-colonel in 1779. He was in the battles at White Plains, Trenton, Princeton, Stillwater, Saratoga, Monmouth, and Stony Point. His services throughout the war received the approbation of his superior officers, and neither his courage nor patriotism was ever doubted. He was governor of Michigan Territory from 1805 till 1812, when he was appointed as brigadier-general to the command of the northwestern army. He marched his troops to Detroit, heard of the declaration of war, and of the fall of Michilimackinac, which let loose the Indians of the Northwest upon him, crossed into Canada, but found his communications cut off, recrossed, and on the arrival of Gen. Brock surrendered to that officer the post of Detroit and the territory. For this he was tried two years after by a court-martial, and sentenced to be shot. The execution of the sentence was remitted by the President in consideration of his age and Revolutionary services. Historians are now agreed that the difficulties which surrounded Gen. Hull were so great that we need not ascribe his surrender either to treason or to cowardice. In 1824 he published a series of letters in defense of his conduct in this campaign which had a wide circulation. Consult 'Life,' by his daughter, Maria Campbell, and his grandson, James Freeman Clarke (1848).

Hull, Canada, town and county-seat of Ottawa County, Quebec, on the Ottawa River, at the junction of the Gatineau River, opposite the city of Ottawa, and on the Canadian Pacific railway. It is connected with its important neighbor by a fine suspension bridge spanning the Chaudière Falls. Iron mining is carried on in the neighborhood, and the Falls afford immense water-power. Lumbering is the chief industry of the district; and Hull has vast lumber yards, saw- and planing-mills, and manufactories of pulp, paper, matches, pails, woodenware, woolens, axes, etc. It has 5 churches, a college, a convent, many fine residences, and French and English newspapers. The population is chiefly French Canadian. The town has been rebuilt since its almost total destruction by fire, 26 April 1900. Pop. (1901) 13,993.

Hull, Kingston-upon-, England, a large river port, municipal and parliamentary borough, city and county of itself, situated in the East Riding of York, on the north shore of the estuary of the Humber, where it is joined by the Hull, 34 miles east-southeast of York. Its buildings of note are the town-hall, the exchange, the corn exchange, market-hall, post-office, the custom-house, Trinity House, dock offices, public rooms, royal institution (containing the rooms of the Philosophical Society, etc.), art gallery, technical schools, central library, Hymers College, grammar-school, the jail, royal infirmary, borough asylum, hospitals, crematorium, and dispensary. The town possesses three well-laid-out public parks. The industries are varied. There are several ship-building yards, iron-foundries, machine-shops, and steam flour-mills; the other principal branches of industry comprehend seed-crushing, color-making, paper-making, canvas, rope, and cable making, tobacco manufacturing, and oil boiling. Hull ranks as the third port in the kingdom, and has extensive ship accommodation, docks, quays, etc. The principal exports are machinery, coal, metal goods, and woolen and cotton goods, the total value in 1900 being £16,933,078 (besides £5,516,723 of foreign and colonial produce); imports — timber, corn, iron, wool, flax, hemp, tallow, hides, pitch, tar, rosin, bones, etc.; in 1900 £31,168,579. The name of Kingston-upon-Hull was given by Edward I., who erected a fortress, and constituted it a chartered town and port. When Edward III. invaded France in 1359 Hull contributed 16 ships and 470 mariners. During the civil war Hull was besieged unsuccessfully by the Royalists twice. Pop. (1901) 240,618.

Hul'lah, John Pyke, English musical composer: b. Worcester 27 June 1812; d. London 21 Feb. 1884. In 1833 he entered the Royal Academy of Music. His first important composition, an opera entitled 'The Village Coquettes,' of which the words were by Charles Dickens, was successfully produced at St. James' Theatre in 1836. Early in 1841 he opened classes in Exeter Hall for the instruction in vocal music of schoolmasters and the general public, and from 1849 to 1860 continued them in St. Martin's Hall, built for him by his friends and supporters. His classes were remarkably successful despite much adverse criticism of his method of teaching. In 1858 he succeeded Horsley as organist at the Charterhouse, and in 1872 received the appointment of musical inspector of training schools for the United Kingdom. He conducted the Philharmonic concerts at Edinburgh 1866–7, and those of the Royal Academy of Music 1870–3. He also held professorships in King's College, Queen's College, and Bedford College. Hullah's best-known compositions are songs, of which several, such as 'The Sands of Dee,' 'Three Fishers,' 'The Storm,' and 'O that We Two Were Maying,' have become very popular. He issued many excellent collections of songs and other musical pieces, among which are: 'Part Music,' in three series (1842–5); 'Vocal Scores' (1846 onward); 'School Songs' (1851); 'Sea Songs'; 'Singer's Library of Concerted Music' (1859); and 'Song Book' (1866). Dr. Hullah was the author of the following among other works on the history and theory of music: 'Grammar of Vocal Music' (1843); 'On Vocal Music' (1849); 'Grammar of Musical Harmony' (1852); 'The History of Modern Music' (1862); 'Grammar of Counterpoint' (1864); 'Music in the House' (1877). See the 'Life' by his wife (1886).

Hulme, Frederick Edward, English botanist: b. Hanley, Staffordshire, 1841. He has long been prominent as a writer upon natural history, art, heraldry, etc., and among his numerous works are: 'Plant Form' (1868); 'Familiar Wild Flowers' (7 vols. 1878–1902); 'Art Instruction in England' (1882); 'History, Principles and Practice of Symbolism in Art' (1891); 'History, Principles and Practice of Heraldry' (1892); 'Cryptography' (1898); 'History of the Flags of the World' (1897).

Humaita, oo-mä-ē'tä, Paraguay, town and fort; on the Paraguay River, near the mouth of the Paraná River; in the southwestern part of the republic. Its situation made its possession of importance during the war of the "Triple Alliance." It withstood a siege for a whole year, the attacking forces being Argentine and Brazil soldiers, but finally, in 1868, surrendered. At the close of the war, in 1870, the fortifications were destroyed. It is surrounded by a fertile agricultural country. There is but little local manufacturing, but there is an extensive trade in coffee, sugar, cotton, tobacco, hides, and live stock. Pop. 4,000.

Humane Association, American, a consolidation of various societies, formed at Cleveland, Ohio, in 1877, becoming a national organization for the prevention of cruelty to animals and children. The initial work of the society was to regulate the abuses in cattle-transportation by the railroads, and to secure the passage of State laws looking to this end. It offered a prize of $5,000 for the best model of a cattle car that would make possible the feeding, watering and resting of cattle in transit, and many improved cattle cars were brought into use. See Animals, Cruelty to; Children, Society for the Prevention of Cruelty to.

Humane Society, Royal, formed in London, in 1774, for the purpose of resuscitating those who had been immersed in water and were apparently drowned. At the present time it distributes rewards, consisting of medals, clasps, testimonials, and sums of money to those who save or attempt to save life from drowning. Also "all cases of exceptional bravery in rescuing or attempting to rescue persons from asphyxia in mines, wells, blast-furnaces, or in sewers where foul gas may endanger life, are recognizable by the society." It likewise gives prizes for swimming to the pupils of public schools and of training-ships.

Hu'manists, the name assumed at the revival of learning by those who looked upon the cultivation of classical literature as the most valuable instrument of education, in opposition to those who clung to the ancient methods of the Scholastics. In their modes of thought also the tendency of the humanists was to exalt paganism at the expense of Christianity. In the 18th century the name became a word of reproach for those who showed a blind zeal for the classics as the sole educational subject, opposing the Philanthropists, who asserted the value of mathematics, science, modern languages, and history.

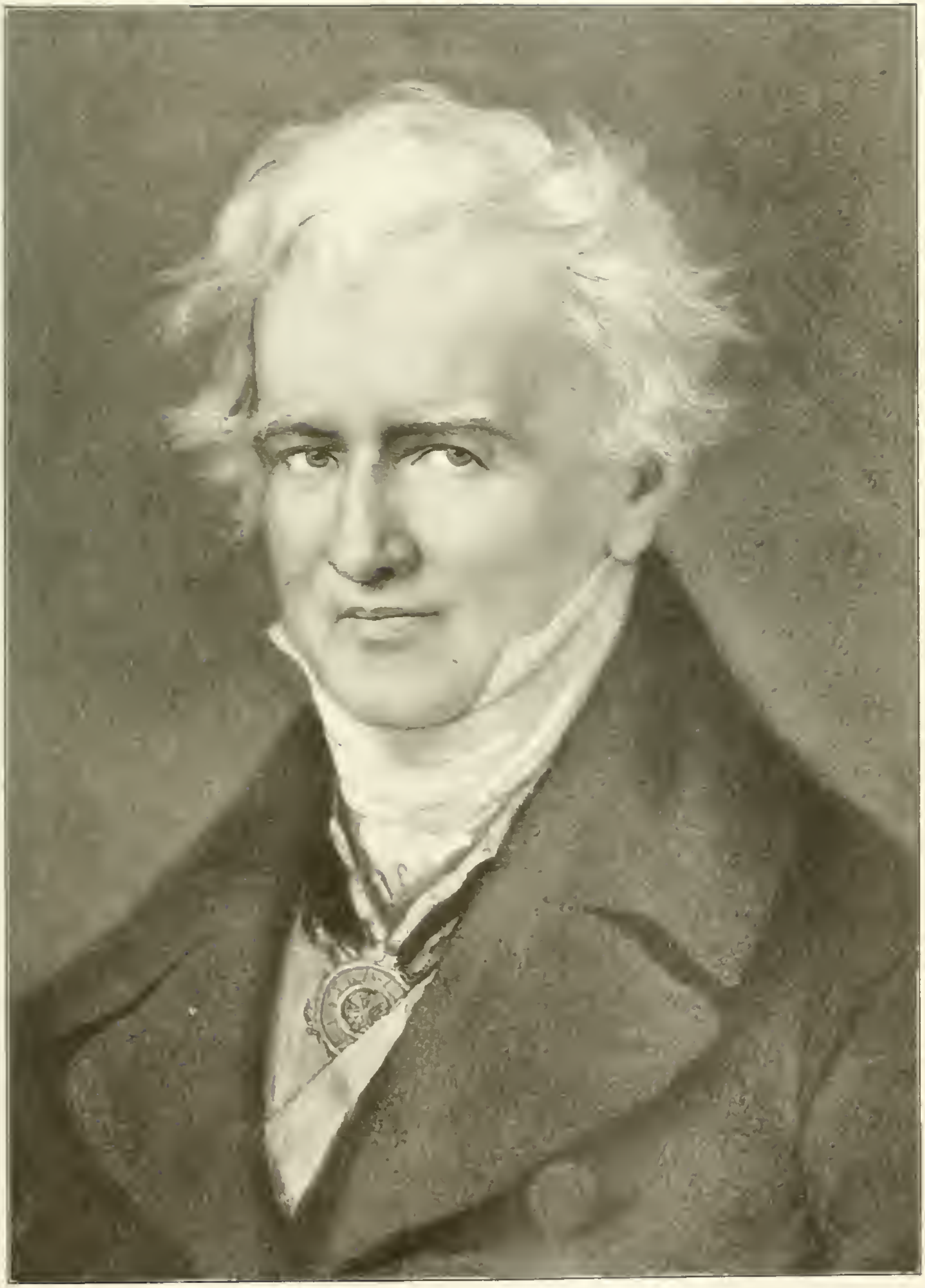
Humanita'rians, a term applied to the various classes of anti-Trinitarians, who regard Christ as a mere man. The earliest known author of the purely humanitarian theory is Theodotus of Byzantium, who lived in the second century. A contemporary of his, Artemon, taught the same doctrine, and asserted that such had been the universal belief of Christians up till the beginning of the 3d century. See UNITARIANISM.

Hum'bert I., RANIERI CARLO EMANUELE GIOVANNI MARIA FERDINANDO EUGENIO, king of Italy: b. Turin 14 March 1844; d. Monza, near Milan, 29 July 1900. He was eldest son of Victor Emmanuel II. and Queen Marie Adelaide, daughter of the Archduke Regnier of Austria. He took part as a youth in the war of independence, and in 1866 was in command of a division at Custozza. On 22 April 1868 he married his cousin, Princess Margherita of Savoy, daughter of the Duke of Genoa. On the death of his father he succeeded to the throne of Italy 9 Jan. 1878 as Humbert I. During his reign he carefully regarded constitutional limitations, and directing his choice of prime-ministers according to parliamentary conditions, selected but one, Rudini, from the Conservatives. In foreign policy he was evidently desirous of an active part in European affairs. In 1891 was concluded the "Triple Alliance" with Germany and Austria, a compact which necessitated the maintenance of a large army and navy, and the oppressive taxation of an already burdened country. Humbert also believed in colonial expansion, which he inaugurated by the occupying of Massowah, on the Red Sea. The Italian troops suffered reverses in 1887 and 1888, when they were defeated by the Mahdi, and 1 March 1896 when they lost the battle of Adowa to the Abyssinians. Humbert's attitude toward the Vatican was one of firmness, respecting all guarantees to the Pope, but insisting on the permanence of the Italian possession of Rome. His private munificence — it is said that he expended not less than $500,000 yearly in benefactions — and his personal interest and courage in the rescue work after the earthquake at Ischia (28 July 1883), and in visits to Busca and Naples during the cholera epidemic (1884), made him greatly respected by the Italians, to whom he was known as "Humbert the Good." He was thoroughly a soldier and eager in the interests of the army. Two unsuccessful attempts were made upon his life, one at Naples 17 Nov. 1878 by Passanante, a fanatic, and another near Rome 22 April 1897 by Acciarito, an anarchist. On 29 July 1900 he was shot and killed at Monza, near Milan, by the anarchist Bresci. See ITALY, *History.*

Humbert Swindle, The, one of the most daring and extensive frauds on record, perpetrated by a Mme. Humbert of Paris with the aid of various accomplices. It was alleged by Mme. Humbert that a certain Robert Henry Crawford, American millionaire, had left to her his fortune of $20,000,000. A subsequent will divided the estate between her younger sister, Marie Daurignac, and Henry and Robert Crawford, nephews of the testator, while a third document bound the heirs to the preservation of the title-deeds and securities, and placed these in the keeping of M. and Mme. Humbert until Marie should attain her majority. Without examination the alleged title-deeds and securities were deposited and sealed in a safe by the authorities. On this wholly fictitious basis Mme. Humbert netted about $10,000,000, while the amount of notes in the form of original loans and renewals equaled $140,000,000. The fraud was discovered, and the Humberts sentenced 22 Aug. 1902 to five years' imprisonment but were released 13 Sept. 1906.

Humble-bee. See BUMBLEBEE.

Humboldt, hŭm'bōlt (Ger. hoom'bōlt), **Friedrich Heinrich Alexander,** BARON VON, German traveler and naturalist: b. Berlin 14 Sept. 1769; d. there 6 May 1859. His father was chamberlain to the king of Prussia. He studied at the universities of Frankfort-on-the-Oder, Berlin, and Göttingen, and in 1790 traveled along the Rhine to Holland, France, and England. This journey gave rise to his 'Observations on the Basalt on the Rhine,' published in 1793. In 1791 he studied mining and botany at the mining school in Freiberg, where his acquirements, his attractive and instructive conversation, his wit, and goodness of heart gained him universal esteem and affection. In 1792 he was appointed assessor in the mining and smelting department, and soon afterward removed to Baireuth, as overseer of the mines in Franconia. Here he introduced many improvements, among which was the establishment of the mining school at Steben; he likewise made valuable galvanic experiments, the results of which were published in 1796, in two volumes. But in 1797 he gave up this office from a desire to travel. Owing to the disturbed state of the Continent, however, it was not easy for him to carry out his project. For some time he resided in various parts of Germany, particularly at Jena, where he became intimately acquainted with Goethe and Schiller. In 1797 he went, in company with his brother, Karl Wilhelm, a Prussian minister of state, to Paris, where he became acquainted with Aimé Bonpland, a pupil of the medical school and botanic garden in Paris. He then went to Madrid, and having obtained permission from the crown to travel through the Spanish colonies in America, immediately sent for his friend Bonpland, and sailed with him from Corunna. They landed at Teneriffe, where they ascended to the crater in Pico, in order to analyze the atmospheric air, and to make geological observations. In July they arrived at Cumana in South America. For five years they were occupied incessantly in traveling through tracts of the earth rich in all that could interest the scientific observer, and till then never scientifically described. They explored the regions of South America watered by the Orinoco and the upper part of the Rio Negro, fully tracing the connection between the Orinoco and the Amazon; then returned to the coast and sailed



FRIEDRICH HEINRICH ALEXANDER VON HUMBOLDT.

for Cuba, where they remained some months. Leaving Cuba in 1801, they returned to the South American continent, sailed up the Magdalena as far as they could, pursued their route by land to Popayan and Quito, and thence as far south as Lima, crossing the Andes no fewer than five times in the course of their journey, and, besides other mountain ascents, climbing Chimborazo (23 June 1802) to an elevation of 19,300 feet, being the highest point of the Andes then reached by man; from Lima they sailed to Guayaquil, and thence to Acapulco, Mexico (January 1803). Some months were spent in examining the city of Mexico and the surrounding country, and in a visit to the United States; and in January 1804, they set sail for Europe, taking Cuba again on their way. On 3 Aug. 1804, they arrived at Bordeaux, bringing with them, as the result of their labors, an immense mass of fresh knowledge in geography, geology, climatology, meteorology, botany, zoology, and every branch of natural science, as well as in ethnology and political statistics. Humboldt selected Paris as his residence, no other city offering so many aids to scientific study, or having so many distinguished savants, and remained there till March 1805, arranging his collections and manuscripts, and experimenting with Gay-Lussac, in the laboratory of the polytechnic school, on the chemical elements of the atmosphere. He was accompanied by Gay-Lussac, who exerted a lasting influence on his chemical studies, in a visit to Rome and Naples, and also by Von Buch on his return through Switzerland to Berlin, where, after an absence of nine years, he arrived in November 1805. As the condition of Germany made it impracticable to publish there his large scientific works, he was permitted by King Frederick William III., as one of the eight foreign members of the French Academy of Sciences, to remain in Paris, which was his residence, excepting brief periods of absence, from 1808 to 1827. There appeared his 'Voyage aux Régions équinoxiales du Nouveau Continent' (with Atlas, 1809–25; German edition, Stuttgart 1825–32; new edition, edited by Hauff, four vols., 1859–60). When in 1810 his elder brother resigned the direction of educational affairs in Prussia to become ambassador at Vienna, the former post was urged upon Humboldt by Hardenberg; but he declined it, preferring his independence. He had also already decided upon a second scientific expedition, through Upper India, the region of the Himalaya, and Tibet, in preparation for which he was diligently learning the Persian language. The political events between the Peace of Paris and the Congress of Aix-la-Chapelle gave him occasion for several excursions. He went to England in the suite of the King of Prussia in 1814; again in company with Arago, when his brother was appointed ambassador to London; and again in 1818 with Valenciennes from Paris to London, and from London to Aix-la-Chapelle, where the king and Hardenberg wished to have him near them during the congress. He also accompanied the king to the Congress of Verona, and thence to Rome and Naples; and in 1827, at the solicitation of the monarch, gave up his residence in Paris, and returned by way of London and Hamburg to Berlin, where in the following winter he delivered a series of public lectures on the cosmos. Under the patronage of the Czar Nicholas he undertook in 1829 an expedition to northern Asia, to explore the Ural and Altai Mountains, the Chinese Dsoungaria, and the Caspian Sea. In this expedition he was accompanied by Ehrenberg and Gustav Rose. Their course lay through Moscow, Kazan, and the ruins of Old Bulghari to Ekaterinburg, the gold mines of the Ural, the platinum mines of Nijni Taghilsk, Bogoslovsk, Verhoturye, and Tobolsk, to Barnaul, Schlangenberg, and Ustkamengorsk, in the Altai region, and thence to the Chinese frontier. From the snow-covered Altai Mountains the travelers turned toward the southern part of the Ural range, and traversed the great steppe of Ischim, passed through Petropavlovsk, Omsk, Miask, the salt lake of Ilmen, Zlatousk, Taganay, Orenburg, Uralsk (the principal seat of the Uralian Cossacks), Saratov Dubovka, Tzaritzin, and the Moravian settlement of Sarepta, to Astrakhan and the Caspian Sea. They visited the Kalmuck chief Sered Jaab, and returned by Voronesh, Tula, and Moscow. The entire journey of over 10,000 miles was made in nine months; its results are given in Rose's 'Mineralogischgeognostische Reise nach dem Ural, Altai und dem Kaspischen Meere' (1837–42); and Humboldt's 'Asie Centrale, Recherches sur les Chaines de Montagnes et la Climatologie comparée.' It extended the knowledge of telluric magnetism, since in consequence of it the Russian Imperial Academy established a series of magnetic and meteorological stations from St. Petersburg to Peking, which was followed, on Humboldt's application to the Duke of Sussex, by the establishment of similar stations in the southern hemisphere by the British government. The convulsions of 1830 gave a more political direction to Humboldt's activity for several years. On the news of the French revolution, and the accession of Louis Philippe, he was selected to convey to Paris the Prussian recognition of the new monarch, and to send political advices to Berlin. The latter office fell to him again in 1834–5, and he was called upon to fulfil it five times in the 12 following years, residing four or five months in Paris on each mission. To this period belongs the publication of his 'Examen critique de la Géographie du Nouveau Continent' (1835–8). He accompanied the king of Prussia in visits to Denmark, England, etc. (1841–5), and resided for several months in Paris in 1847–8, from which time he lived in Prussia, usually in Berlin, occupying a high position at the court until his death. His last great work, 'Cosmos' (1845–58), has been unanimously recognized as one of the most valuable contributions to science ever published. It explains the physical universe according to its dependencies and relations, grasps nature as a whole, moved and animated by internal forces, and by a comprehensive description shows the unity which prevails amid its variety. It has been translated into all languages in which a book of science is required, and has been without an equal in giving an impulse to natural studies. See Bruhns, 'Alexander von Humboldt, eine Wissenschaftliche Biographie' (Eng. trans., 1873); Klenke, 'Alexander von Humboldt, ein biographisches Denkmal' (1859).

Humboldt, Karl Wilhelm, Baron von, German statesman and philologist, brother of the preceding: b. Potsdam 22 June 1767; d. Tegel near Spandau, 8 April 1835. He studied law at Berlin, at Frankfort-on-the-Oder, and at Göttingen, and at the same time devoted equal attention to antiquities, æsthetics, and the philosophy of Kant. In 1789–90 he lived in Erfurt and Weimar, where a friendship commenced with Schiller, continued without interruption till the poet's death. A valuable memorial of his friendship with Schiller is the correspondence between them (Briefwechsel zwischen Schiller und Wilhelm von Humboldt, 1830). In 1801, at the request of the Prussian government, he accepted the situation of ministerial resident at Rome. From 1806–8 he was here minister plenipotentiary, but, having been called from Rome to fill the office of minister of the interior in connection with ecclestiastical and educational matters, had a most important share in the educational progress, which Prussia has since made: more especially is the erection of the Berlin University to be ascribed to him. He exchanged this situation in 1810 for that of extraordinary ambassador and minister plenipotentiary to Vienna. He took an active part during the armistice of 1813 in the peace congress at Prague: in 1814 at the Congress of Chatillon, and the conclusion of the first Paris peace: in 1815 at the Congress of Vienna; and in 1816 at Frankfort-on-the-Main, in all matters connected with the German diet. He was afterward appointed ambassador to London, and in 1818 attended the Congress of Aix-la-Chapelle. In 1819 he was an active member of the Prussian ministry, but sent in his resignation the same year, in favor of a freer and more constitutional system. His collected works (1841–52), include poems, essays on subjects of taste, and in particular numerous valuable disquisitions in regard to the origin and progress of language.

Humboldt, a river which has its rise in the northeastern part of the State of Nevada, flows west and southwest, a distance of about 350 miles into Humboldt Lake, in the eastern part of the State. The stream is narrow, the waters saline, and the whole course is through a barren region, destitute of large trees and but few shrubs, except a few clusters of willows. The fields are covered with sage brush. The only east and west pass through the mountains of Nevada is the valley of the Humboldt. The Central Pacific railroad, in its course through the State, follows this river. Humboldt Lake has no outlet; but the waters evaporate so rapidly that sometimes its bed is dry, but when the water is high it overflows the banks. A dam built a few years ago prevents the overflow from falling in Carson Sink.

Hume, David, Scottish historian and metaphysician: b. Edinburgh 27 April 1711; d. there 25 Aug. 1776. He appears to have entered the University of Edinburgh at 12, and to have left at 14 or 15 without taking a degree. He began the study of law, but abandoned it in order to devote himself to the 'pursuits of philosophy and learning." His first work, the 'Treatise of Human Nature,' was published partly in 1739 and partly in 1740; the books entitled 'Of the Understanding' and 'Of the Passions' appearing in the former, and that entitled 'Of Morals' in the latter year.

The 'Treatise of Human Nature' is the final and most complete exposition of the fundamental principles of the old school of empirical philosophy,— the school to which belonged Bacon, Locke, and Berkeley. According to Hume, the contents of the mind are embraced in the term 'perceptions.' Perceptions consist of sensuous impressions and ideas. Ideas are merely images of sensuous impressions. Knowledge is the cognition of the relation between two perceptions. There is no necessary connection between cause and effect. The idea of cause depends on the habit of the mind which expects the event that usually follows another. Mind is but a series or succession of isolated impressions and ideas. As knowledge is dependent on experience derived through the senses, and as the senses frequently deceive, one can have no absolute knowledge of things, but only of one's impression of them. Hence, to give the conclusion later arrived at in the famous 'Essay on Miracles,' a miracle even if genuine is incapable of proof.

The 'Treatise of Human Nature' is clear, forcible, and untechnical. Its most striking characteristics are its spontaneity and individuality. Hume owed little to academic training, and wrote his earlier works at a distance from centres of learning, without access to large libraries. The literary beauties of the 'Treatise,' however, are marred by its structural defects. It is a series of brilliant fragments rather than a well-rounded whole, and is concerned more with criticism of metaphysical opinions from the point of view of Hume's theory of knowledge than with the construction of a complete system of philosophy.

In 1741 appeared the first volume of the 'Essays, Moral and Political,' the second volume coming out in the following year. These, with some additions and omissions, were republished in 1748 under the expanded title, 'Essays, Moral, Political, and Literary,' which has been retained in the many subsequent editions. Hume's essays are models of their kind, full of sparkle, interest, and animation. Hume accompanied General Sinclair in 1746 and 1747 in his expedition against France and in a military embassy to Vienna and Turin. He now published a recasting of his 'Treatise upon Human Nature,' under the title 'An Inquiry Concerning the Human Understanding' (1747). In 1752 he published his 'Political Discourses,' which were well received, and his 'Inquiry Concerning the Principles of Morals.' The same year he obtained the appointment of librarian of the Advocates' Library at Edinburgh, and began to write his 'History of England,' of which the first volume appeared in 1754. It was, like most of the succeeding volumes, severely attacked both for its religious and political tendencies; but, in spite of adverse criticism, after its completion in 1761, was recognized as a standard work. Its merits are chiefly clearness and force of narrative and philosophical breadth of view in the judgment of men and events. In 1763 he accepted an invitation from the Earl of Hertford, then proceeding as ambassador to Paris, to accompany him, and was enthusiastically received by Parisian circles in his character of philosopher and historian. After the departure of Lord Hertford in 1756, he remained as *chargé d'affaires*, and returned to England in 1766, bringing with him Rousseau, for whom he procured a pension and a retreat in Derbyshire. But the morbid sensitivity of Rousseau brought about a disagreement which put an end to the friendship. In 1767 Hume was appointed under-secretary of state, a post which he held till 1769. As a philosopher, in which quality his reputation is perhaps greatest, Hume's acute skeptical intellect did great service by directing research to the precise character of the fundamental conceptions on which our knowledge and our beliefs are based. His acute negative criticism of these conceptions (for example, his reduction of the ideas of personal identity, conscience, causality, to mere effects of association) compelled philosophy either to come to a dead halt or to find, as Kant did, a new and profounder view of the nature of human reason. See Burton, 'Life and Correspondence of David Hume' (1840); Jodl, 'David Humes Lehre von der Erkenntnis' (1871); Gizyck, 'Die Ethik David Humes' (1878); Huxley, 'Hume' (1879); Knight (1886), and Hume, 'My Own Life.'

Hume, Fergus, English novelist: b. 24 July 1862. He was educated at the University of Otago, New Zealand, became a barrister, and in 1888 removed to London. His first long work, 'The Mystery of a Hansom Cab,' published in Melbourne (1887), and later in London, achieved a phenomenal circulation. Later publications are: 'The Piccadilly Puzzle' (1889); 'Miss Mephistopheles' (1890); 'A Creature of Night' (1891); 'An Island of Fantasy' (1894); 'The Bishop's Secret' (1900); 'The Turnpike House' (1902); 'The Mandarin's Fan' (1904).

Hume, Martin Andrew Sharp, English historian: b. London 8 Dec. 1847. He was educated in Madrid and was attached to the Turkish army 1878–9. He is editor of Spanish State Papers in the Public Record Office and examiner of Spanish in the University of London, and has published: 'Chronicle of Henry VIII.' (1889); 'Courtships of Queen Elizabeth' (1896); 'The Year after the Armada' (1896); 'Sir Walter Raleigh' (1897); 'Philip II. of Spain' (1897); 'The Great Lord Burghley' (1898); 'Spain: Its Greatness and Decay' (1898); 'Modern Spain' (1899); 'History of the Spanish People' (1901); 'Treason and Plot' (1901); 'The Love Affairs of Mary, Queen of Scots' (1903).

Humidity. See RAINFALL.

Hum'mel, Abraham H., American lawyer: b. Boston, Mass., 27 July 1849. He went to New York city in his youth, was educated in the public schools there and entered the law office of William F. Howe as an office boy. He early showed an unusual aptitude for the law, was admitted to the bar of New York in 1870, and subsequently was admitted to practice in the United States courts. In 1870 he founded the law firm of Howe & Hummel, of which he has been ever since a member, and has attained distinction as a divorce lawyer, in theatrical litigation, and important will contests. He represents nearly every important theatre in the United States, many prominent theatrical managers, and leading American and European actors. He is counsel in the United States for the Société des Auteurs Français — organized at Paris, France, for the purpose of protecting all foreign plays produced in the United States and elsewhere.

Hummel, hoom'mĕl, **Karl,** German landscape painter: b. Weimar 31 Aug. 1821. In 1841 he studied painting with Preller. His more idealistic pictures belong to the earlier part of his career, and his later work consists largely of German landscapes. Among his most noted works are: 'The Gardens of Armida' (1888); 'Keller Lake in Holstein' (1884); 'Wooded Landscape near Michaelstein' (1888).

Humming-birds, a family of small birds, the *Trochilidæ*, closely allied to the swifts, peculiar to America and almost exclusively tropical. They are distinguished by small size, iridescent plumage, long slender bill and the peculiar form of the tongue, which consists of a double tube tapering and separating at the tip into two externally lacerated sheaths, which contain the extensile portion. "The horns of the hyoid apparatus are greatly elongated, and pass round and over the back of the head, meeting near the top, and thence stretching in an ample groove to terminate in front of the eyes. This arrangement, analogous to that found in woodpeckers, allows the tongue to be suddenly protruded to a considerable distance, and withdrawn again in an instant." This is a modification of parts adapted to food-getting habits, and is accompanied by others equally characteristic. Humming-birds feed almost entirely upon minute living insects, especially those which gather about flowers and loiter in the corollas, feeding upon the nectar; or dwell on the leaves and bark of plants and trees. Such honey as may be taken with them seems to be gratefully accepted, but the birds do not seek for, nor "suck" the nectar from flowers, as has been popularly supposed. They will dart from a perch and capture an insect like a flycatcher, but ordinarily they obtain them by poising upon their wings about leaves and in front of tree-trunks, picking up morsels, not with the mandibles, but with the tongue; and still more frequently by searching flowers. As it is in the deep, tubular, sweet corollas of trumpet-creepers, orchids, and similar great blossoms of tropical shrubs and vines that insects most abound so there does the humming-bird find its richest hunting-ground; and the long curved beaks of most species have been developed in the constant effort to penetrate to the nectarous depths of these deep blossoms; in truth, the head and half the tiny body may often be pushed into the flower, and in so doing gather and dispense pollen from flower to flower, so that humming-birds are important if not exclusive agents in the cross-fertilization of certain large-flowered plants. This method of obtaining food requires the power of sustaining themselves in the air in a fixed position while they explore leaves or blossoms, since no perch is available for their feet, which are small and weak at best. Hence humming-birds have developed lightness of body coupled with extraordinary muscularity and extent of wings, which in most species reach far beyond the root of the tail. These long narrow wings are operated by pectoral muscles which proportionately exceed in size those of any other bird,— even those of the chimney-swifts; and these huge muscles actuate remarkable short wing-bones, so that extreme rapidity of movement is possible, but it is accompanied by a loss of that power secured by the relatively longer alar bones of other birds. By this apparatus the humming-birds are able to beat the air with a rapidity which enables them to stand still, or to dart and dodge in pursuit of some agile insect, or in escaping danger, with a speed which defies human sight to trace; the moving wings at such times, indeed, appear only as a misty halo about the body of the bird, and make a loud humming noise. Most species have very long bills — frequently exceeding, and sometimes twice as long as the head; but some have short, owl-like beaks, with which they pierce the base of such flowers as are too deep for them.

A characteristic of humming-birds is that flashing beauty of plumage which long ago led to calling them the gems of the air, and is due mainly to the quality of the feathers, upon the surface of which are small scales that reflect the light in prismatic hues, giving an iridescent or metallic sheen to certain parts, especially the throat (gorget), comparable only to the shards of some beetles. Such brilliance, however, belongs only to the males, the females being uniformly more plainly dressed, though still highly colored. In many species, also, the males are further adorned with fanciful crests, mustaches, tufts, pendants of the chin and throat, "puffs" upon the legs, and especially with ornamental developments of the tail-feathers; and these they seem to take great delight in displaying for the admiration of the female, and the exasperation of rivals. They are extremely pugnacious, especially in the nuptial season, when constant and bitter fighting occurs, and their courage is so great that neither sex has any hesitation in attacking any bird which offends them or comes too near the nest,— even hawks and crows often flee ignominiously before the impetuous onslaughts of these little furies. On the other hand no bird is more fearless of man and easily tamed.

The nests of humming-birds are small cups of downy materials, sometimes resting upon the limb of a tree (as is the method with the common ruby-throat of the eastern United States; sometimes fastened in a crotch of a bush or of large leaves; or fastened to the tip of a pendant leaf, or in a bunch of hanging moss or foliage. The materials are adapted to the place in color and appearance, and further concealment is gained by coating the structure with lichens, or bits of bark, or with cone-scales, as is the habit of the familiar Calliope hummer of California, which nests in pine trees. The eggs of all species are only two in number, and purely white.

The family is exclusively American, and is represented from Labrador and southern Alaska to Patagonia; but the more vagrant species are few, and withdraw in winter toward the equator. About 125 genera with some 500 species, are recognized by ornithologists. Nine tenths of them belong to the Amazon and Orinoco valleys, or to the lowlands of Central America; yet some species habitually spend the summer on high mountains. The variety decreases northward, but nearly 20 species reach the boundary of the United States, and several are regularly present in summer west of the great plains, as far north as southern Alaska. One species wanders over the whole country, and is abundant in the Eastern States. This is the ruby-throat (*Trochilus colubris*). It is about 3½ inches long. The whole upper part, sides under the wings, tail coverts, and two middle feathers of the tail, are rich golden green; the tail is forked, and, as well as the wings, of a deep brownish purple; the bill and eyes black; but what constitutes their chief ornament is the splendor of the feathers on the throat of the male, which are ruby-red, and gleam like a great jewel. The females and immature young lack this gorget.

Consult: Jardine, 'Naturalists' Library.' Vols. I and II (Edinburgh 1833); Lesson, 'Histoire Naturelle des Colubris' (1830); Gould, 'Monograph of the Trochilidæ' (5 vols. 1850–9); Mulsant and Verreaux, 'Histoire Naturelle des Oiseaux-Mouches ou Colubris' (4 vols. 1876); Ridgway, 'The Humming-birds' (Am. Rept. U. S. National Museum for 1890 (Washington 1892).

Ernest Ingersoll.

Hu'mor, a fluid of the living body, of which Hippocrates enumerated four, namely, blood, phlegm, yellow bile, and black bile. These were considered to be the principal seats of disease in man. In modern medicine humor is a term generally applied to the thinner fluids, whether natural or morbid, limpid, serous or sanious, such as the humors of the eye or the watery matter in a blister of the skin caused by heat, etc.

Hump'back Salmon, Whitefish, etc., several kinds of fishes are said to be "humpbacked" because of an unusually raised dorsal outline. The humpback salmon of the Pacific coast is a commonly known, but little valued species (*Oncorhynchus gorbuscha*), whose flesh is styled in market "pink" salmon. (See Salmon.) The common whitefish (q.v.) is known locally as humpback or bowback; and the curious razor-backed sucker (*Xyrauchen cypho*), is locally called the humpback.

Humpback Whale, one of the baleen whales or rorquals (q.v.) of the genus *Megaptera*, characterized by a low hump in place of the inconspicuous dorsal fin and a tuberculous head. The genus is world-wide, and an undetermined number of species exist, of which the best known is the northern *M. longimanus*, the specific name referring to the elongated pectoral fin, with which the animal beats the water, itself and often its playmates. These whales reach 50 or 60 feet in length, and go about in small schools. See Whale.

Humped Cattle. See Indian Humped Cattle.

Humperdinck, Engelbert, ĕng'ĕl bĕrt hoom'pĕr-dink, German composer: b. Siegburg, near Bonn, 1 Sept. 1854; after studying music at Cologne and elsewhere he taught in the conservatoriums of Barcelona and Cologne, and was musical adviser to a publishing firm in Mainz. Wagner asked him to assist in the production of the latter's only symphony; and he prepared and coached the first cast of 'Parsifal' at Baireuth (1882). He subsequently became famous as the author of the phenomenally successful children's musical fairy play, 'Hänsel und Gretel' (1894); followed by 'Schneewittchen' (The Snow Maiden) and 'The Royal Children.'

HUMMINGBIRDS

1. Double-crested (T. cornutus). 2. Ruby-throat (Trochilus colubris). 3. White-collared (T. melivorus) 4. Tufted-neck (T. ornatus). 5. Delande's (T. delandii). 6. Cora's (T. cora). 7. Golden-green (T. prasina). 8. Vieillot's (T. chalybeus). 9. Evening (T. vesper). 10. Avocet-billed (T. avocetta). 11. Curve-bill (T. curvirostris). 12. Harlequin (T. multicolor). 13. Natterer's (T. scutatus).

Humphrey, hŭm'frĭ, **Charles Frederick,** American soldier: b. New York. He served in the 5th artillery in the Civil War, became 1st lieutenant of the 4th artillery in 1868, was transferred to the quartermaster's department in 1879 as assistant-quartermaster with captain's rank, and in 1897 attained the post of deputy quartermaster-general with grade of lieutenant-colonel. In 1898 he entered the volunteer service, participated in the Cuban expedition, and was promoted brigadier-general of volunteers. In 1899–1900 he was chief-quartermaster of the division of Cuba, in 1900 of the United States China relief expedition. In 1903 he was appointed quartermaster-general, United States army, with rank of brigadier-general.

Humphrey, Heman, American Congregational clergyman and college president: b. West Simsbury, Conn., 26 March 1779; d. Pittsfield, Mass., 3 April 1861. He was graduated from Yale in 1805, was pastor of the Congregational church at Fairfield, Conn., 1807–17, and of that at Pittsfield, Mass., 1817–23 while from 1823 to 1845 he was president of Amherst College. He published several works, including a popular 'Tour in France, Great Britain, and Belgium,' but is best known by a famous pamphlet called 'Parallel Between Intemperance and the Slave Trade.' See Tyler, 'History of Amherst College.'

Humphreys, hŭm'frĭz. **Alexander Combie,** American engineer: b. Edinburgh, Scotland, 1851. He entered business in New York in 1866; in 1877–81 studied at Stevens Institute of Technology (Hoboken, N. J.). He then held various posts first in a lighting, and then in a gas improvement, company, in 1892 became connected with a gas company of London, and in 1894 established a branch business in New York. During this time he did much to improve the manufacture of commercial water-gas. In 1902 he was elected president of Stevens Institute.

Humphreys, Andrew Atkinson, American soldier: b. Philadelphia, Pa., 2 Nov. 1810; d. Washington, D. C., 27 Dec. 1883. He was graduated at West Point 1831, receiving a commission in the artillery. Resigning in 1836 he was associated with Major Hartman Bache as a civil engineer in government work. He re-entered the army in 1838, and was engaged in several government surveys. In the Civil War he was topographical engineer to the Army of the Potomac. In 1862 he was made brigadier-general and commanded the Fifth corps of the Army of the Potomac at the battles of Fredericksburg and Chancellorsville. He commanded a division in the battle of Gettysburg and earned promotion to a major-generalship in the volunteer forces. He commanded the Second corps of the Army of the Potomac in the campaign which closed with Lee's surrender. After his services at Sailor's Creek, he was brevetted major-general in the regular army and was subsequently placed in command of the engineer corps with the regular rank of brigadier-general. He has written: 'The Virginia Campaigns of 1864 and 1865' (1882); 'From Gettysbury to the Rapidan' (1882).

Humphreys, David, American poet: b. Derby, Conn., 1753; d. New Haven 21 Feb. 1818. He was educated at Yale, entered the army at the beginning of the Revolutionary War, and in 1780 became a colonel and aide-de-camp to Gen. Washington. In 1784 he accompanied Jefferson to Europe as secretary of legation, in 1786 was elected to the legislature of Connecticut, and was soon associated with the "Hartford Wits," Hopkins, Trumbull, and Barlow, in the composition of the 'Anarchiad,' being thus one of "the four bards with Scripture names" satirized in London. He was minister to Lisbon 1791–7, minister plenipotentiary to Spain in 1797–1802, and on his return imported from Spain 100 merino sheep, the first introduced into the United States, and engaged in the manufacture of woolens. He held command of the Connecticut militia in the War of 1812. His principal poems are: an 'Address to the Armies of the United States' (1772); 'On the Happiness of America'; a tragedy, entitled the 'Widow of Malabar,' translated from the French of Le Mierre; and 'On Agriculture.' His 'Miscellaneous Works' (1790 and 1804) contain beside his poems 'An Essay upon the Life of Gen. Israel Putnam,' and several orations and other prose compositions.

Humphreys, Frank Landon, American Protestant Episcopal clergyman: b. Auburn, N. Y., 16 June 1868. He was educated at Columbia and Oxford universities. He was precentor and minister in charge of the Cathedral of the Incarnation, Garden City, L. I., 1885–90, and is now canon in the Cathedral of St. John the Divine, New York. Among his writings are: 'The Evolution of Church Music' (1896); 'The Mystery of the Passion' (1898); 'Men of Understanding' (1897); 'Christmas Carols and Caroling' (1900); and 'Clerical Education' (1896).

Humphreys, Joshua, American shipbuilder: b. 1751; d. 1838. He was the first builder of war vessels for the American colonists, and is therefore often called the "father of the American navy." Among the ships constructed by him were the Chesapeake, Congress, United States, Constellation, and the famous Constitution.

Hundred Years' War, the name given to the prolonged struggle between France and England which began in 1337 and ended in 1453. Among the chief of the immediate causes of the war was Edward III.'s claim to the French throne, but the keen rivalry of the two nations rendered conflict inevitable. It lasted during the reigns of five English kings, from Edward III. to Henry VI., and of five French kings, from Philip VI. to Charles VII., ending in the expulsion of the English from France.

Hu'neker, James Gibbons, American musical and dramatic critic: b. Philadelphia 31 Jan. 1859. In Paris he was a pupil of Barili, Ritter, and Dontreleau, and subsequently became an instructor in piano at the National Conservatory of New York. He was musical and dramatic critic of the New York *Recorder* in 1891–5, and of the *Morning Advertiser* in 1895–7. Subsequently he was musical editor, and from 1902 dramatic editor of the New York *Sun*. Among his writings are 'Mezzotints in Modern Music,' essays (1899); 'Chopin, as Man and Musician' (1900), an interesting study; and 'Melomaniacs' (1902), clever but often extravagant stories satirizing the musical profession.

Hungarian Language and Literature. See HUNGARY.

Hungary (Hungarian, Magyar-Ország, «Land of the Magyars»), a kingdom in the southeast of Europe, forming with Austria (q.v.), the Austro-Hungarian monarchy. It includes, in its widest acceptation, Hungary proper, Transylvania on the east, Slavonia and Austrian Croatia on the southwest, extending in this direction so far as to comprise a strip of coast on the Adriatic Sea, together with the former military frontiers, a long strip of territory on the southern borders. Total area, 125,039 square miles, with a population (1900) of 19,254,599. The capital is Budapest. In a more restricted sense Hungary proper is limited to the territory encircled from the east round the north to the northwest by the Carpathian Mountains; bounded west by the river March and some offsets of the Noric Alps; southwest by the Drave; south and southeast by the Danube and the Transylvanian Alps (a continuation of the Carpathian range); with an area of 109,007 square miles, and a population (1900) of 16,721,574. Hungary proper may be considered as a large basin surrounded by mountains on every side except the south; but even there the natural boundaries of this geographical basin are completed at no great distance from the frontier by the highlands of Croatia, Bosnia, and Servia, that meet those of Wallachia and Transylvania at the «Iron Gate», a pass formed by the abrupt divisions of the mountains on either side of the Danube, which there forms a celebrated rapid. From that point the Carpathians proceed by various ranges at first east, but afterward successively northwest and southwest. Several of their summits rise to between 8,000 and 9,000 feet above the sea. The Carpathians are richly wooded in many parts, and their branches are interspersed with numerous romantic and fertile valleys. On the west the Leitha Mountains, a spur of the Alps separating Hungary from Styria and Austria, progressively decline toward the Danube. The Bakonywald (Bakony Forest), another Alpine spur, upward of 2,000 feet in height, and clothed with dense forests of oak, beech, and other trees, intersects the southwest region of Hungary in a northeast direction to near Waitzen, where the Danube bends south, and with the Matra Mountains, beyond that river, divides Central Hungary into a greater and a smaller plain, respectively about 21,000 and 4,000 square miles in extent. The Danube and Theiss rivers traverse the south half of the country in parallel streams about 60 miles apart, the former previously flowing from the west, and the latter from the east or northeast to near the latitude of the capital. Near Eszek, in Slavonia, the Danube, met by the Drave, turns suddenly again to the east, and forms all the rest of the south frontier of Hungary, receiving in this part of its course the Theiss and several minor affluents. The March, Waag, Neutra, Gran, and Ipoli, in Upper Hungary, flow to the Danube from the north; the Bodrog, Schajo, Hernad, and Zagyva, flowing from the same direction, unite with the Thesis; and the Szamos, Körös, Maros, etc., join that river from the east. The Poprad, in the north, flows into Galicia, and is tributary to the Vistula, it being the only Hungarian river not belonging to the basin of the Danube. The Drave forms the southwest frontier on the side of Croatia and Slavonia, and is joined in Hungary by the Mur from Styria. Excepting these two, the Raab, which joins the Danube near the town of its name, is the only river of much magnitude in the southwest quarter of the country; but in that division of Hungary are its two principal lakes, on either side of the Bakonywald—Balaton, in the great plain, and the Neusiedler-See (Hungarian, *Fertö Tava*), close to the border of Austria. In the Carpathians are several smaller lakes, between 4,000 and 5,000 feet above the sea. In the lower courses of the Danube and Theiss are extensive marshes and swamps, especially along the Theiss. The total area of the morasses in Hungary has been estimated at 1,500,000 acres, or upward of 2,300 square miles; within the 19th century enough marsh-land was drained to furnish subsistence for 500,000 inhabitants. Mineral springs are numerous; the most celebrated are those which form the baths of Mahadia in the Banat. Among the minerals are gold, silver, copper, iron, lead, zinc, cobalt, antimony, sulphur, arsenic, salt, soda, saltpeter, alum, vitriol, marble, coals, peat; among the precious stones the opal and chalcedony are remarkably beautiful.

Hungary, including Transylvania, used to yield nearly a half of all the gold annually obtained in Europe. Its principal localities are Kremnitz, Chemnitz, and other places in the north, and Nagy Banya on the Transylvanian frontiers. Silver is found in independent localities, though more frequently in connection with the gold. They are sometimes found pure, but generally in combination with copper. Mining is not yet carried on to a great extent; but the production of coal and iron is rapidly increasing. Hungary is one of the healthiest countries in Europe. Owing to the variety of its surface it possesses a great diversity of climate, which, combined with the fertility of the soil, abundantly supplies her with natural productions.

The Hungarian has a natural inclination to agriculture and the breeding of cattle. Both are however, still in a backward state, though making rapid advances. But the inexhaustible fertility of nature supplies every deficiency of industry and skill, and Hungary is now one of the chief corn-growing countries of Europe, much wheat and flour being exported. Hungarian wheat is well known for its excellent quality. All kinds of grain, a species of maize, rice, kitchen vegetables, and garden plants of every description, melons (which are cultivated in open fields), Turkish pepper, fruits (particularly plums, for the sake of the brandy prepared from them, called *Slivovitza*), wines of different kinds, wood, gall-nuts, potash, tobacco, hemp, flax, hops, saffron, woad, madder, sumach, cotton, and rhubarb are among the products of Hungary.

Many improvements are made by individual proprietors, and Hungary has a large number of technical institutes in which students are thoroughly trained in agriculture. Next to France, Hungary is the chief wine-producing country of Europe, both as regards the quantity and the variety of the product. The annual produce of Hungary and the connected territories is estimated at between 26,000,000 and 27,000,000 eimers, of about 15 gallons each. The finest variety is the Tokay, which is produced in the Hegyallya, in the county of Zemplin.


AUSTRIA-HUNGARY
SCALE OF MILES
Population of places is indicated by different lettering, thus;
200,000 and over BUDA-PEST
100,000 to 200,000 Szegedin
50,000 to 100,000 Linz
10,000 to 50,000 Hof
Smaller towns Cermo
Railroads
Canals
BOHEMIA
MORAVIA
SILESIA
GALICIA
UPPER AUSTRIA
LOWER AUSTRIA
SALZBURG
TYROL
STYRIA
CARINTHIA
CARNIOLA
ISTRIA
HUNGARY
TRANSYLVANIA
BUKOWINA
CROATIA AND SLAVONIA
BOSNIA
HERZEGOVINA
DALMATIA
MONTENEGRO
SERVIA
ROUMANIA
BULGARIA
TURKEY
RUSSIA
GERMANY
ITALY
GULF OF VENICE
ADRIATIC SEA
VIENNA
PRAGUE
BUDA-PEST
BUKHAREST
Belgrade
Trieste
Venice
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Horses, cattle, sheep, hogs, game (in the north bears), poultry, fish (among which the sturgeon and salmon, *Salmo dantex,* are the principal), bees, and silkworms are among the productions of the animal kingdom.

The principal artisans are tanners, furriers, manufacturers of *tschism* (cordovan boots), lace-makers, harness-makers, makers of wooden wares, of straw-plait work, etc. There are few extensive manufactures in Hungary. There are numerous iron and steel works, some iron-foundries, tin-plate and wire works; also potteries, glass manufactories, sugar-refineries and beet-root sugar works, soap-works, tallow, stearine, and wax-candle works; soda, saltpeter, and potash works, and brandy distilleries. Trade is almost exclusively in the hands of the Germans, Greeks and Jews. Internal commerce is promoted by the railways and rivers, the Temes and Francis canals (the former 75, the latter 60½ miles long), the fairs (which amount to 2,000), and the complete absence of tolls. The railways in 1901 had a total length of 10,794 miles, 4,876 miles being state lines; 3,439 worked by the state, and the rest private commercial lines. The total length of navigable rivers and canals in the monarchy is over 3,000 miles. The Danube is the most important highway of traffic, but the foreign trade by it is comparatively small. Inland navigation and roads are given careful attention.

The great number of distinct races with entirely different habits which is found in Hungary is remarkable. According to the census of 1900 on the basis of language, the races inhabiting Hungary including Croatia and Slavonia were divided as follows:

Magyars	8,679,014
Rumanians	2,785,265
Germans	2,114,423
Slovaks	2,008,744
Croatians	1,667,377
Servians	1,045,550
Ruthenians	427,825
Various	526,401
	19,254,599

The Magyars, who are the dominant race, are located for the most part in the centre of the kingdom. They are high-spirited, brave, warlike and generous, and, according to travelers, more sincere than their Servian and Wallachian neighbors; impatience of control, pride, indolence, and ignorance are their besetting faults. Their general deportment is serious; and in many respects they resemble the Turks, who followed them out of Asia, and belong to the same great family of mankind. The Magyar costume is remarkable for its picturesque elegance. Most of the Hungarian nobles are Magyars; and it is by this section of the population that the constitutional form of government and municipal institutions have been mainly, if not wholly, upheld. The Slovaks are among the people apparently the earliest settled in Hungary; they inhabit the northwest, and are similar in race, customs, and language to the adjacent Moravians, to whose extensive empire they belonged before the Magyar conquest. The Ruthenians or Rusniaks dwell beneath the north and northeastern Carpathians. The Rumanians (Wallachians) occupy a tolerably wide tract of country on both sides of the west and north boundaries of Transylvania. They are far behind the Slovaks, and, indeed, nearly all the other nations of Hungary, in education and civilization. They appear to be the descendants of Italian colonists, placed in Dacia during the Roman dominion there, and have been accordingly called Daco-Romans — an epithet to which their classic features, easy manners, language, and antique costume seem to give them a claim. They call themselves *Romouni;* and speak a dialect of Latin, but they write it with the Cyrillian or Russian character. In this last particular they unite with their Servian neighbors inhabiting the Banat on their southwest. The Croats people nearly all Slavonia and Croatia, and stretch into seven of the counties of Hungary proper as far as the county of Pesth. The Wends (Vandals) inhabit two counties of Hungary proper as far as the county Theresianopel, and a few other parts of the Banat; the Montenegrins a part of the county Temes; and the Armenians portions of three of the eastern counties. The Germans appear, in the first instance, to have emigrated into the country during or before the 7th century, subsequently to which many successive immigrations took place, especially under Geysa, king of Hungary, who ascended the throne 1141 A.D. and who established large numbers of German colonists from Franconia, Thuringia, and Alsace in several of the northern counties, and in Transylvania. They speedily became dispersed in detached settlements over all Hungary; and early in the 13th century Pesth was described as a «large and rich German town.» In the 18th century other Teutonic immigrants, with some French refugees, settled in the kingdom. The Germans are marked by their industry and thrifty condition, but also, it is said, by their litigious and avaricious propensities. They people the greater part of the western frontier, from Presburg and around the shores of Lake Neusiedler south nearly to the limit of Croatia; elsewhere they are most numerous in the county of Zips, the mining districts, the Banat, and especially in the towns, where they compose the bulk of the trading population.

With regard to popular education, attendance in elementary schools is compulsory from the completion of the sixth year (in Croatia and Slavonia the seventh) till the completion of the twelfth, and also in continuation-schools up to the age of 15. Every parish or commune is also bound to maintain an infant school. The great bulk of the schools are supported by the denominations. Besides gymnasiums and real-schools there are numerous technical schools for arts and industries of all kinds. There are universities at Budapest, Klausenburg, and Agram, attended by over 6,000 students. Over two thirds of the periodicals issued are in the Magyar language. The various religious bodies have long enjoyed equal rights in Hungary and Transylvania.

The civil population according to religion, on the basis of the census of 1900, comprised Roman Catholics 9,846,533, over 51 per cent; Greek Catholics 1,843,634; Greek Oriental 2,799,846; Evangelical Augsburg, 1,280,070; Evangelical Helvetian 2,423,818; Unitarians 68,005; Jews, 846,254; others 14,180.

The Roman Catholic clergy are powerful by reason of their large landed property, and the influence they possess over the appointments to many offices. There are three Roman Catholic archbishops and 17 suffragan bishops, with a Greek (United) Catholic archbishop and five suffragan bishops. Among the Protestants, laymen and clergymen united manage the affairs of the different congregations under the direction of superintendents. Lutherans and Calvinists have each four superintendents in Hungary and one in Transylvania.

A sketch of the Hungarian constitution has already been given in the article AUSTRIA. Hungary is divided into counties and districts, according to a very old division of the country. These have the right to administer their own internal affairs. At the head of each is an *Obergespann* (or lord-lieutenant) and two *Vice gespanne*. There are three county courts in civil cases, according to the importance of the subject in question, consisting either of a judge with a jury, or of the vice-officer of the county with a judge and jury, or of the supreme tribunal of the county (*Sedes Judicaria, Sedria*), which also revises the decisions of the two other courts and of the seignorial courts. The courts of appellate jurisdiction are the Royal Table (which, however, in several cases has original jurisdiction) and the Table of the Seven. The former sits in Budapest and the latter in Agram. They are both comprised under the name of *Curia Regia,* the sentences of which have the force of law in case there is no positive law.

History.— The nations which occupied parts of Hungary before its conquest by the Magyars were the Dacians, Bastarnæ, Illyrians, Pannonians, Sarmatians, Vandals, Bulgarians, Jazyges, Alans, Huns, Marcomanni, Longobards, etc. The Romans held the southwest part of the country under the name of Pannonia, while the southeast belonged to their province of Dacia. Various Slavic tribes, together with Wallachians, Bulgarians, and Germans, were the chief occupants at the time of the Magyar invasion. The Magyars, a warlike people of Turanian race, had made various migrations, and long dwelt in the vicinity of the Caucasian Mountains, and afterward in the region between the Don and the Dniester, before they approached and crossed the Carpathians (about 887) under the lead of Almos, one of their seven chiefs (*vezér*), and elected head (*fejedelem*) or duke. Arpád, the son of Almos, conquered the whole of Hungary and Transylvania, organized the government, and also made various expeditions beyond the limits of these countries. These incursions were extended under his son Zoltán (907–46) and grandson Taksony (946–72), as far as the German Ocean, the south of France and Italy, and the Black Sea. These formidable enemies were first defeated by Henry I., the German emperor, at Merseburg in 933; they then invaded Franconia in 937, and Saxony in 938, were defeated at Stederburg, and also on the river Ohre. Their last incursion into Bavaria (954 and 955) terminated with their complete overthrow on the Lech, where Otho I., king of the Germans, conquered them. They gradually learned from the Slavonians and Germans whom they conquered, and from the prisoners whom they had taken in their incursions, the arts of peace, agriculture, and manufactures. The hospitality of Geysa (972–97), and the religious zeal of Sarolta his wife, did much to attract strangers from different countries and of all classes into Hungary. The Hungarians violently opposed the introduction of Christianity, and Geysa was obliged to leave the extension of it to his son Stephen (997–1038), who finally prevailed by the assistance of Latin monks and German knights. King Stephen granted a constitution, the principal features of which were never lost, but the unsettled state of the succession to the crown, and the consequent interference of neighboring princes and of the Roman court in the domestic concerns of Hungary, long retarded the prosperity of the country. The religious zeal and bravery of St. Ladislaus (1077–95),) and the energy and prudence of Coloman (1095–1114), shine amid the darkness of this period.

The introduction of German colonists from Flanders and Alsace into Zips and Transylvania by Geysa II. (1141–61) had an important influence on those districts. In 1186 Hungary became connected with France by the second marriage of Béla with Margaret, sister to Henry, king of France, and widow of Henry, king of England, who introduced French elegance at the Hungarian court. The reforms of Béla IV. (1235–70) were interrupted by the invasions of the Mongols (1241), and the kingdom was in a most deplorable condition. With Andrew III. (1290–1301) the male line of the Arpád dynasty became extinct, and the royal dignity became purely elective. Charles Robert of Anjou, by his mother a descendant of the extinct dynasty, was the first elected (1309). The reign of his descendant Sigismund (1387–1437) is interesting from the invasion by the Turks (1391) and the war with the Hussites. From their first appearance the Turks constantly disturbed the tranquillity of Hungary, which served as a bulwark to the rest of Europe. The death of Ladislaus I., in the unfortunate battle of Varna (1444) is to be regretted, as the plan of the hero John Huniades, for driving the Turks from Europe, failed through the coldness of the Christian courts and the intrigues of his enemies.

Matthias Corvinus (1458–90), son of Huniades, held the reins of government with a firm hand, and gained the love and confidence of the nation, notwithstanding the severe measures which he was often compelled to adopt.

During the reigns of Ladislaus II. (1490–1516) and Louis II. (1516–26) the ambition and rapacity of the optimates, headed by Stephen Zapolya, and afterward by his son John, excited domestic troubles and caused an insurrection of the peasants, which was only suppressed by the severest measures (1514), while they destroyed the foreign influence of the kingdom. The battle of Mohács (1526), in which Louis II. lost his life, and which for 160 years made a great part of Hungary a Turkish province, was the natural consequence of this state of things. The rest of the country was in dispute between the rivals Ferdinand of Austria and John Zapolya. The contest was decided by the Protestants, who, fearing the persecution of Zapolya, declared for Ferdinand. Their adherence gave him the superiority, and Zapolya was compelled to rest satisfied with the possession of Transylvania and some counties of Upper Hungary; but this division of the kingdom caused continual disputes with the descendants of Zapolya, instigated by the Turks and the French, gave rise to civil commotions, which were quieted by the treaties of Vienna with Stephen Botskay (1606), of Nikelsburg with Gabriel Bethlen (1622), and of Lintz with George Rakoczy (1645). These circumstances delayed the expulsion of the Turks, in which Leopold I. finally succeeded so far that he took Buda (1686), and by the Peace of Carlowitz (1699) recovered the rest of Hungary (except the Banat) and Transylvania.

The Congress of Passarowitz (1718) restored the Banat to Hungary, and the Peace of Belgrade (1739) terminated hostilities with the Porte for a long time. Charles VI. (1711–40) by the pragmatic sanction secured the inheritance of the Hungarian crown to the female descendants of the house of Hapsburg, and improved the administration of the kingdom by giving the royal chancery and the vice-regal office an organization better suited to the age. He also formed a standing army for Hungary, and established the military contribution for its support. Joseph II. (1780–90), one of the greatest sovereigns of his age, was influenced by the best intentions in the changes which he undertook in the Hungarian constitution; but his zeal made him forget the necessity of proceeding gradually in such reforms, and the nation, far from entering into his views, opposed them.

The subsequent history of Hungary — the adoption of the Magyar language in its diet; the resistance against the encroachments of Austria; the heroic struggles for independence, and the noble work of Batthyani, Deak, Kossuth, and Klauzal, along these lines; the disastrous war of 1848 and the reduction of Hungary to the position of an Austrian crown-land; its rehabilitation to independence in 1867 and the constitution of the dual Austro-Hungarian Empire, are described under AUSTRIA. See paragraphs *Austria under the House of Hapsburg-Lorraine*, and *Recent Politics*.

Hungarian Language.— The language of the Magyars, as spoken and written at present in Hungary, is a phenomenon in philology, disclosing rich stores for the philosophical historian and philologist. It is classed in the Ugric branch of the northern division of the Turanian family of languages, and as such is most closely allied to the Ostiak, Vogulic, and Mordvinic, though it is also nearly akin to the Finnish and the Turkish. Differing from all the cultivated languages of Europe in internal structure and external form, the Hungarian nevertheless was obliged to express with the Roman alphabet, adopted with Christianity, all the Asiatic shades of sounds. The alphabet contains the following 26 simple and 6 compound sounds, pronounced as in Italian, except where otherwise marked:— 8 vowels: *a* (like *a* in what, swallow), *e* (=*é* French), *i* and *y*, *o*, *u*, *ö* (= French *eu* or German *ö*), *ü* (French *u*); 18 consonants: *b*, *d*, *f*, *g*, hard *h* (German), *j* (German), *k*, *l*, *m*, *n*, *p*, *r*, *s* (English *sh*), *t*, *v* (also *w*), *z* (French), *sz* (English *s*), *zs* (or *ś*, French *j*); 4 compounds with *y*: *gy* (pronounced *dy*, *gyar*, factory, pronounced *dyar*, in one syllable), *ly* (French liquid sound as in *fille*), *ny* (French and Italian *gn*), *ty*; and two compound sibilants: *cs* (written also *ch* and *ts* = English *tch*), and *cz* (English *ts*). If we add the long vowels, marked with the acute accent, *á*, *í*, *ó*, *ő* (long *ö*), *ú*, *ű* (long *ü*), we have 38 sounds in all, besides *x*, which is used in foreign names. The Hungarian has adopted a good many Slavic, Latin, German, Greek, and other foreign words; but it still retains the essential characteristics of its grammar and phonology. As in the other Turanian languages the root is never obscured in words, whatever changes they undergo. Determining or modifying syllables are placed at the end, and have a double form, always taking a different vowel when attached to a sharp-vowel root from what they have when attached to a flat-vowel root. This is a general characteristic of the Turanian languages. These suffixes represent the case-endings of nouns and the conjugations of verbs in other languages, and are very numerous. Hungarian is destitute of diphthongs. At the beginning of a syllable the Hungarian never allows more than one consonant; in foreign words which begin with two consonants, the consonants are made to go with different syllables by putting a vowel before them (for example, of *schola* they make *iskola*), or a vowel is put between (as from *král* they make *király*). In common with the other languages allied to it, it has no distinction of sex whatever. Family names are considered as adjectives, from which they mostly originated, and hence are put before the baptismal name; for instance, Bátori Gábor (Gabriel Bátori), as if it were the Batorish Gabor, the Gabor of the Batori family. The beautiful proportion between vowels and consonants, the accurate shadowing and full articulation which every syllable requires (the Hungarian suffers no mute vowels), and the fixed succession of vowels, give to the Hungarian language a character of masculine harmony, in which it will bear a comparison with any other. The richness and expressiveness of its various forms give it great energy; the regularity of its inflections and compositions, in which it is to be compared with the Sanskrit, makes it clear and distinct, and its infinite power of composition gives it the means of increasing its stores beyond almost any western language.

Hungarian Literature.— The preference given to Latin over the national language, not only in the church, but in judicial proceedings, legal documents, and forms prevailed until past the middle of the 19th century. The use of a dead language in common life, as well as on all scientific subjects, could neither be advantageous to the language itself, to the general improvement of the people, nor to the national literature. Despite these disadvantages, some buds of literature from time to time unfolded themselves, and native genius, notwithstanding its chains, would sometimes attain distinction. Though with the introduction of Christianity into Hungary the Latin language acquired the ascendency in the church, in schools, and public affairs; yet Hungarian was used in commerce, in the camp, and even the resolutions of the diet were first drawn up in Hungarian. When the missionaries addressed the people in Latin an interpreter was usually present; and there are several relics of poetry, sacred eloquence, and state papers extant in Hungarian. A new impulse was given to this language on the accession of the house of Anjou to the throne of Hungary. The Latin was indeed still the language of church and state; but the Hungarian became the language of the court. Documents were drawn up in Hungarian, and the Hungarian oath, in the Corpus Juris Hungaricæ, dates from this time. The Holy Scriptures were translated into Hungarian; in the imperial library, Vienna, there is a manuscript translation of 1832; and several other translations were published. In 1465 Janus Pannonius wrote a Hungarian grammar, which is lost. The 16th century was favorable to Hungarian literature, through the religious disputes in the country, the sacred, martial, and popular songs, as well as by the histories written and published for the people, and the multiplied translations of the Bible. It then reached a degree of perfection which it retained until the latter part of the 18th century. Among writers of ballads or metrical tales belonging to the 16th century may be mentioned Tinódi, Kákonyi, Tsanádi, Valkai, Tserényi, Szegedi, Iliésfalvi, Fazékas, Balassa, etc. A higher aim was manifested by the epic poems of Count Niklas Zrinyi (1652), Ladislaus Lissthi (1653), Christopher Paskó (1663), Count Stephen Koháry (1699), and in particular the numerous and excellent productions of Stephen von Gyöngyösi (1664–1734), as well as the lyric poems of Rimai, Balassa, Benitzky, etc. In 1653 an encyclopædia of all the sciences, and in 1656 a work on logic, were drawn up in the Hungarian language by John Tsere (Apátzai). A large number of grammars and dictionaries were printed from the 16th century to the 18th. But the hopes of the further development of Hungarian literature were not realized; a Latin period again succeeded, from 1700 to 1780, during which time numerous and finished works were composed in Latin by Hungarian writers. In 1721 a Latin newspaper was established, and the state calendar, which commenced in 1726, was regularly published in Latin. In 1781 the first Hungarian newspaper was printed in Presburg.

After Joseph II. died (1790) many violent yet bloodless changes were made in the Hungarian constitution, and several laws were passed in favor of the Hungarian language. It was required to be used in all public proceedings. Courses of lectures were delivered in Hungarian in some of the schools, and it was taught in all of them. Several periodicals were established, Hungarian theatres erected in Buda and Pesth, many works were written both in poetry and prose. The modern period of Hungarian literature may be said to date from the time of Joseph II. The epic poem of Arpád was written by Andrew Horváth, and published at Pesth in 1830. The brothers Alexander and Charles Kisfaludy acquired a great and deserved reputation as poets and dramatists, and did much toward developing the national language and literature. The latter (who died in 1830) may be looked upon as the founder of the modern drama in Hungary. The most celebrated works of the former are his lyrical masterpiece, 'Himfy Szerelmei' (Himfy's Love, 1807), his 'Regék a Magyar elöidöből' (Tales of the Early Hungarian Times), and his historical tragedies, which were partly modeled on those of Schiller. The development of the Hungarian literature owes much to the influence of the periodical press, which spread abroad a taste for literature at the same time as it intensified the sentiment of nationality among the people. In this department the name of Kossuth deserves honorable mention. Previous to the troubles of 1848–9, which checked for a time the natural growth of the literature, almost every species of composition was successfully practised. Works on politics and narratives of travel were written by Eötvös, Szechényi, Szalay, Szemere, etc.; on history by Stephen and Michael Horváth, Szalay and Jaszay; on philology by Fogarassy and Bloch; works on the exact sciences, however, were confined to translations from the German, French, and English. Novels and romances were written by Baron Jósika, Eötvös, Kemény, Kuthy, Nagy, Pálffy, etc., which, though of no great originality, showed considerable artistic skill, and helped to diffuse a more correct style. The dramatic pieces of Eötvös, Obernyik, Vörösmarty, and the prolific Szigligeti — who for a long time had almost the exclusive possession of the national stage — have greater value and originality. It is in poetry, strictly so called, however, that modern Hungarian literature shines. Many of the poems (songs, ballads, etc.) of Czuczor, Vörösmarty, Bajza, Garay, Bachot, Szász, Erdélyi, Kerény, and others, are among the finest things that modern literature has produced. In this field the palm must be awarded to Alexander Petöfi, who completely freed Hungarian poetry from its dependence on foreign models and subjects, and inspired it with a life drawn fresh from nature and national feeling; and who, in artistic skill and masterly handling of his mother tongue, ranks as a model. Tompa, Hiador, Lisznyai, and others, have copied him with more or less success. The collection of ancient Hungarian national poetry, compiled and edited by John Erdélyi, at the instance of the Kisfaludy Society (three vols., Pesth, 1845–7), contributed greatly toward bringing back the modern poetry to nature and originality, and to impress upon it the stamp of nationality. The ill success of the revolutionary struggle seemed for a time to have dealt a heavy blow to the progress of Hungarian literature, the most gifted writers having either fallen in battle (as Petöfi), or been imprisoned or banished. Time, however, opened the prisons and brought back the exiles; to the writers already mentioned others were added, and an active literary life again began. The greatest recent Hungarian poet is John Arany, who surpasses even Petöfi in artistic feeling, and whose national epic, 'Toldi,' is looked upon as a masterpiece. Baron Jósika holds the first place among the novelists; Jokai, Kuthy, Berczy, Pálffy, Miksrath, and Dobzsa are also favorite fiction writers. Narratives of travel have been written by Count Andrassy, Ladislaus Magyar, Vámbéry, etc.; on politics by Esengery, Szalay, Pákh, and Eötvös. National history has attracted much attention; and besides the works of Szalay and Horváth, we should mention Teleki's 'Age of Hunyad,' Jászay's 'Hungary after the Battle of Mohács,' Salomon's 'The Rule of the Turks in Hungary,' etc. Many excellent translations of modern foreign works have been made, some of which, such as Esengery's translation of Macaulay's 'History of England,' and Somssich's translation of Guizot's 'Histoire de la Révolution d'Angleterre,' rival the originals in style. The best works on Hungarian literature are those of Toldy, some of which have been translated into German.

Hunger. See Appetite; Digestion; Fasting; Food.

Hungerford, hŭng'gėr-fōrd, **Margaret Hamilton Wolfe Argles** («The Duchess»), Irish novelist: b. Ross, Ireland; d. Bandon, County Cork, 24 Jan. 1897. She was the daughter of a vicar choral of Cork Cathedral and the death of her first husband, Edward Argles, left her with a young family to support, whereupon she took to writing novels, using the pseudonym «The Duchess.» Later she was married to T. H. Hungerford. Her more than 30 novels were widely popular both in America and England and without possessing a large amount of literary value are cleverly written, entertaining fictions. Among them may be cited: 'Phyllis' (1877); 'Molly Bawn' (1878); 'Airy Fairy Lillian' (1879); 'Beauty's Daughters' (1880); 'Mrs. Geoffrey' (1881); 'Portia' (1882); 'O Tender Dolores' (1885); 'Green Pastures and Gray Grief' (1886); 'A Modern Circe' (1887); 'The Duchess' (1887); 'Undercurrents' (1888); 'Hon. Mrs. Vereker' (1888).

Hunk'ers (supposably from Dutch *honk*, «post» or «station;» «stick-in-the-muds»), in American politics, at present a contemptuous nickname, like «moss-backs,» for the unprogressive elements of a party, which detest change. Originally, a name given about 1844 to the section of the New York State Democrats which opposed new issues: the points for which it then stood, however, had become party tenets from about 1835. Thence till 1840 the Hunker faction was in opposition to the Locofoco wing (q.v.) which opposed bank charters; but was obliged to yield in 1838. From 1840 to 1846 they oposed the Radicals, who wished a revised State constitution, elective judges, and cessation of State canal building. Thence till 1852 they opposed the Barnburners (q.v.), who, at first separately and then in alliance with the Free-Soil Party (q.v.), fought the national Democratic Party for recognition of its State power. After the election of Pierce in 1852, it divided into «hards» and «softs»; the first under Daniel S. Dickinson opposed the administration, the second under William L. Marcy supported it. The former made up the bulk of the «War Democrats» after 1861. Besides those named, Horatio Seymour is the best remembered Hunker leader; while the opposition has the familiar names of Martin Van Buren, Silas Wright, and John A. Dix, besides others remembered by the older generation.

Hunneus, ûn-nā'ŭs, **George**, Chilean statesman: b. Santiago, Chile, 1831. He was graduated at the university of his native town in 1857, and became professor of political economy and jurisprudence at the same institution the following year. Montt, president of Chile, drove him out of the country on account of his liberal opinions, which he found carried into actuality in the government of the United States, where he spent his time of banishment. He was recalled to his native land in 1861, was elected to the House of Representatives and became its speaker. He was also appointed secretary of public instruction and is now rector of Santiago University, while holding from time to time high positions in the Chilean administration.

Hun'newell, James Frothingham, American bibliographer, and historical writer: b. Charlestown, Mass., 3 July 1832. He has written: 'Historical Monuments of France' (1884); 'The Imperial Island: England's Chronicle in Stone' (1886); 'A Century of Town Life' (1886); 'The Lands of Scott' (1871).

Huns, a people who make their appearance in authentic history about 375 A.D. Ethnologists identify them with a Mongolian people of Northern Asia, who invaded the Chinese Empire about 200 B.C., and after various migrations entered Europe. They appear afterward to have sided with the Goths of Mœsia against the Romans, and sometimes in alliance with the emperors, who purchased their services, and sometimes in hostility with them, they continued to extend their dominion along the Danube until the time of Attila (434), their greatest leader, whose reign constitutes the best-known period of their history. See Attila.

Hunt, Helen. See Jackson, Helen Fiske Hunt.

Hunt, Henry Jackson, American soldier: b. Detroit, Mich., 14 Sept. 1819; d. Washington, D. C., 11 Feb. 1899. He was graduated from West Point in 1839, receiving a commission in the artillery. He saw service in the Canadian rebellion 1837-8; afterwards in the Mexican War. In General Scott's advance on the city of Mexico he distinguished himself as officer of the artillery at Contreras (18 Aug. 1847) and Churubusco (20 Aug. 1847) and subsequently received the brevet rank of major for his gallantry. In 1856 he was placed on the board engaged in revising the system of light artillery tactics. At the outbreak of the Civil War he was stationed at Fort Pickens, Fla., 1861, and the same year commanded the artillery at the battle of Bull Run, and in the defense of Washington. He subsequently organized and commanded the reserve artillery of the Army of the Potomac. As commander of artillery he was present at the battle of Malvern Hill (1 July 1862) and he also took part in the battle of South Mountain. He was brevetted brigadier-general of volunteers in 1862, and was present at the battles of Antietam, Fredericksburg, Chancellorsville, Gettysburg, served in the Wilderness campaign and at the end of the war retired from his position with the rank of brigadier-general in the United States army. In 1866 he received the commission of colonel in the reorganized army, and in 1883 became governor of the National Soldiers' Home at Washington. Among his writings are: 'Instruction for Field Artillery' (1860); 'Battles and Leaders of the Civil War'; 'The Battle of Gettysburg.'

Hunt, James Henry Leigh, English journalist, essayist, and critic: b. Southgate, Middlesex, England 19 Oct. 1784; d. Putney, near London, 28 Aug. 1859. He was the youngest of a large family of children, and was descended on the one side from Tory cavaliers of West Indian adoption, and on the other from American Quakers of Irish extraction. From his father, an improvident and engaging clergyman of convivial habits and of lax doctrines, Hunt seems to have inherited his optimism of temperament, his liberal views, and his courage of conviction; from his mother, a passionate love of nature and of books. From birth a delicate child, he early developed hypochondriacal tendencies that never left him. The years from 1791 to 1799 were spent at Christ's Hospital, and were his only formal preparation for a literary life. In 1801 his father published 'Juvenilia,' a collection of Hunt's poems written from the age of 12 to 17. They show wide reading and some fluency in versification, but are mostly poor imitations. From 1803 to 1805 he worked in his brother Stephen's law office and, at the same time, began his long career as a journalist with contributions to *The Traveller*, *The News*, and other papers. His theatrical criticisms were reprinted separately in 1807.

His next position was in the office of the Secretary of War, resigned in 1808 in order to start his political journal, *The Examiner*, in its far-reaching effects the most significant step of his career. With his brother John as publisher, he continued editor until 1821. *The Examiner* was a departure from the standards of contemporary journalism in its combination of the news-giving quality of the daily sheets with the essay style of the weeklies (Fox-Bourne, 'English Newspapers'). Discussion of politics was its chief object. The liberal policy and boldness of attack of the editor caused one charge of libel by the Tory government to follow closely upon the heels of another. The third resulted in prosecution and conviction for applying to the Prince Regent, afterwards George IV., the phrase, "a fat Adonis of fifty." The two brothers were sentenced to imprisonment of two years, dating from 15 Feb. 1813, in separate prisons, and a fine of £1,000 to be divided between them. They rejected offers from the government to remit the punishment on condition that *The Examiner* should change its attitude, and served the full sentence. Hunt's finances, which up to this time had been good, became greatly involved during his incarceration. Not until 1844 was he free from want. His health suffered greatly from the long confinement. *The Reflector* (1810-12) had much the same political and literary character as *The Examiner*. The chief measures for which Hunt labored through these journals were Catholic Emancipation, reform of Parliamentary representation, liberty of the Press, reduction and equalization of taxes, greater discretion in increasing the public debt, education of the poor and amelioration of their sufferings, cessation of child labor, abolition of the slave trade, reform of military discipline, and of prison conditions, and of criminal and civil laws. After Hunt's release from prison, he was never again so active in political matters.

In 1809 Hunt married Marianne Kent. She was an invalid the greater part of her life; consequently, the 'hugger-mugger' condition of domestic affairs which so greatly distressed the Carlyles. Curiously enough, Hunt was allowed to continue *The Examiner* while in prison. During that time, he republished from *The Reflector* his 'Feast of the Poets,' a wholesale satire on contemporary poets in the manner of Suckling's 'Session of the Poets.' It antagonized the literary world, as *The Examiner* had done the political, and played a large part in creating the antagonism of *Blackwood's* and the *Quarterly* towards Hunt, which resulted in the creation and the long and bitter persecution of the so-called Cockney School. The 'Descent of Liberty' appeared in 1815. The 'Story of Rimini' (1816), also written in prison, was the most important of Hunt's poems up to that time, and brought him into immediate notoriety. For its influence on his contemporaries, particularly Keats, in the use of idiomatic language, and in the revival of the free, heroic couplet, it is the most important of Hunt's poems. It was at once denounced as most pernicious and immoral by the *Quarterly* and *Blackwood's*. 'Foliage' (1818) contains some of Hunt's best epistles and sonnets. 'Hero and Leander,' and 'Bacchus and Ariadne' appeared jointly in 1819, and a translation of Tasso's 'Amyntas' in 1820. His prose style of this period reached its best expression in *The Indicator*, in essays of the occasional and personal type. They are distinguished by a unique charm and tenderness, by delicate humor and keen observation.

During Hunt's imprisonment he had made the acquaintance of Byron, Shelley, Moore, and Lamb. The friendship with Keats probably did not begin until the winter of 1816. In the case of Shelley, it was the beginning of a wonderful friendship that involved personal sympathy and public defence with his pen on the part of Hunt, and much financial aid on the part of Shelley. It was through the latter that Byron, in 1821, invited Hunt to Italy to undertake the management of *The Liberal*, an ultra-political-literary journal, suddenly abandoned after a few months of unsuccessful running. The failure of the project led to Byron's desertion of Hunt and his family in a foreign land, and Hunt's revenge in 1828 in the shape of 'Lord Byron and Some of his Contemporaries,' an error which Hunt later greatly deplored. During the stay in Italy, he edited the *Literary Examiner*, wrote 'Ultra Crepidarius,' a satire on William Gifford, translated the 'Bacchus in Tuscany' of Redi, and contributed the 'Wishing-Papers' to *The Examiner*. He returned to England in 1825 in great poverty. From this time on his work consisted of editing numerous magazines: *The Companion* (1828), *Chat of the Week* (1830), *The Tatler* (1830-1832), *Leigh Hunt's London Magazine* (1834-1835), *Monthly Repository* (1837-1838), *Leigh Hunt's Journal* (1850-1851), unsuccessful because of the great impracticability of the schemes and the monotony of one chief contributor; of contributing to an incredible number of other magazines; of publishing reprints from previously edited journals and collected editions of his 'poetical works'; of selections from other writers made with running comment or introductory essays, as 'Imagination and Fancy' (1844), 'Wit and Humor' (1846), 'Stories from the Italian Poets' (1846), of guide books, as 'The Town' (1848), and 'The Old Court Suburb' (1855). His only novel, 'Sir Ralph Esher,' appeared in 1832. 'The Legend of Florence' was produced at Covent Garden in 1840. His 'Autobiography' was published in 1850, and in a revised form in 1859; the 'Correspondence' posthumously in 1862.

Hunt's best prose work is to be found in his 'Autobiography' and in his essays of the kind already mentioned as having appeared first in *The Indicator*. Carlyle said of the former, "except it be Boswell's of Johnson, I do not know where we have such a picture drawn of a human life as in these volumes." Though less of a poet than an essayist, some of his short poems are exquisite, notably the famous 'Abou Ben Adhem,' 'Mohammed,' 'Jaffar,' 'The Nile,' 'On a Lock of Milton's Hair,' 'Paganini,' and others. As a translator, some of his work is admirable. Hunt's powers of criticism and of selection will not be fully recognized until scattered notes and buried prefaces are collected. He had an inborn love of poetry and all beautiful things. His insight was most remarkable of all in the appreciation of his contemporaries. His personal quality was as rare as his opportunity. He had a personal ascendency, a strange fascination born of the sympathy and chivalry, the sweetness and joyousness of his nature. Barry Cornwall said that he was "compact of all the spicy winds that blow."

Bibliography.—Hunt's works have never been collected and as a whole are difficult of access. His poems and essays, except in small selections and cheap editions, are out of print. The best edition of the former is that edited by S. Adams Lee (Boston 1857); of the latter *The Indicator* and *Companion* (2 vols., London 1834). Scribner publishes in a uniform edition some of the most popular of his works. Consult also: R. B. Johnson, 'Leigh Hunt' (1896); Cosmo Monkhouse, 'Life of Leigh Hunt' (1893); Clarke, 'Recollections of Writers' (1878); Trelawney, 'Recollections of the Last Days of Shelley and Byron' (1858). Frequent references to Hunt are to be found in the writings of Byron, Shelley, Keats, Carlyle, Dickens, Lamb, William Hazlitt and Alexander Ireland. Excellent bibliographies of Hunt's works are to be found in Ireland's 'Lists of the Writings of William Hazlitt and Leigh Hunt' (1868); Monkhouse's 'Life of Leigh Hunt' mentioned above, and in R. B. Johnson's 'Essays and Poems of Leigh Hunt' (Temple Library, 1891).

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Hunt, Richard Morris, American architect: b. Brattleboro, Vt., 31 Oct. 1828; d. Newport, R. I., 31 July 1895. He began the study of architecture in Europe at an early age, attended the Ecole des Beaux-Arts in Paris, traveled in Germany, Italy, Asia, and Egypt, and under his former teacher, Lefuel, was clerk of the works on the buildings that were erected to connect the Tuileries with the Louvre. In 1855 he returned to the United States and proceeded to signalize himself by a remarkable series of noble architectural creations, such as the Capitol extension at Washington, the Lenox Library, New York, the Yorktown Monument, Va., etc. He also designed the pedestal for Bartholdi's colossal statue of 'Liberty Enlightening the World' on Bedloe's Island, New York harbor. Some of the finest private houses in the country were built by him on a truly palatial scale of magnificence, such as that of W. K. Vanderbilt in New York; the country house of George Vanderbilt at Biltmore, N. C.; the so-called 'Marble House' and the 'Breakers' at Newport. He was one of the founders and president of the Institute of Architects. Through his artistic and structural faculty he exercised a profound influence over American architecture.

Hunt, Theodore Whitefield, American Presbyterian clergyman and educator: b. Metuchen, N. J., 19 Feb. 1844. He was graduated from Princeton 1865 and from Princeton Theological Seminary 18[illegible]), was instructor in English at Princeton 1868–71 and has been professor of English there from 1872. He has published 'The Principles of Written Discourse' (1884); 'English Prose and Prose Writers' (1887); 'Studies in Literature and Style' (1890); 'Ethical Teachings in Old English Authors' (1892); etc.

Hunt, Thomas Sterry, American chemist and geologist: b. Norwich, Conn., 5 Sept. 1826; d. New York 12 Feb. 1892. In 1845 he became an assistant to the elder Silliman at Yale College; was chemist and mineralogist to the Canadian Geological Survey 1847–72, professor of chemistry at Laval University 1856–62, and at McGill University 1862–68, and professor of geology in the Massachusetts Institute of Technology 1872–8. In 1859 he invented the green ink with which greenbacks (q.v.) are printed. He was made an officer of the Legion of Honor in 1867, Fellow of the Royal Society in 1859, and was president of the Royal Society of Canada in 1884. Among his published books are 'Chemical and Geological Essays'; 'New Basis for Chemistry'; etc.

Hunt, William Henry, American lawyer: b. New Orleans, La., 5 Nov. 1857. He was educated at Yale, became attorney-general of Montana in 1884; and held various public offices there after Montana became a State. He was for a time United States agent before the Chilean Claims Commission, but resigned that post in 1900 to become secretary of Porto Rico, and in July 1901 succeeded Charles H. Allen as governor of that island. On 1 July 1904 he was succeeded by Gov. Winthrop and since then has been United States district judge for Montana.

Hunt, William Holman, English Pre-Raphaelite painter: b. London 2 April 1827. He entered the schools of the Royal Academy in 1845, and next year exhibited his first picture, 'Hark!' representing a child holding a watch to her ear. About 1848 Hunt, D. G. Rossetti, and J. E. Millais formed the Pre-Raphaelite Brotherhood, afterward enlarged by the admission of other painters and writers, and which attained a position of great influence through the eloquent support of Ruskin. Each of the three founders exhibited in 1849 a picture painted in strict accordance with the principles of the Brotherhood. Hunt's picture represented 'Rienzi Vowing to Obtain Justice for the Death of his Younger Brother Slain in a Skirmish between the Colonna and Orsini Factions,' and was exhibited at the Royal Academy. The exhibition of 1854 included two of his greatest pictures, one of them the well-known 'Light of the World.' Both it and 'The Awakening Conscience' are characterized by the careful draughtsmanship and attention to detail which form notable features of the best Pre-Raphaelite work, but their full meaning is far from clear to the average spectator. In 1854 Mr. Hunt went to Palestine in order to obtain a living acquaintance with the scenes of the Biblical stories, and the first fruits of his study of Eastern life was 'The Scapegoat' (1856), one of his most original and most poetical works; but much finer is his 'Finding of the Saviour in the Temple,' exhibited in 1860. Among subsequent works of Hunt's are: 'A Street Scene in Cairo—the

Lantern-Maker's Courtship' (1861): 'Portrait of D. G. Rossetti' (1850); 'Fairlight Downs' (1858): 'The After-Glow in Egypt' (1865), "that modern masterpiece of technical art"; 'Isabella, or the Pot of Basil' (1868), based on the well-known story from Boccaccio utilized by Keats, and in respect of coloring, the finest of the artist's works; 'The Shadow of Death' (1873), showing a prevision of the Crucifixion in the carpenter shop where Jesus is working beside his mother; 'The Triumph of the Innocents' (1885), one of his masterpieces; 'Christ among the Doctors' (1860). See biography by Farrar and Meynell (1893); Williamson, 'Life of Holman Hunt.'

Hunt'er, David, American soldier: b. Washington, D. C., 21 July 1802; d. there 2 Feb. 1886. He was graduated at West Point in 1822, became captain in 1833, and resigning from the army in 1836 settled in Chicago. He, however, re-entered the army in 1842 as paymaster with the rank of major, and in May 1861 was appointed brigadier-general of volunteers, and a few months later major-general. He recruited and organized in South Carolina the first negro regiment in the Union army. He defeated the Confederates at Piedmont, 5 June 1864, and was chairman of the military commission which tried the conspirators engaged in the assassination of President Lincoln. He was brevetted major-general United States army, 13 March 1865, and retired on account of age in 1886.

Hunter, John, British surgeon and physiologist: b. Long Calderwood, Lanarkshire, 13 Feb. 1728; d. London 16 Oct. 1793. He was a younger brother of William Hunter (q.v.) In 1749 and 1750 he studied surgical pathology at Chelsea Hospital, London, and already began to make original observations, which his subsequent experience confirmed. In 1751 he attended St. Bartholomew's Hospital and in 1754 entered as a surgeon pupil at St. George's Hospital. In 1754 or 1755 he was admitted to a partnership in his brother's school of anatomy, and continued to lecture there till 1759. He served as staff-surgeon in France and Portugal 1760–3, and then returned to London and commenced practice as a surgeon. In 1767 he received an unexpected proof of the high estimation in which he was held by men of science in being elected a member of the Royal Society, and in 1768 he was appointed surgeon to St. George's Hospital. His investigations at this time extended over every branch of natural history, particularly pathology, comparative anatomy, and physiology, to which he devoted his entire leisure time. In 1790 he was appointed inspector-general of hospitals and surgeon-general to the army. Hunter left at his death a museum which he had built for himself, and filled with upward of 10,000 preparations illustrative of the departments of science to which his attention had been devoted. It was afterward purchased by government, and presented to the Royal College of Surgeons. In addition to papers contributed to the 'Transactions' of learned societies, his leading works are the 'Natural History of the Human Teeth' (1771); 'Treatise on the Venereal Disease' (1786); 'Observations on Certain Parts of the Animal Economy' (1786); 'Treatise on the Blood, Inflammation, and Gun-shot Wounds' (1794).

Hunter, Robert Mercer Taliaferro, American statesman: b. Essex County, Va., 21 April 1809; d. 18 July 1887. He was graduated at the University of Virginia, and, choosing the law for his profession, commenced practice in 1830. He soon began to take an active part in politics and at 24 was elected to the house of delegates, where he remained until 1837, when he was elected to Congress. In the discussions growing out of the commercial convulsion of that year, he at once took his stand on the side of the administration in favor of the independent treasury bill, and in his first speech developed those principles of free trade to which he consistently adhered throughout his public career. In the succeeding Congress he was elected to the speakership; and at the close of his term of service, the usual vote of thanks was passed without a dissenting voice, in a House of Representatives strongly marked by partisan bitterness. At the election in the spring of 1843 for members of the 28th Congress, Hunter was defeated by a small majority, mainly on account of his adherence to that clause of the independent treasury scheme requiring all dues to the government to be paid in specie. At the next congressional election in 1845, he was successful. In 1846 Hunter, in common with other southern representatives, resisted the application of the Wilmot Proviso. He voted for all the measures necessary to prosecute the war to a just and honorable conclusion, but altogether opposed the project, favored by some, of incorporating the whole of the Mexican states into our political system. During the winter of 1846–7 he was chosen by the legislature of Virginia to the United States Senate, and took his seat in December 1847, remaining there until 1861. He was active in framing the tariff act of 1857 and after leaving the Senate became the Confederate secretary of state. At a later period he was a Confederate senator and in 1865 commissioner of peace. He became treasurer of Virginia in 1877 and retired from public life in 1880.

Hunter, William, British anatomist: b. Long Calderwood 23 May 1718; d. London 30 March 1783. After studying at Glasgow University 1732–7, and subsequently medicine at Edinburgh, he went to London in 1741, and in 1746 received the appointment of lecturer on anatomy to a society of naval surgeons. In 1747 he became a member of the College of Surgeons, and practised surgery and midwifery, but at length confined himself entirely to that branch, and was appointed accoucheur to the British Lying-in Hospital. In the first volume of 'Observations and Inquiries,' published by the Medical Society in 1757, appeared Hunter's 'History of an Aneurism of the Aorta.' In 1762 he published 'Medical Commentaries,' and in 1764 was appointed physician-extraordinary to the queen. Hunter was elected a fellow of the Royal Society in 1767; and in 1768, on the establishment of the Royal Academy of Arts, he was appointed professor of anatomy. He was made a foreign associate of the Royal Medical Society at Paris in 1780, and of the Royal Academy of Sciences in 1782. The most elaborate of his publications, the 'Anatomy of the Human Gravid Uterus,' appeared in 1774. In 1770 he purchased and completed a house and theatre, in which he constituted a splendid museum At first he only contemplated a collection of preparations in human and comparative anatomy, but added a collection of shells, corals, and other objects of natural history, paintings and ancient coins and medals. He bequeathed the whole of his splendid museum, valued at £150,000, to the University of Glasgow, with the sum of £8,000 in cash to be expended in an appropriate building for its reception, and a further sum of £500 per annum to bear the charges of its preservation.

Hunter, Sir William Wilson, English statistician and author: b. Glasgow 15 July 1840; d. 1900. He was educated at the University of Glasgow and foreign universities, and appointed to the Bengal Civil Service in 1862. As director-general of statistics he made a statistical survey of India, the results of which are embodied in the well-known 'Imperial Gazetteer of India' (1881; 1885-7). He also published 'Annals of Rural Bengal' (1868; 5th ed. 1872), continued in 'Orissa' (1872); 'The Life of the Marquess of Dalhousie'; 'A Dictionary of the Non-Aryan Languages of India and High Asia'; 'Brief History of the Indian Peoples,' which has been translated into five languages, and was editor of the series of biographies known as 'The Rulers of India.' He was knighted in 1887.

Hunting, the sport or recreation of pursuing game, is a very ancient amusement. Alexander the Great is said to have paid a large sum of money for a treatise on hunting by Aristotle. The true sportsman rarely kills game for any other purpose than eating. The hunting of large game, as bear, deer, tigers, lions, leopards, etc., will be found treated under the titles by which they are described. In Europe the various methods of shooting game are known as open shooting, covert shooting, river and pond shooting, and salt-water wild fowl shooting. Deer-stalking (q.v.) and wild-boar hunting are favorite amusements of royalty in Europe; in India boar-hunting is commonly known as "pig-sticking." See Fox Hunting; Game Laws; Game Preserves, etc. Consult Dodge, 'Hunting Grounds of the Great West' (1877); Gasper, 'The Complete Sportsman' (1893); Mills, 'The Sportsman's Library'; Long, 'American Wild-Fowl Shooting' (1874); Murphy, 'American Game Bird Shooting' (1892); Pringle, 'Twenty Years' Snipe Shooting' (1899); Ramsford, 'Hunting' (1896); Roosevelt, 'Big Game Hunting' (1899); Ward, 'Records of Big Game' (1896).

Hunting-dog. See Hyena-dog.

Hunting Leopard. See Cheeta.

Hun'tingdon, Selina Shirley, Countess of, English religious leader: b. 24 Aug. 1707; d. 17 June 1791. She was married in 1728, to the Earl of Huntingdon and on his death in 1746 became very devout, appointing the famous George Whitefield (q.v.) her private chaplain. Adopting the principles of the Methodists, she was long considered, owing to her rank and fortune, as the head of the Calvinistic Methodists, her followers being known as the "Countess of Huntingdon's Connection." She founded a College at Trevecca in Wales, for the education of ministers, built some 64 chapels, and contributed liberally to the support of the clergy.

Huntingdon, Pa., borough, county-seat of Huntingdon County; on the Juniata River, and on the Pennsylvania railroad; about 200 miles west of Philadelphia. Where Huntingdon is located was once a famous council ground for the Indians of the central part of Pennsylvania. It was first settled by white people in 1760, and was chartered in 1796. The country around is a fertile agricultural region, with valuable mineral deposits and quite extensive forests. The chief manufactures are boilers, machinery, radiators, sewer pipe, flour, furniture, stationery, knit goods, and stoves. The trade is in the manufactures, and grain and fruits. Huntingdon is the seat of the State Industrial School, and of Juniata College, an institution opened in 1876 under the auspices of the German Baptist Brethren. The original charter is still in force and provides for a chief burgess, who holds office three years, and a council. Pop. (1900) 6,053.

Huntingdon's Disease, hereditary chorea. Chorea, or St. Vitus' dance, sometimes attacks adults, most frequently pregnant women. In such cases it is hard to distinguish from locomotor ataxia. The offspring of adults thus affected are likely to have congenital or hereditary chorea.

Hun'tington, Collis Potter, American capitalist: b. Harwinton, Conn., 22 Oct. 1821; d. Pine Knot Camp, near Lake Raquette, N. Y., 13 Aug. 1900. He worked on his father's farm, until his 14th year. In his 16th year he procured credit in New York for $3,000 worth of clocks, and peddled them through the South and West. He shipped goods to California in 1848; followed them in person in 1849 and began to make his fortune in the hardware business. In 1860 he matured a plan for a transcontinental railroad in conjunction with Leland Stanford, Charles Crocker, and Mark Hopkins. The Central Pacific was finished in 1869. This was the crowning achievement of his life, and at his death the railroad system known as the Southern Pacific, of whose managing board he was president, comprised 26 corporations, with more than 9,000 miles of tracks and 5,000 miles of steamship line. He was one of the largest landholders in the country and his fortune was estimated at $35,000,000. He built a granite church, to the memory of his mother, in his native town; gave C. W. Peale's portrait of Washington to the New York Metropolitan Museum; a library and reading-room to Westchester, N. Y., materially aided in building and equipping Hampton (Va.) Normal Agricultural Institute; and gave $50,000 for the endowment of Tuskegee (Ala.) Normal and Industrial Institute.

Huntington, Daniel, American painter: b. New York 14 Oct. 1816; d. there 18 April 1906. He was educated at Hamilton College, where he made the acquaintance of Charles L. Elliott, from whom he received a decided bias for his art. In 1835 he entered the studio of Professor Morse, president of the National Academy of Design, and soon after produced the 'Bar-room Politician'; 'A Toper Asleep,' besides some landscapes and portraits. In 1839 he went to Europe and in Florence painted the 'Sibyl' and the 'Florentine Girl.' Removing to Rome soon after, he painted the 'Shepherd Boy of the Campagna,' and 'Early Christian Prisoners,' both of which were purchased by New York collectors. He became a member of the National Academy in 1840 and was its president in 1862 and 1869, and continuously from 1877 to 1899. He devoted himself mainly to portraits and among portraits by him of well known people are those of Presidents Lincoln and Van Buren, and of Sir Charles Eastlake. His noted 'Mercy's Dream' is now in the Corcoran Gallery at Washington.

Huntington, Frederic Dan, American Protestant Episcopal bishop: b. Hadley, Mass., 28 May 1819; d. Hadley, Mass., 11 July 1904. He was graduated at Amherst in 1839, and studied three years in the divinity school of Cambridge. In 1842 he was ordained pastor of the South Congregational (Unitarian) church in Boston, which he left in 1855 to become Plummer professor of Christian morals at Harvard. In 1860 he resigned and took orders in the Episcopal Church, founding Emmanuel Church, Boston, and serving as its rector 1861–9. In April 1869 he was consecrated bishop of Central New York. He has published: 'Sermons for the People' (1856); 'Christ in the Christian Year'; 'Helps to a Holy Lent' (1872); 'The Gospel and the People'; etc.

Huntington, Jedidiah Vincent, American author, brother of Daniel Huntington (q.v.): b. New York 20 Jan. 1815; d. Pau, France, 10 March 1862. He was educated as a physician, but in 1839 entered the Episcopal ministry, officiating for a short time as rector of an Episcopal church in Middlebury, Vt. In 1849 he became a Roman Catholic. His published works are: 'Poems' (1843); 'Lady Alice, or the New Una,' a novel (1849), which is the most popular of his works; 'Alban' (1850); 'The Forest,' a sequel to 'Alban' (1852); etc.

Huntington, Samuel, American jurist: one of the signers of the Declaration of Independence: b. Windham, Conn., 3 July 1732; d. Norwich, Conn., 5 Jan. 1796. He was educated to the law, and previous to 1775 held the offices of king's attorney and associate justice of the superior court of Connecticut. In January 1776 he entered the Continental Congress as a delegate from his native State. In September 1779 he succeeded John Jay as president of Congress, and discharged the functions of that office until July 1780, when he resumed his seat on the Connecticut bench. He served again in Congress from May to June, 1783, and in the succeeding year was appointed chief justice of the superior court of Connecticut. In 1785 he was elected lieutenant-governor of Connecticut, and in 1786 he succeeded Roger Griswold as governor, to which office he was annually re-elected until his death.

Huntington, William Reed, American Episcopal clergyman: b. Lowell, Mass., 20 Sept. 1838. After graduation from Harvard in 1859 he took orders in the Episcopal Church, was assistant at Emmanuel Church, Boston, 1861–2, rector of All Saints, Worcester, Mass., 1862–3, and since 1883 has been rector of Grace Church, New York. He has long been prominent in the councils of the Episcopal Church and is an acknowledged leader of the Low Broad Church school of thought.

Huntington, Ind., city, county-seat of Huntington County: on the Little River, and on the Chicago & E. and the Wabash R.R.'s; about 20 miles southwest of Fort Wayne and 70 miles southeast of South Bend. It was settled in 1834, incorporated as a town in 1834, and received its charter in 1873. The city has excellent water power. Its chief manufactures are bicycles, boots and shoes, pianos, plows, barrels, lime, and cement. It has railroad shops, and wood-working factories. The trade, in addition to the manufactures, is in coal and lime from the coal fields and lime-kilns nearby, and agricultural products. It is the seat of the United Brethren College. The public library has about 12,000 volumes. The city owns and operates the electric-light plant and the water-works. Pop. (1900) 9,491.

Huntington, N. Y., town in Suffolk County on Long Island. It is on Long Island Sound and on the Long Island Railroad. Huntington originally included the village of Babylon and other adjoining places. As first laid out, the area was 150 square miles. The first settlement was made in 1653, and the first deed of land given to actual settlers was made on 2 April 1653, on behalf of the Matinecock tribe of Indians, and conveying to the whites six square miles between Cold Spring and Northport. The consideration paid was six coats, six kettles, six hatchets, six "howes," six shirts, 10 knives, six fathoms of wampum, 30 "muxes," and 30 needles. Additional lands were purchased in 1656–8. The early settlers were nearly all Puritans from England. The inhabitants of Huntington were among the first of the colonists to protest against "taxation without representation." From the first agriculture was the chief occupation; but trade with the West Indies began at an early date. In 1675 Thomas Fleet was listed as owning 40 vessels. Whales were often caught along the south coast. Nathan Hale (q.v.) was captured in Huntington. The place of capture is marked by a boulder, a shaft, and a drinking fountain. The town celebrated its 250th anniversary on 4 July 1903. The chief manufactures are pottery, brick, and dairy products. Large market gardens are in parts of the town, but much of it is a favorite residential suburb of New York. Pop. (1900) 9,483.

Huntington, W. Va., city, the capital of Cabell County, on the Ohio River, just below the confluence of the Guyandotte River, 18 miles above Ironton, 52 miles west of Charleston and on the Chesapeake & O., the Guyandotte Valley, and the Ohio River R.R.'s. The city, named after the late Collis P. Huntington, was founded and incorporated in 1871. It is an important commercial and industrial centre, has steamship communication with all the important river ports, and among its industrial establishments are the car manufacturing shops of the Chesapeake & Ohio railroad, foundry and machine shops, lumber and planing mills, manufactures of woodwork, paints, glass, stoves, bricks, and ice, bottling and meat-packing establishments, etc. The city is regularly laid out, has electric lights and street railways, two national banks, and is noted for its educational establishments which include Marshall College (the State Normal School), the Douglas High School for colored students, and a Carnegie library. The West Virginia Asylum for Incurables is situated here. Pop. (1890) 10,108; (1900) 11,923.

Huntsville, Ala., city and county-seat of Madison County, on the Nashville, C. & St. L. and the Southern R.R.'s; 96 miles due north of Birmingham; 97 miles due west of Chattanooga; 125 miles south of Nashville, and 210 miles east of Memphis. The city is located in the heart of the famous Tennessee Valley, and is surrounded by a large and fertile agricultural, cotton, fruit, and stock-raising country, making it the most important commercial centre of this entire valley territory. In manufacturing it is fast reaching a position among the most important in the south. As a cotton manufacturing point it is to-day without a rival in all this section, and in spindles leads the South, and is second only to Lowell, Mass. Its nine cotton mills have 203,000 spindles, with 4,374 looms, the annual product of which amounts to $4,775,000. Besides these, Huntsville has machine and foundry shops, cottonseed-oil mills, hoop and heading factory, fibre factory, spoke and handle factories, saw and planing mills, brick plants, gas and electric plants, electric car lines, paid fire department, waterworks owned and operated by the city and supplied from a magnificent spring of purest water with a daily capacity of 2,400,000 gallons. The first settler here was John Hunt, a Virginian, and a soldier of the Revolution, who came to the "Big Spring" in 1805, built his cabin, the first, near by, and in 1806 went back to Tennessee and brought his family, having lived in that State before coming to Alabama. In 1811 the town was incorporated by the Territorial Legislature as "Huntsville." The first State constitutional convention sat here and framed the first constitution of the State, the convention convening 5 July 1819. The first legislature sat here and assembled on the first Monday in August 1820, and this was the first capital of Alabama. The city is well supplied with a number of private schools, and an excellent public city school with a new modern building erected at a cost of $25,000. Four miles north of the city is located the "Alabama Agricultural and Mechanical College for Negroes." The government of the city, under a new charter of 1897, is composed of a mayor and board of aldermen of eight, and it controls all of the city's affairs, including the waterworks. Pop. 16,000.

Benjamin Powel Hunt.

Hunts'ville, Mo., city, county-seat of Randolph County; on the Wabash railroad; 130 miles northwest of Saint Louis and 145 miles northeast of Kansas City. It is situated in an agricultural and coal-mining region. Its principal industrial establishments are flour mills, machinery shops, rake and stacker factory. Its trade is chiefly in agricultural and mining implements, live stock, and farm products. Pop. (1900) 1,805.

Huntsville, Texas, city, county-seat of Walker County; on the International & G. N. railroad; about 200 miles southeast of Austin and 68 miles north of Houston. The first settlement was made about 1835. It is in a fertile agricultural region in which cotton is one of the large crops. The chief manufactures are cotton goods, cottonseed oil, cigars, steam-engines, foundry-products agricultural implements, furniture, ice, corn meal, and wagons. Here are the home and grave of Sam Houston, which are of historic interest; the main State Penitentiary, and the Sam Houston State Normal School are located in this city. Huntsville has an extensive trade in cotton. Pop. (1890) 1,509; (1900) 2,484.

Hurlbut, hėrl'bŭt, **Stephen Augustus,** American soldier and politician: b. Charleston, S. C., 29 Nov. 1815; d. Lima, Peru, 27 March 1882. He was admitted to the bar in 1837 and removing to Illinois became prominent in State politics, being a member of the Illinois Legislature 1859, 1861, and 1868. At the opening of the Civil War he became a brigadier-general of volunteers, and he commanded a corps in the expedition to Meridian in 1864. He was United States minister to the United States of Colombia, 1869–73; Republican member of Congress from Illinois, 1873–7; and United States minister to Peru.

Hur'ley, Wis., town, capital of Iron County, on the Montreal River, at the State boundary, opposite Ironwood, Mich. It is 49 miles by rail east by south of Ashland, on the Chicago & N. W., the Milwaukee, L. S. & W., and the Wisconsin C. R.R.'s. It is in a rich iron mining district and has saw-mills and considerable lumbering interests. Pop. (1900) 1,823.

Huron, hū'rŏn, an Indian tribe. See Wyandot; Indians, American.

Huron, S. Dak., city, county-seat of Beadle County; on the Chicago & N. W. and the Great N. R.R.'s; about 115 miles northwest of Yankton. It is situated in an agricultural and stock-raising region, where there is a large acreage of wheat and from which many cattle are shipped annually to market. Its manufactures are flour, bricks, dairy products, carriages, and wagons; and it has the Chicago & Northwestern railroad repair-shops, and grain elevators. Pop. (1900) 2,793.

Huron, Lake, one of the Great Lakes on the boundary between the United States and Canada. Canada is on the north and east, Canada and Michigan on the south, and Michigan on the west. It receives the waters of Lake Superior through the Saint Mary's River, and the waters of Lake Michigan through Straits of Mackinac, and discharges its waters through Saint Clair River into Lake Saint Clair (q.v.). Its general direction is northwest and southeast. Its length is about 250 miles, its average width about 155 miles, and its area, 22,322 square miles. This area includes Georgian Bay and North Channel. It is 581 feet above the sea, the same as Lake Michigan, 21 feet below the level of Lake Superior. The depth of the waters beyond the land shelf is from 200 to 750 feet; and along the coast, from 20 to 60 feet. The waters of the whole lake are remarkably clear, and in the northern part cold. In summer the temperature of the surface varies from 52° to 58° and of the bottom from 42° to 52°.

The chief arm of the Lake on the east coast is Georgian Bay, which indents Ontario; and on the west, Saginaw Bay, in Michigan. Other indentations on the west coast are Thunder, Presque Isle, and Hammond bays. A number of short streams flow into the lake from Michigan, the largest of which are Thunder Bay, Au Sable, and Black rivers. The Lake receives from Canada a large amount of water from lakes Nipissing, Simcoe, Muskoka, and several other small bodies which discharge their waters through short rivers into Georgian Bay.

There are no large islands in the main body of the Lake, but on the north and northeast shores are a number of small islands, composed chiefly of glacial deposits and limestone. Grand Manitoulin and Cockburn islands, together with several small islands, belong to Canada. Drummond, Mackinac, and Bois Blanc islands belong to the United States. The long group of islands in the northeast are separated from the mainland of Ontario by North Channel. The greater part of the shore line is low and at one time the country on the west was well-wooded. Regular terraces showing different water levels, deposits of fine sand and clay containing fresh-water shells, extend inland fully 20 miles and at heights above the Lake to 100 and 200 feet. These wide beaches show that at one time this Lake, as the other Lakes, must have been much larger than at present. The area of the whole basin of the Lake, including the surface of the water, is about 74,000 square miles. Some picturesque cliffs along the southeastern coast rise to a height from 80 to 150 feet. The harbors are nearly all protected by breakwaters. The chief ports on the west coast are Cheboygan, Alpena, Tawas City, Bay City (at the head of Saginaw Bay), and Sandbeach. Mackinaw and Saint Ignace, at the entrance to the Straits of Mackinac, are important ports. A railroad line from Detroit to Mackinaw is almost parallel with the west coast. There is an abundance of fish in this Lake, one kind, the whitefish, is most important.

Violent storms, to which the Lake is subject, make navigation dangerous. During the summer months, from the first of May to December, there are but few storms. Lake Huron as a factor in commercial enterprises is most important: it is one of the great waterways of the world, and the shipping on its waters is growing in amount and importance. The great bulk of the iron ore from the Lake Superior district is now brought to the Cleveland and Pittsburg districts: the wheat and flour from the Northwest comes east, and nearly all are carried over Lake Huron; and a large proportion of the products of the east which are sent to the Northwest pass over this same Lake. The Saint Mary's Falls Canal or "The Sault Canal," has been the means of greatly increasing the travel and traffic on Lake Huron.

As early as the 17th century this Lake was crossed by the French missionary, Père Marquette, who, in 1668, established a mission at Sault Sainte Marie, Saint Mary's Falls. In 1673 he was in charge of the mission at Mackinaw, from which place, on 17 May 1673, he departed with Joliet and others in search of the "Big River." For amount of tonnage see GREAT LAKES.

Huronian Series, the name (now largely abandoned) first given by Sir William Logan to a series of strata lying in the vicinity of Lake Huron. They are about 18,000 feet thick, and consist chiefly of quartzite with great masses of greenish chloritic schist, sometimes containing pebbles derived from the Laurentian rocks. No organic remains have yet been found in them, and limestones are rare. They are believed to be of Lower Cambrian age, and lie unconformably on the Laurentians. They occupy the same relative position as the upper parts of the Archæan rocks of Great Britain.

Hurricane. See CYCLONE; STORMS; TORNADO; TYPHOONS.

Hurst, hėrst, **Hal**, English artist: b. London 25 Aug. 1865. He started on his artistic career by drawing eviction scenes in Ireland. He emigrated to the United States, and joined the staff of the Philadelphia *Press;* afterward at New York, Paris, and London he contributed to various journals and periodicals. He became a painter, studying at the Art League in New York and under Julian at Paris. Among his paintings are 'The Siren' (1896); 'The Capture' (1898); and 'The First Court of Henry VII.'

Hurst, John Fletcher, American Methodist bishop: b. near Salem, Md., 17 Aug. 1834; d. Washington, D. C., 4 May 1903. He was graduated from Dickinson College, Carlisle, Pa., in 1854, studied theology in Halle and Heidelberg, Germany, and after holding pastorates in New Jersey and Staten Island became bishop in 1880, and chancellor of the American University in 1891. He was one of the leading men in his denomination and of much prominence as a writer. Among his many works may be cited: 'Literature of Theology'; 'History of Rationalism' (1865); 'Martyr to the Tract Cause' (1873); 'Life and Literature in the Fatherland' (1874); 'Outline of Church History' (1875); 'Our Theological Century' (1876); 'Bibliotheca Theologica' (1883); 'Short Histories of the Church' (1888–90); 'Short History of the Christian Church'; 'Indika: the Country and People of India and Ceylon' (1891); 'History of the Christian Church' (1897); translations of theological works and histories; etc.

Husband and Wife. See LAW OF HUSBAND AND WIFE.

Husbandry, Patrons of. See GRANGERS.

Huskisson, hŭs'kĭ-sŏn, **William**, English statesman and financier: b. Birch-Moreton, Worcestershire, 11 March 1770; d. 15 Sept. 1830. He was sent to Paris in 1783 to study medicine. In 1789 he became an enthusiastic sympathizer with the French Revolution, was present at the taking of the Bastille, and joined the Club of 1789, instituted the following year. He made a speech at the club against the proposed creation of paper money, and withdrew from it when the assembly decreed the issue of assignats. His views of the Revolution afterward underwent a change. In 1790 he was appointed secretary to the British ambassador; and when the ambassador was recalled in 1792 he returned to England, and in 1795 he became under-secretary for war and the colonies. In 1796 he was elected member of Parliament for Morpeth. He resigned in 1801, and returned in 1804. In Pitt's administration formed in this year he became secretary of the treasury, and during the Whig ministry that succeeded Pitt's death was an active member of the opposition. In 1807 he resumed his post as secretary of the treasury, which he resigned in 1809. In 1823 he was elected M.P. for Liverpool, and appointed president of the board of trade, and treasurer of the navy. In 1827 he became secretary of state for the colonies. He was killed at the opening of the Liverpool and Manchester railway 15 Sept. 1830. He seldom spoke in Parliament except on commercial or financial subjects, on which he was an authority. He also anticipated Peel in his advocacy of a free-trade policy. A collective edition of his speeches appeared in 1831.

Huss, Henry Holden, American composer: b. Newark, N. J., 21 June 1861. In 1882 he entered the Munich Conservatory, Germany, and studied music, in theory and practice, under Rheinberger, Giehrl, and Abel. In 1885 he settled in New York, where he has had a successful career as composer, performer, and teacher. He has composed 'Cleopatra's Death,' a scene for soprano and orchestra, as well as songs, anthems, and charming chamber music.

Huss, or Hus, John, Bohemian religious heresiarch: b. Husinec, Southern Bohemia, about 1369; d. Constance, Switzerland, 6 July 1415. He studied at the University of Prague and in 1398 began to lecture on theology and philosophy. In 1401 he was made dean of the faculty of philosophy, and was made rector of the university (1400). Since 391 he had been acquainted with the writings of Wickliffe, and his denunciations of the indulgences, of masses for the dead, of auricular confession, etc., alarmed Archbishop Stynko of Prague, who had 200 volumes of Wickliffe's writings burned (1410) in the archiepiscopal palace, and the preaching of his doctrines in Bohemia prohibited. Huss appealed to the Pope John XXIII., who summoned him to appear at Bologna. Huss refused to appear and was in consequence excommunicated, and Prague threatened with an interdict as long as Huss should remain in it. Wenceslaus, the king, alarmed by this menace, thought to bring about peace; and at his demand, Huss made an orthodox profession of faith in 1411. But the quarrel broke out again when Huss and his friend Jerome publicly condemned the papal indulgences granted for the crusade against Ladislaus of Naples. Huss was again excommunicated and Prague interdicted. He now retired to Husinec to the protection of his feudal lord and here he wrote his books 'On the Six Errors' and 'On the Church,' in which he attacks transubstantiation, the belief in the papal primacy and the saints, the efficacy of the absolution of a vicious priest, unconditional obedience to earthly rulers, and makes the Scriptures the only rule of matters of religion. In the meantime the Council of Constance had convened in 1413. Huss was summoned to this council to render an account of his doctrines. The emperor Sigismund granted him a safe conduct to the council. After several examinations of his doctrines, and his persistent refusal to retract the points which were regarded as heretical, he was sentenced to death and burned 6 July 1415.

Husted, James William, American politician: b. 1833; d. Peekskill, N. Y., 25 Sept. 1892. He was graduated at Yale in 1854, studied law, and in 1869 was elected to the New York Assembly. He was re-elected 15 times, and was chosen speaker in 1874, 1876, 1878, 1886, and 1887. He also served in such varied capacities as superintendent of public schools, deputy superintendent of insurance, harbor master, deputy captain of the port of New York, judge-advocate of the Seventh brigade, and major-general of the Fifth Division, National Guard.

Hutcheson, hŭch'ĕ-sŏn, **Francis,** Irish philosopher: b. Drumalig, Ireland, 8 Aug. 1694; d. Dublin 8 Aug. 1746. He was educated at the University of Glasgow, taught in Dublin 1717–29, and in 1729 became professor of philosophy at Glasgow. In 1725 the first edition of his celebrated 'Inquiry into the Ideas of Beauty and Virtue' appeared without his name. In 1728 he published his 'Treatise on the Passions,' often reprinted, and admired even by those who dispute the soundness of its philosophy. In 1775 was published from his MSS. a 'System of Moral Philosophy.' The philosophy of Hutcheson is based primarily on that of Locke. His particular theory of conscience as a distinct sense was attacked by Richard Price in a celebrated work, 'Principal Questions and Difficulties in Morals.' The views of Hutcheson and Price are reviewed in Jouffroy's 'Cours de Droit Naturel.' Hutcheson was a writer of considerable originality, and justly regarded as the precursor of Reid, and the founder of the Scottish school in philosophy. An admirable résumé of his works is contained in Cousin's 'Philosophie Ecossaise.'

Hutch'ins, Thomas, American geographer: b. Monmouth, N. J., 1730; d. Pittsburg, Pa., 28 April 1789. In early life he enlisted in the English army, and saw active service in the French and Indian war. He was in England in 1779, and was arrested in London, and thrown into prison as an advocate of American independence. He escaped to France, from which country he sailed to America, and joined the Continental army and was appointed geographer-general by Gen. Greene. Among his published works are: 'Topographical Description of Virginia, Pennsylvania, Maryland, and North Carolina' (1778); 'History, Narrative and Topographical Description of Louisiana and Western Florida' (1784).

Hutch'inson, Anne, American religious leader, the founder of the Antinomian party in the New England colonies: b. Lincolnshire, England, about 1590; d. Westchester County, N. Y., August 1643. She was the daughter of a Lincolnshire clergyman. In England she was interested in the preaching of John Cotton and her brother-in-law John Wheelwright, and it was her desire to enjoy the ministry of the former which induced her to follow him to New England. She arrived in Boston with her husband, 18 Sept. 1634, was admitted a member of the Boston church 2 November, and rapidly acquired esteem and influence. She instituted meetings of the women of the church to discuss sermons and doctrines, in which, with a ready wit, bold spirit, and imposing familiarity with the Scripture, she gave prominence to peculiar speculations which even on her voyage had attracted the attention and caused the displeasure of her fellow passengers. Such were the tenets that the person of the Holy Spirit dwells in every believer, and that the inward revelations of the Spirit, the conscious judgments of the mind, are of paramount authority. She had been two years in the country before the strife between her supporters and her opponents broke out into public action. Among her partisans were the young governor Vane, Cotton, Wheelwright, and the whole Boston church with the exception of five members, one of whom was the associate pastor, Wilson, while the country clergy and churches were generally united against her. "The dispute," says Bancroft, "infused its spirit into everything; it interfered with the levy of troops for the Pequot war; it influenced the respect shown to the magistrates, the distribution of town lots, the assessment of rates; and at last the continued existence of the two opposing parties was considered inconsistent with the public peace." The peculiar tenets of Mrs. Hutchinson were among the 82 opinions condemned as erroneous by the ecclesiastical synod at Newtown 30 Aug. 1637; and in November she was summoned before the general court, and after a trial of two days sentenced, with some of her associates, to banishment from the territory of Massachusetts, but was allowed to remain during the winter at a private house in Roxbury. She joined the larger number of her friends, who, led by John Clarke and William Coddington, had been welcomed by Roger Williams to his vicinity, and had obtained through his influence from the chief of the Narragansetts the island of Aquidneck, subsequently called Rhode Island. There a body politic was formed on democratic principles, in which no one was to be "accounted a delinquent for doctrine." The church in Boston, from which she had been excommunicated, vainly sent a deputation of "four men of a lovely and winning spirit" to the island with the hope of reclaiming her. After the death of her husband in 1642 she removed with her surviving family into the territory of the Dutch, probably from apprehensions that Rhode Island might not be a safe place of refuge from the encroachments of Massachusetts. The precise locality where she settled has been a matter of dispute, but according to the latest authorities it was near Hell Gate, Westchester County, N. Y. The Indians and the Dutch were then at war, and in an invasion of the settlement by the former her house was attacked and set on fire, and herself and all her family, excepting one child who was carried captive, perished either by the flames or by the weapons of the savages.

Hutchinson, Horatio Gordon, English golfer: b. 16 May 1869. He was educated at Charterhouse School, London, and graduated with classical honors in the University of Oxford. He was golf champion in England 1886–7. He has published 'Hints on Golf'; 'Golf' (in Badminton Library); 'Creatures of Circumstance'; 'Peter Steele the Cricketer'; 'My Wife's Politics'; 'Cricketing Laws and Stories'; 'The Book of Golf and Golfers' (1899); 'Little Lady Mary' (1900); 'Dreams and Their Meanings'; 'A Friend of Nelson' (1902).

Hutchinson, John, Puritan English soldier: b. Nottinghamshire 1617; d. Sandown castle, Kent, 11 Sept. 1664. Being of a religious turn of mind, he devoted much time to the study of divinity, from which his attention was soon diverted by the serious political questions which agitated the kingdom. A careful investigation of the matters at issue between the king and the parliament satisfied him of the justice of the latter's cause, and after the commencement of the civil war he declared for the parliament and was appointed governor of Nottingham castle, which he held until the close of the war. He afterward represented Nottingham in parliament, and, as a member of the high court of judiciary appointed for the trial of the king concurred in the sentence pronounced on him. The subsequent course of Cromwell, however, met with the disapproval of Hutchinson. At the restoration he was comprehended in the general act of amnesty, but was subsequently arrested on a suspicion of treasonable conspiracy, and after a detention of ten months in the Tower was removed to Sandown castle, where he died of fever.

Hutchinson, John, English philosopher; founder of a mystical school of philosophy and theology: b. Spennithorne, Yorkshire, 1674; d. 28 Aug. 1737. In 1724 appeared the first part of his 'Moses' Principia,' in which he disputed the Newtonian theory of gravitation. In the second part (1727) he continued his criticisms of Newton, and maintained on Biblical authority the doctrine of a *plenum* in opposition to that of a *vacuum*. From this time one or more of his uncouthly written volumes, containing a sort of cabalistic interpretation of the Hebrew Scriptures, appeared annually. His leading idea is that the Scriptures contain the elements of all rational philosophy as well as of general religion. The Hebrew language has not only its literal but its typical sense, every root of it being significant of hidden meanings. With this elastic principle of exegesis he deduces a system from which the occult powers of attraction, gravitation, magnetism, and electricity are excluded, but according to which the whole mechanism of the heavens is the result of the agency of fire, light, and spirit, the three material elements which were set to work in the beginning, and which typify the three persons of the Trinity.

Hutchinson, Thomas, American colonial governor: b. Boston 9 Sept. 1711; d. Brompton, near London, 3 June 1780 He was the son of a merchant of Boston who was long a member of the council, and graduated at Harvard College in 1727. He represented Boston for 10 years in the general court, of which he was for three years speaker; became judge of probate in 1752, was a councillor from 1749 to 1766, lieutenant-governor from 1758 to 1771, and appointed chief justice in 1760, thus holding four high offices at one time. In the disputes which led to the Revolution he sided with the British government. His brother-in-law, Andrew Oliver, was appointed distributor of stamps under the law which was to go into effect 1 Nov, 1765, but was compelled by mobs to resign the office before that time. The mansion of Hutchinson was also twice attacked in consequence of a report that he had written letters in favor of the act, and on the second occasion (Aug. 26), when the rioters were maddened by liquor, his house was sacked, the furniture burned in bonfires in the street, and many manuscripts relating to the history of the province, which he had been 30 years in collecting and which could not be replaced, were lost. The inhabitants of the town on the following day in public meeting voted their abhorrence of the proceedings; but though many of the actors were well-known, no one was punished. He, however, received compensation for his losses. When in 1769 Gov. Bernard was transferred to Virginia, the government of Massachusetts fell to Hutchinson. The popular excitement had already been increased by the arrival of the British troops, and after the so-called Boston massacre a committee of citizens, headed by Samuel Adams, obliged him to consent to the removal of the regiments. The popular indignation against Hutchinson became so great that he at last obtained leave of absence and sailed for England 1 June 1773. The privy council investigated his official acts, and decided in favor of "his honor, integrity, and conduct," which decision was approved by the king. He was rewarded with a pension. He published 'History of the Colony of Massachusetts Bay, from the First Settlement Thereof, in 1628, until the Year 1750' (2 vols., 1760–7, vol. 3, 1828); 'Brief State of the Claim of the Colonies' (1764); 'Collection of Original Papers Relative to the History of the Colony of Massachusetts Bay' (1869). His diary and letters appeared (1804–6). The sober judgment of later times has reversed the prejudiced accusations of his American contemporaries and he is now seen to have been a conscientious man, zealous in the performance of duty but sorely perplexed between the claims of loyalty to the king and his natural inclinations in favor of the colony. See Hosmer, 'Life of Thomas Hutchinson' (1896); Fiske, 'Historical Essays, Vol. I.' (1902).

Hutchinson, Kan., city and county-seat of Reno County; on the Arkansas river, and on the Atchison, T. & S. F., the Chicago, R. I. & P., the Hutchinson & S. and the Missouri P. R.Rs.; 40 miles west of Wichita. The city has one of the largest salt interests in the world, producing about 6,000 barrels per day. It is also an important meat packing and shipping centre; and has manufactures of lumber, machinery, boilers, etc., and the railroad shops of the Hutchinson & Southern railroad. It has a public library, high school, state reformatory, electric lights, a national bank, and an assessed property valuation of $1,500.000. Pop. (1900) 9.376.

Hutch'ison, John, English sculptor: b. Edinburgh, Scotland, 1832. He served his apprenticeship in his native town at the trade of wood carving. Meanwhile he attended an art school, visited Rome and chose as his profession that of a sculptor. He exhibited in the London Royal Academy for the first time in 1862. He is best known for his statues of Robert Bruce and John Knox, and his busts of Norman McLeod, Queen Victoria, and the Prince Consort, as well as for the four figures he contributed to Scott's monument at Edinburgh (Baron Bradwardine, Hal-o'-the-Wynd, the Glee Maiden, Flora MacIver. Among his imaginative works are 'Greek Torch Racer'; 'Roman Dancing Girl.'

Hut'son, Charles Woodward, American educator: b. McPhersonville, S. C., 23 Sept. 1840. He was graduated from South Carolina College in 1860; served in the Confederate army, 1861–5; was professor of Greek in Louisiana State University, 1869–81; of modern languages in the University of Mississippi, 1881–9, and of English and history in the Texas Agricultural and Mechanical College from 1893. He has published 'Out of a Besieged City' (1887); 'The Beginning of Civilization' (1888); 'French Literature' (1889); 'The Story of Language' (1897).

Hutten, hoot'tĕn, **Philip von,** German adventurer; cousin of Ulrich von Hutten (q.v.): b. Birkenfeld about 1490; d. Venezuela 1546. In 1528 the Emperor Charles V. made a grant of the province of Venezuela to the Welsers, a firm of Augsburg merchants; and Hutten sailed with one of the companies sent out by them. He accompanied the viceroy, Georg Hohemut, in a journey (1536–8), in which they reached the headwaters of the Rio Japura, near the equator. In 1541 he set out in search of the Golden City. After several years of wandering, harassed by the natives and weakened by hunger and fever, he and his followers came on a large city, the capital of the Omaguas, in the country north of the Amazons; where they were routed by the Indians, and Hutten himself severely wounded. He led those of his followers who survived back to Coro in 1546, where Juan de Caravajal had in the meantime usurped the office of viceroy; and by him Hutten and his lieutenant, Bartel Welser, were seized and beheaded. Eight years later the Welsers' grant was taken from them, and the German rule in Venezuela was concluded. Hutten left an account of his journeyings which was published under the title 'Zeitung aus Indien' (1765). See Von Langegg, 'El Dorado' (1888).

Hutten, Ulrich von, ool'rĭн fōn, German knight, distinguished for his poems and satires, and for the influence which his writings exercised upon the Reformation: b. Steckelberg on the Main 21 April 1488; d. Ufnau, an island in the Lake of Zürich, 23 Aug. 1523. His father placed him at Fulda, in order to educate him for a monk. The monastic school there was one of the most famous in all Germany, and he received an excellent education. Here he lost his faith and the declared enemy of Christianity fled to Erfurt in 1504, where he became intimately acquainted with several scholars and poets. In 1511 he went to Wittenberg, where he published a work on versification. Ulrich, duke of Würtemberg, having murdered a cousin of Hutten, Hutten gave free course to his indignation in poems, letters, and addresses, which made him known throughout Germany. He distinguished himself no less in the Reuchlinian controversy with the Dominican Hogstraaten in Cologne.

Hutten severely criticized the monastic life, and was so much the enemy of the clergy, that by his edition of Laurentius Valla, 'De falso credita et ementita Donatione Constantini,' he declared war upon the Church and prepared the way for Luther. In 1518 he entered the service of Albert, archbishop of Mayence, and made several official journeys to Paris. He also accompanied the archbishop to the diet at Augsburg, where Luther held his well-known discussion with Cajetan, and Hutten, in a Demosthenic oration, urged the German princes to a war against the Turks. He took the field with the Swabian League in 1519, against his hereditary enemy, Ulrich of Würtemberg, and then retired to the solitude of his paternal castle of Steckelberg, to engage anew in the controversy with the monks. Here he published work after work, violently assailing the Church, the clergy and the state. Leaving Steckelberg in 1822 he went first to Basel and thence to Zürich, where he died. He was a savage and violent controversialist during his life and was unsparing in the vehemence of his invective.

Hutton, hŭt'n, **Charles**, English mathematician: b. Newcastle-upon-Tyne 14 Aug. 1737; d. 27 Jan. 1823. The destruction of the old bridge at Newcastle having attracted his attention to the subject of the construction and properties of arches, he was led to the production of a small work on the 'Principles of Bridges' (1772), which laid the foundation of his future fame. He was in 1773 appointed professor of mathematics at Woolwich Academy, elected a fellow of the Royal Society in 1774, and in 1785 published his 'Mathematical Tables,' preceded by an introduction, tracing the progress and improvement of logarithms from the date of their discovery. Later works were: 'Tracts, Mathematical and Philosophical' (1786); 'Elements of Conic Sections'; 'Mathematical and Philosophical Dictionary' (1795–6); 'Course of Mathematics' (1798–1811).

Hutton, Frederick Remsen, American mechanical engineer: b. New York 28 May 1853. He was graduated from Columbia in 1853 and is professor of mechanical engineering there. He has published: 'Mechanical Engineering of Power Plants' (1897); 'Heat and Heat Engines' (1899); 'Machine Tools.'

Hutton, James, Scottish geologist: b. Edinburgh 3 June 1726; d. there 26 March 1797. He studied medicine at Paris and Leyden, but on his return (1754) devoted himself to agricultural pursuits and to chemistry, from which he was led to mineralogy and geology. In 1768 he removed to Edinburgh, and there spent his time in scientific investigations. He published 'A Theory of the Earth' (1795) and 'A Theory of Rain' (1784); 'Dissertations in Natural Philosophy' (1792); 'Considerations on the Nature of Coal and Culm' (1777); and other works. See HUTTONIAN THEORY.

Hutton, Laurence, American editor and critic: b. New York 8 Aug. 1843; d. Princeton, N. J., 10 June 1904. He was privately educated, for some time devoted himself to the study of literature and to foreign travel, in the early 70's became a dramatic critic, and began contributions to periodicals of many sorts. From 1886 to 1898 he was literary editor of 'Harper's Magazine,' and subsequently he became lecturer in English literature at Princeton University. He was a well-known collector, possessing among various things a famous series of death-masks of historical personages. He was also an organizer and founder of the Authors' Club, and of the American Copyright League. Among his numerous writings were: 'Plays and Players' (1875); 'Literary Landmarks' (1885–1903), etc.

Hutton, Richard Holt, English essayist and journalist: b. Leeds 2 June 1826; d. Twickenham 7 Sept. 1897. The son of a Unitarian clergyman, he was educated at University College, London, and in Germany, for the Unitarian ministry, but, coming under the influence of F. D. Maurice, he entered the English Church. In 1861 he became editor of the 'Spectator,' which owed its prominence largely to him. Hutton's best work is in the critical 'Essays, Theological and Literary' (1871), and 'Essays on Some Modern Guides of English Thought' (1887), and in the biography of Sir Walter Scott in the 'English Men of Letters' (1878).

Hutton, William Holden, English Anglican clergyman and historian: b. Gate Burton, Lincolnshire, 24 May 1860. He was educated at Oxford where he was select preacher 1898–1900 and Bampton lecturer for 1903. He has published 'The Misrule of Henry III.'; 'Simon De Montfort'; 'St. Thomas of Canterbury'; 'William Laud'; 'Sir Thomas More'; 'Short History of the Church in Great Britain'; 'Constantinople'; etc.

Huttonian Theory, a view of geological processes first published by James Hutton (q.v.) in 1788, in his 'Theory of the Earth,' and developed in 1795. He was the first to distinguish between cosmogony and geology, believing the latter to be in no way concerned with "questions as to the origin of things." His view was that the upraised land of the globe must be worn away by atmospheric influences and the débris be finally deposited in the bed in the sea, where it is consolidated under great pressure; it is then forced upward by subterranean heat, acting with an expansive power, and thereby split and cracked, the fissures at the same time filling with molten mineral matter; and so the process goes on. Hutton was the precursor of Sir Charles Lyell, whose views were essentially the same, and who procured for them large acceptance among geologists. See UNIFORMITARIANISM.

Huxley, hŭks'lĭ, **Thomas Henry**, English biologist: b. Ealing, Middlesex, England, 4 May 1825; d. Eastbourne, Sussex, 29 June 1895. When he was 12 or 13, he wished to become a mechanical engineer; but a medical brother-in-law (Dr. Salt) took him in hand, and he commenced at this early age the study of medicine. Eventually he went to Charing Cross Hospital, and passed the first M. B. examination of the University of London. Stern necessity compelled him, as soon as his medical course was over, to seek at once, even before he was of age, some post or employment. At the suggestion of a fellow student, Huxley in 1846 applied for admission to the medical service of the navy, was admitted, and was in attendance at the naval hospital at Haslar. The next year he was appointed assistant-surgeon of the Rattlesnake, which was sent on an exploring and surveying cruise in the seas on the east and northeast of Australia. The voyage lasted four years, and gave Huxley an opportunity of gaining an almost unrivaled knowledge of marine zoology. Various papers on this subject were contributed by him to the Linnæan and the Royal Society (one of them gaining a medal from the latter body, of which he was elected a member in 1851), and a further result of his investigations was the important work published in 1859, entitled 'The Oceanic Hydrozoa.'

The Rattlesnake returned to England at the end of the year 1850 and Huxley found that the scientific papers he had sent home had already made him famous. By the aid of those who valued the promise given by his published work, he was allowed by the admiralty for

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three years to draw pay as a navy surgeon whilst devoting himself to the working up of the results of his observations when at sea. In 1854 he was appointed lecturer or professor of natural history in the Royal School of Mines, a post long combined with that of naturalist to the geological survey. In 1855 he was appointed Fullerian professor of physiology to the Royal Institution, and delivered four courses of lectures in as many years; while he was also an examiner for seven years to the University of London. The posts of Croonian lecturer to the Royal Society and Hunterian professor in the College of Surgeons were likewise filled by him.

There is no doubt that Huxley was fortunate to obtain at 27 a post, worth nearly a thousand a year, in London, and unburdened with any excessive duties. He had to give during winter (October to end of February) a course of lectures on five days of the week, and attend in his study at the Museum in Jermyn Street, but had not the cares of a laboratory. He carried out his researches alone, and consequently was able to arrange the employment of his day in his own way. He wrote largely for the press upon such topics as belonged to his branch of science; lectured frequently in other places besides Jermyn Street; and took an active and important part in various government commissions, to which his official position rendered it proper that he should be appointed. His lectures to workingmen, in 1860, on the 'Relation of Man to the Lower Animals,' gave rise to much discussion, and led him to treat the subject in his 'Evidence as to Man's Place in Nature' (1863). By this time the Darwinian theory had given rise to much excited controversy, and Huxley's thorough-going Darwinism brought many a bitter attack upon him. In 1862 he was appointed by government to assist in inquiring into the effects of the acts regarding trawling for herring; and his labors and advice had much influence in determining the course of fishery legislation and administration. In 1870 his name became more prominent than ever on the publication of his collection of papers entitled 'Lay Sermons, Essays, and Reviews,' which met with fierce denunciation in many quarters. In this year he presided over the Liverpool meeting of the British Association, and was also elected a member of the first London School Board. In 1872 he was elected Lord Rector of Aberdeen University; in 1875–6 lectured on natural history in Edinburgh University.

In 1883 Huxley received the crowning honor of his life, being elected president of the Royal Society. But ill health soon compelled him to give up his official work. In 1885 he retired from his professorship, from his fishery post, and from the presidency of the Royal Society, and confined himself to such work as he could perform in his study at Eastbourne (where in 1890 he built himself a house), or in the Engadine, where he usually spent the summer.

He produced between 1885 and his death in 1895 a large series of brilliant and interesting essays, especially on the relation of science to Hebrew and Christian tradition, and on the evolution of theology and of ethics. During this period he was president of the Marine Biological Association, in the founding of which he took an active part, and in 1892 was made a member of the Privy Council.

In 1888 Huxley received the Copley medal of the Royal Society, and in 1894 the Darwin medal. Huxley was one of the first scientists of his time; his chief and most valuable work was in the direction of the popularization of science, particularly of the Darwinian theory; he was active also in lines of social and political reform, and in the development and organization of scientific education. His works include 'Oceanic Hydrozoa' (1859); 'Evidence as to Man's Place in Nature' (1863); 'Elementary Physiology' (1866); 'Anatomy of Vertebrated Animals' (1871); 'Elementary Biology' (with Dr. H. N. Martin); 'Anatomy of Invertebrated Animals' (1877); 'Physiography' (1877); 'Hume' (1878); 'The Crayfish' (1880); and numerous essays and addresses on scientific and sociological subjects. Consult: the 'Life,' by Mitchell; 'Life and Letters,' by L. Huxley; and Clodd, 'Thomas Henry Huxley.'

Huygens, hoi'gĕns or hī'gĕnz, **Christian**, Dutch mathematician and physicist: b. The Hague 1629; d. there 8 June 1695. He studied at Leyden, and at Breda, where he went through a course of civil law from 1646–8. Among his most important contributions to science are his investigations on the oscillations of the pendulum, and his 'System of Saturn,' in which he first proved that the ring completely surrounds the planet, and determined the inclination of its plane to that of the ecliptic. In 1690 he published important treatises on light and on weight. His 'Traité de la Lumière' was founded on the undulation theory, but in consequence of the prevalence of the Newtonian theory was long neglected till later researches established its credit.

Huygens' Principle. See Light.

Huysmans, hīs-măns, **Jorris Karl**, French novelist: b. Paris 5 Feb. 1848; d. 12 May 1907. He studied law and entered the French civil service, but abandoned it for literature. At first a pronounced realist, he turned to idealism and even mysticism. His first work was 'Pack on Back'; then followed 'Martha' (1876); 'The Vatard Sisters' (1879); 'The Ménage' (1881); 'Down There' (Lá-bas) (1889).

Hwang or **Hoang-ho**, hwăng'hō, or **Yellow River**, China, a large river which rises in the mountains of north Tibet, in the Koko-Nor territory, about lat. 34° 30′ N., and lon. 97° 30′ E. It derives its name from the vast quantities of yellow mud continually carried down by its waters. After a winding course, north, east, and south, of about 2,600 miles, it flows since 1853 into the Gulf of Pe-chi-li, prior to that year its outlet being in the Yellow Sea. It is a turbulent, turbid, and impracticable stream, but little used for navigation and subject to disastrous floods, to prevent which and the former frequent changes in its bed and outlet, great expense is incurred maintaining artificial embankments.

Hy'acinth (1) A genus (*Hyacinthus*) of lilies with corolla-like, bell-shaped, six-cleft perianth, six stamens fixed in the tube of the perianth, and dry capsular fruit. The Oriental hyacinth (*H. orientalis*), one of the chief favorites of florists' flowers, is a native of Asia Minor, Syria, and Persia. It is now naturalized in some parts of the south of Europe. It has broad linear leaves, and a scape with a raceme of many flowers pointing in all directions. The flowers in cultivation exhibit great variety of color, chiefly blue, purple, and white. They are very beautiful and very fragrant. The fragrance is strongest about or after 11 o'clock at night. Among cultivated hyacinths are many with double flowers. The hyacinth has been cultivated from a remote period. It was introduced into Europe, probably by the Dutch, about the beginning of the 16th century. The grape-hyacinth is a somewhat different plant of the genus *Muscari*, of which *M. racemosum* is common in gardens. (2) See ZIRCON.

Hyacinthe, Père, pār ē-ā-sānt. See LOYSON, CHARLES.

Hyænodon, hī-en'ō-dŏn, a genus of primitive carnivorous mammals (creodonts), fossil in the upper Eocene and lower Miocene rocks of Europe and the western United States, of which several species are known by well preserved skeletons. The skull was relatively very large and long, with great canines and strong hyena-like molars, but the brain-cavity was very small. The feet were fully five-toed, had powerful claws, and the animal, which must have somewhat resembled a small, cat-like bear, was partly plantigrade. The remains of *H. cruentus* are numerous in the White River beds of North Dakota.

Hyams, Henry Michael, American lawyer and politician: b. Charleston, S. C., 1805; d. 1875. In 1828 he went to New Orleans, studied law, and after 15 years of country practice in Alexandria, La., resumed his residence in New Orleans, where his investments in landed property made him wealthy. In politics he was originally an old line Whig, but on the outbreak of Know-Nothingism joined the Democratic party. In 1855 he was elected to the State Senate; in 1859 he was chosen lieutenant-governor; the first Israelite to hold such an honor in the United States. He was devoted to the Southern cause, sent his sons to fight in the Confederate army, and after the war found his large fortune vanished. Prepared to begin life anew, he resumed the practice of law until his death.

Hyatt, Alpheus, American naturalist: b. Washington 5 April 1838; d. Cambridge, Mass., 15 Jan. 1902. He was graduated from the Lawrence Scientific School at Harvard in 1862, then entered the army and served during the war in the 47th Massachusetts regiment, being promoted to the rank of captain. After leaving the army, he resumed his studies under the instruction of Agassiz, and later studied abroad. In 1867 he went to Salem, where he was one of the founders of the Peabody Academy of Sciences and one of the curators of the Essex Institute. In 1870 he was made custodian of the collections of the Boston Society of Natural History, becoming curator in 1881. He was also connected with Boston University, was manager of the Teacher's School of Science, had charge of a laboratory of natural history founded by the Women's Educational Society at Annisquam, and was for several years professor of zoology and palæontology at the Massachusetts Institute of Technology. In his later life he had charge of invertebrate fossils in the Museum of Comparative Zoology at Cambridge. He was a member of the American Academy of Arts and Sciences, of the National Academy of Sciences, and of the American Society of Naturalists. He was one of the founders of the last mentioned society and its first president (1883); he was also one of the founders and editors of the 'American Naturalist.' His most distinctive work was the investigation of the development of the fossil *Cephalopoda* and of the fossil and semi-fossil *Planorbis* on Steinheim Lake, Germany, from which investigations he deduced laws of growth very important to the evolutionary theory. His works include 'Observations on Polyzoa' (1866); 'Fossil Cephalopods of the Museum of Comparative Zoology' (1872); 'Revision of North American Poriferæ' (1875–7), the only work on North American commercial sponges; 'Genesis of Tertiary Species of Planorbis at Steinheim' (1880); 'Genera of Fossil Cephalopoda' (1883); 'Larval Theory of the Origin of Cellular Tissue' (1884); 'Genesis of the Aretidæ' (1889); 'Bioplastology and the Related Branches of Biologic Research' (1893); 'Phylogeny of an Acquired Characteristic' (1894); 'Cephalopoda' (1900).

Hy'att, John Wesley, American inventor: b. Starkey, N. Y., 28 Nov. 1837. After an education in the common schools he became a printer and then an inventor. He perfected a composition billiard ball (1865), secured a "bonsilene" compound (1878), a water-purifying system, and a method of dissolving pyroxylin. He has secured about 200 patents for his inventions.

Hybridity, the crossing of two individuals of distinct species. The result of the intercrossing of species is a hybrid, for example, the mule, which is the result of breeding the horse with the ass. As the mule is invariably sterile, the infertility has always been supposed to be a test of species. But this is not an invariable rule, as not a few so-called "good" species have been crossed with one another. It may be set down as a general proposition that the difficulty of crossing increases the more distant the systematic relationship of the species experimented with. Also these difficulties are, says Hertwig, by no means directly proportional to the systematic divergence of the species.

Nature tends to keep species separate, in the higher animals, as well as among insects, etc.; mating is usually prevented by the structure of the parts concerned with sexual union; also the principle of preferential mating comes into play among mammals as well as insects, as often between males and females, even of closely allied species, or varieties. When there is no structural differences there may exist an aversion which prevents any union of the sexes.

Artificial Hybridization.— Many experiments have recently been made on the lower marine animals in which the eggs are fertilized in the sea without sexual union, by placing the eggs of starfish and sea-urchins, etc., in a watch-glass and adding the sperm of the males, thus securing artificial fertilization. In this way hybrids have been obtained from species belonging to quite different genera, while it has been found that in some cases closely related species will not cross. For example, among the sea-urchins the spermatozoa of *Strongylocentrotus lividus* readily fertilize the eggs of a species of Echinus, but only rarely those of the more closely allied *Sphærechinus granularis.* Hybrids have been obtained from different genera of fishes, as those between the salmon and brown trout. It appears that salmon eggs have been fertilized by trout sperm, but not trout eggs by salmon sperm. According to Hertwig eggs have been fertilized by sperm belonging to species of different families, orders, and possibly classes. For example, the eggs of a flounder (*Pleuronectes platessa*) and of *Labrus rupestris* have been fertilized by the sperm of the cod; frog's eggs (*Rana arvalis*) by sperm of a triton, and even, it is said, the eggs of a starfish by milt from a sea-urchin; in such cases, however, the hybrids die during or at the close of segmentation of the yolk.

Fertility of Hybrids.— While the mule and many other hybrids are sterile, there are some known exceptions. Hybrids of hares and rabbits have continued fruitful for generations, and also hybrids obtained from the wild buck and she-goat, from the Chinese goose (*Anser cygnoides*) and the common goose (*A. domesticus*); from *Salmo salvelinus* and *S. fontinalis; Cyprinus carpio* and *Carassius vulgaris,* as well as between the two silkworm moths, *Philosamia cynthia* and *P. ricini,* the Arrhindy worm. In this country Caton has hybridized the common Virginian deer with the Ceylon deer and the Acapulco deer, and states that the hybrids seemed perfectly healthy and prolific. Ewart states that the Indian buffalo and the American bison produce fertile hybrids with the European wild ox.

In the human species it is a well-established fact that marriages between remote varieties or races tend to sterility, while crossing between allied races are fertile, and such unions are most beneficial. Thus the most mixed white races are the most fertile and vigorous. Ewart thinks that as there are no definite limits between species and varieties, there can be "no fundamental difference between a hybrid and a cross, nor yet any *a priori* reason why any given hybrid should be sterile, or any given cross fertile." He also states that sterility has in some cases been slowly acquired, in others abruptly, but how it has been acquired is not known.

As the result of breeding thousands of moths Standfuss states that in no case observed by him has the female of a true hybrid been shown to be fertile. On the other hand, the occurrence of undoubted cases of fertility in male hybrids has been proved by crossing the male hybrids with the females of both parent species.

Ewart's Experiments with crossing the Zebra and Horse, and the Wild Ass and Horse. — A Burchell's zebra stallion, "Matopo," became the father of nine zebra hybrids by mares of various sizes and breeds. The hybrids exhibited a curious blending of characters, which seemed to have been derived partly from their actual and partly from their remote ancestors; some of the hybrids strongly suggest their zebra sire, others their respective dams, "but even the most zebra-like in form are utterly unlike their sire in their markings."

According to 'Nature,' August 1903, he succeeded in 1902 in securing a male wild ass (kiang) from Central Asia and a couple of Mongolian pony mares, one a yellow dun and the other a chestnut. The wild ass was mated with the dun Mongol mare, a brownish-yellow Exmoor pony, and a bay Shetland-Welsh pony. The kiang hybrid in its long legs, slender joints and speed took after its kiang parent. The mane and tail "are exactly what one would expect in a mule." This kiang hybrid also differs from the wild horse (Przewalsky's horse) in not neighing like a horse. The result is to prove that the wild horse is not a kiang-pony male, but a "good" species. Also in accordance with Mendel's law (see under HEREDITY) the kiang proved to be dominant, the Exmoor pony recessive.

Hybridity in Plants.— The method of hybridizing hermaphroditic flowers is to cut away their stamens before they are ripe, and then enclose the flower in a paper bag. After the stigma has ripened the pollen is placed on it, the bag is again tied over the flower and not removed until the seed begins to form. Great advantages and improvements have resulted from hybridizing plants, chief among which are many new varieties of cultivated plants, increased size and vigor, hardiness, or adaptation to warmer climates, and increased resistance to disease, as well as increase in odor of flowers and the quality and flavor of fruits.

Thus far the cause of infertility in animals is unknown, but botanists attribute the frequent sterility of plants to the imperfect formation of the pollen. Standfuss' experiments with moths agree with Focke's statement as to the great variability of the offspring resulting from the crossing of a plant hybrid with one of the parent species. In plants, as discovered by Mendel, the proportion of the pure races is constantly increasing in the successive generations descended from a hybrid. Malformations and sports are much more frequent, especially in the floral organs in hybrids, than in individuals of a pure descent. Double flowers appear to be formed especially easily in hybrids. Recent experiments and results in the study of hybridity show how intimately the subject bears on heredity (q.v.) and the origin of species.

Consult: Bailey, 'Plant Breeding' (New York 1896); De Vries, 'Die Mutationstheorie' (Leipsic 1901–3); Bateson, 'Mendel's Principles of Heredity' (Cambridge, England, 1902) contains a bibliography of the subject.

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Hydatid, hī'dā-tĭd. See BLADDERWORM; TAPEWORM.

Hyde, Edward, British colonial governor in America: b. England about 1650; d. North Carolina 8 Aug. 1712. In 1710 he arrived as governor of the Albemarle district of North Carolina province. The provincial governor, by whom he was to be commissioned, was dead, and Thomas Carey, formerly a deputy-governor, had undertaken an armed insurrection. Hyde, at the request of the better class of the population, took office as governor, and, assisted by Spottswood, governor of Virginia, crushed the revolt. Not long after massacres by the North Carolina Indians compelled him to seek aid from Virginia and South Carolina.

Hyde, Edward Wyllys, American mathematician: b. Saginaw, Mich., 17 Oct. 1843. He was graduated from the civil engineering school of Cornell University in 1872, was instructor in civil engineering there in 1871–3, assistant professor of mathematics in the University of Cincinnati in 1875–8, and professor from 1878. Besides extensive contributions to mathematical journals, he wrote: 'Skew Arches' (1875); 'Directional Calculus' (1890); 'A Portion of Higher Mathematics' (1896).

Hyde, William Dewitt, American college president: b. Winchendon, Mass., 23 Sept. 1858. He was graduated from Phillips Exeter Academy in 1875, from Harvard in 1879, and studied theology at Union and Andover. After completing his theological studies he was pastor for a time at Paterson, N. J. In 1885 he became president of Bowdoin College; at that time he was the youngest college president in the United States, and was not widely known. He has since won a high reputation as a scholar and an able executive, the college having grown largely in numbers and resources during his administration. He has written 'Practical Ethics' (1892); 'Social Theology' (1895); 'Practical Idealism' (1897); 'The Evolution of a College Student' (1898); 'God's Education of Man' (1899); 'The Cult of Optimism' (1900).

Hyde Park, London, a park in the West End, adjoining Kensington Gardens. It derived its name from having been the manor of the Hyde belonging to the Abbey of Westminster, and contains nearly 400 acres. It was opened to the public shortly after the Restoration in 1660, and abounds with fine trees and pleasing scenery. The sheet of water called the Serpentine River was made between 1730 and 1733 by order of Queen Caroline. It is much frequented in summer for bathing, and during frosts for skating. Other attractive features of the park are the fashionable drive, bridle path, and promenade of Rotten Row, the Ladies' Mile, and Marble Arch.

Hyde Park, Mass., town in Norfolk County; on the Neponset River, and on the New York, N. H. & H. railroad; about four miles southwest of Boston. The town contains four small villages. It was incorporated as a town in 1868. The chief manufactures are rubber goods, paper, morocco, cotton and woolen goods, curled hair, chemicals, dyestuffs, looms, and machinery. It is a residential suburb for many of the Boston business men. It has good schools and a free library which contains about 14,200 volumes. Pop. (1890) 10,193; (1900) 13,244.

Hyde Park, Vt., village in the town of Hyde Park; county-seat of Lamoille County; on the Lamoille River and on the Boston & M. railroad; about 31 miles northeast of Burlington and 23 miles north of Montpelier. The stone-quarries nearby are a source of industrial wealth. The manufactures are flour, lumber, dairy products, and leather. Pop. village (1900) town, 1,472.

Hyder Ali, hī'dėr ā'lē, Indian Mohammedan prince: b. Bangalore about 1728; d. Chittore, 7 Dec. 1782. Having deposed Kandih Rao, he was chosen rajah of Mysore in 1762, and he so greatly extended his dominions, that in 1766 they contained 84,000 square miles, and afforded an immense revenue. His reign was passed in wars with the English and with the Mahrattas. A treaty which he made with the East India Company in 1769, was violated in 1780, and, forming an alliance with the Mahrattas, he obtained the services of French officers, and took Arcot on the 31st October of the same year. He was defeated by Sir Eyre Coote, 1 June 1781. He was succeeded by his son Tippoo Saib (q.v.).

Hyderabad, hī-dėr-a-băd', or **Haidarabad,** hī-da-ra-băd', India. (1) One of the largest native states occupying the greater part of the Deccan plateau of southern India, in possession of the Nizam, a Mohammedan prince, and frequently called the NIZAM'S DOMINIONS. It is bounded north by Berar, northeast by the central provinces, southeast by Madras, and west by Bombay. Area, 82,698 square miles; pop. (1901) 11,141,142. The chief rivers are the Godavery in the north and the Kistnah in the south. The soil generally is fertile but poorly cultivated; the principal crops are rice, wheat, maize, sugarcane, tobacco, cotton, and fruits. Indigo is manufactured, and the forests yield valuable timber; there are coal and iron deposits as yet little exploited, and diamonds and other gems are found. The ruler belongs to the dynasty founded by Asaf Jah, a distinguished soldier, whom the Emperor Aurungzebe made viceroy of the Deccan in 1713 with the title of Nizam or Regulator.

(2) HYDERABAD, the capital, is on the Musi River, at an elevation of 1,672 feet above the sea, about 400 miles in a direct line southeast of Bombay, with which it is connected by rail. It is wall-girt, and its chief buildings are the extensive nondescript palace of the Nizam, the handsome British Residency, the Charshinar, or Four Minarets, built about 1590 as a Mohammedan college, but now used for warehouses; and the Jumma Musjid or cathedral mosque, a reproduction of that at Mecca. Pop. (1901) 448,466. (3) HYDERABAD, the capital of a district of Sindh, British India, on the east bank of the Indus, is a well fortified town connected by rail with Karachi, 105 miles to the southwest. Pop. (1901) 69,378.

Hy'dra, a minute fresh-water polyp, living on the stems and underside of submerged leaves. The body is a club or vase-shaped sac, the mouth at the upper end surrounded by a crown of from five to eight long tentacles armed with lasso or nettling cells buried in the skin. The hydra feeds on minute crustacea, etc., which become paralyzed when swimming in contact with the arms of the hydra, thus being easily drawn by the creature into its stomach. The body is very retractile, and the hydra can slowly move from one place to another, by detaching the end of the body. The sexual cells are, during the reproduction season, developed in the skin, appearing as circular swellings, one (male) just below the tentacles, the other mass, corresponding to the ovary of higher animals, farther down the body. The hydra is famous from its power of regenerating parts of its body. Trembley in 1744 experimented upon this animal; he cut them in two, also into slices, and found that each bit became a new hydra, finally he turned one inside out, the stomach-lining becoming the skin, this experiment having recently been successfully repeated. This is due to the lack of differentiation in the tissues and organs of the body, there being no distinct nervous, or circulatory system, the hydra being the most generalized member of its class, except the Protohydra, which has no tentacles.

Hydrangea, hī-drăn'jē-a, a genus of shrubby plants of the order *Saxifragaceæ,* with about 30 species indigenous to eastern Asia and temperate America. They have large simple leaves and very large cymes of flowers, the outer ones being infertile. The *H. vulgaris* grows on the Alleghanies, and in other parts of the United States. *H. nivea,* a more ornamental shrub, is most abundant in the region of the southern Alleghanies, but is found as far north as Pennsylvania. The *H. quercifolia,* distinguished by its lobate leaves, inhabits the country bordering on the Gulf of Mexico. The best-known species is *H. hortensis,* the Japan rose. The fruit is a multilocular capsule.

Hy'drants. See Valves and Hydrants.

Hydras'tis, an herb, the rhizome and rootlets of which are used as a bitter stomachic tonic and a tonic to the uterus in various diseases. In poisonous doses it stops the heart-action.

Hy'drate, in chemistry, a compound containing one or more molecules of the radical «hydroxyl» (OH). In these compounds, the water may be considered as playing the part of an acid, and the compounds themselves are entirely analogous to salts. Thus water, H_2O, combines with sodium oxid, Na_2O, according to the equation $Na_2O + H_2O = 2NaOH$; the reaction being accompanied by the liberation of considerable heat. The sodium hydrate (NaOH) that is produced is quite a different substance from the simple oxid, Na_2O, and it cannot be resolved into Na_2O and water by the action of heat alone. In organic chemistry hydrates are met with very frequently. The large and exceedingly important class of substances collectively known as the alcohols, for example, are hydrates of organic radicals. (See Alcohol.)

The word «hydrate» is also used in a less definite manner, to signify any compound which contains water, or from which water can be expelled by the action of heat. Thus salts or minerals which are associated with water of crystallization are said to be «hydrated.» When an aqueous solution of a salt, containing an excess of the salt in the free state, is cooled until it freezes, a mechanical mixture of ice and of the precipitated salt is obtained, which is known as a «cryohydrate,» although it is not a definite chemical compound.

Hydraulic (hī-drâ'lĭc) Cement. See Cement.

Hydraulic Crane. See Hoisting Apparatus.

Hydraulic Engine, or Hydraulic Motor, an engine or motor driven by water under pressure. The water is admitted at a high pressure at the beginning of the stroke, and exhausted at a low pressure at the end of the stroke, thus giving a reciprocating motion to the plunger. The velocity of the piston has to be kept low to avoid injurious shocks in suddenly bringing the column of water to rest. Working under greater pressure than steam-engines — 700 pounds to the square inch is not an uncommon pressure — the hydraulic pressure engine can be built much smaller than an equivalent steam-engine. An additional advantage of the hydraulic engine for intermittent work is the comparative ease with which it may be started or stopped; hence it is commonly used for capstans, winches, cranes, and drawbridges. Single action in the hydraulic engine avoids shock at dead centres; and the three-cylinder single-acting form is in common use, since the three cranks make the turning force uniform and make it possible to start the engine from any position. Another form, of very recent development, is the turbine (q.v.).

Hydraulic Engineering, that branch of civil engineering which deals with the application to the use and convenience of man of the natural laws governing liquids. A liquid is a substance appreciable to the senses of sight and touch, and the particles composing which are incompressible and offer no resistance to interchange of position from any external force applied to them. The typical liquid is water, and the generic term hydraulics, used to denote the science and practice of handling liquids, is derived from a Greek word which means «pertaining to water.» There are three distinct sets of laws or principles of science which have to be considered: hydrostatics, which relates to liquids at rest; hydraulics, which relates to liquids in motion; and hydrodynamics or hydromechanics, which relates to the mechanical effects produced upon other substances by liquids when acted upon by external forces.

The science of hydraulics is entirely modern. There is no evidence, either traditional or documentary, that the principles governing the action of liquids either at rest or in motion were studied and formulated at all prior to the days of Archimedes, 2,200 years ago. A few of the facts of both hydrostatics and hydraulics were established experimentally, so that aqueducts to convey water long distances were built by the Romans, and possibly before them by the Phœnicians and the Greeks; but no record remains of any elucidation of principles or formulation of laws. After the destruction of Rome in 475 A.D. even what had been known seems to have been lost for more than 1,000 years. As late as 1630 Galileo said that the laws governing the motions of the stars were better understood than those controlling the movement of water on the earth.

Hydrostatics.— It was Galileo who discovered and formulated the important law of hydrostatics that the pressure exerted by a column of fluid on any square unit of the surface which confines it is equal to the weight of a column of one unit square and of the height of the surface of the liquid above the point at which the pressure is measured, no matter whether the horizontal area of the column at that point is greater or less than at other points in its height. If the confining walls of the column are horizontal at any point, or if they are inclined to the perpendicular, the pressure of the liquid at that point is the same, whether upward or downward, as it is laterally against a vertical wall, and the wall at that point must be of such thickness that it will resist that pressure.

Where the pressure is upward the resisting force of the wall is increased by its own weight, and where the pressure is downward the resisting force is diminished by the weight of the wall itself. It is essential therefore to the stability of a wall which is surrounded by a liquid mass that the adjacent liquid should be excluded from passing under the wall so as to permit of an upward pressure which would tend to lift the wall from its base.

In all mechanical problems there are three units of comparison needed: the units of time, of distance, and of weight. The unit of time in modern science is the second, or $\frac{1}{86400}$ part of the average day. The unit of distance which is generally used in England and America is the foot, which is subdivided into twelfths, called inches, or into thousandths, while the unit of weight is the pound, which is arbitrarily fixed by law. In France and Germany the unit of distance is the metre, which is supposed to be one ten-millionth part of the distance from the pole to the equator, and is 3.28 feet long, and is subdivided into thousandths, while the unit of weight is the gram or cubic centimetre, which is the $\frac{1}{1000000}$ part of the weight of a cubic metre of pure water. Efforts are making by scientists to secure the universal adoption of the metric system of measures and weights, but in the English-speaking countries the foot and the pound are the only standards generally used and understood. In hydraulic science the basic hydrostatic facts are that a cubic foot of pure water weighs 62.417 pounds, and that to exert a pressure of one pound on every square inch of surface a column of water must be 2.307 feet high.

Hydraulics.— The instant that an orifice is made in the barrier confining a volume of liquid the particles of the liquid begin to move in the direction of the orifice. The theoretical velocity with which they issue from the orifice was discovered in 1644 by Torricelli, a pupil of Galileo, to be equal to that acquired by a cubic unit of the liquid in falling through the height between the surface of the liquid and the orifice. It was not until 1738 that Bernoulli formulated the fundamental expression for the acceleration of gravity, $v=\sqrt{2gh}$, in which v represents the speed per second of time, h represents the distance of the orifice below the surface of the liquid, and g is a quantity determined by experiment to be the velocity acquired by any body in falling freely in a vacuum, from a state of rest, in one second of time. Taking the foot as the unit of distance, $g=32.16$ and $\sqrt{2g}=8.020$, while if the metre is the unit, $g=9.80$ and $\sqrt{2g}=4.427$.

The students of hydraulic problems soon discovered that the conditions under which the movements of fluid take place modify materially the theoretical results obtained from the formulæ based on the laws of gravitation only. For 260 years they have been striving by a combination of reasoning and experimentation to formulate the laws which govern the movements of water under varying conditions of form and character of material composing the enclosing channels in which the movements occur. The value of v, as found to exist in practice, is only a fractional part of the theoretical value, and is designated by the expression $v=c\sqrt{2gh}$, in which c is a numerical coefficient which varies with the form of the orifice or channel through which the water passes, and with the character of the material through which the orifice is made. The reason of this is that the particles of the liquid which are in contact with the restraining solid material are retarded in their fall by the solid, and they in turn retard the next adjacent particles of fluid, the amount of retardation decreasing as the distance from the immovable solid increases. This retarding effect varies also with the roughness of the limiting solid, and with the velocity at which the initial movement, due entirely to the force of gravity, takes place. The quantity of water discharged is equal to the product of the velocity by the area of the orifice or $q=ac\sqrt{2gh}$. The value of c under the most favorable conditions has been found from numerous carefully conducted experiments to be about 0.60, or in other words, only about 60 per cent of the amount of water which the theoretical calculation of the velocity due to the head indicates as possible to be passed through an orifice in the side or bottom of a vessel or reservoir containing a mass of water, can be actually so passed. After passing the orifice of entry to a long channel, a new set of conditions is encountered in conveying water for long distances, as in a pipe or open canal. Gravity is the impelling force as before, and to ensure flow there must be a difference of elevation between the extremities of the channel, but the retarding forces are numerous, consisting of variations in the slope of the channel, in the proportion which the length of the wetted perimeter of the channel bears to the area of the waterway, and in the irregularity of the surface over which the water flows.

The fundamental formula for the velocity of the flow in channels of all kinds which is now accepted was suggested by Chézy in 1775 and is

$$v=c\sqrt{rs}$$

in which v represents the mean velocity of the fluid, r represents the hydraulic radius, as it is termed, or the area of waterway divided by the length of the wetted boundary of the channel, and s represents the slope of the surface, or the difference of elevation of the two ends of any section of channel, divided by the length of the section. The value of c is determined by experiments on the discharge of channels of different forms, materials, and dimensions. It is purely experimental. In the last 100 years numerous carefully conducted series of observations have been made by hydraulicians with the object of determining an exact mathematical expression for this coefficient under different conditions. The formula which so far seems to approach most nearly to the obtaining of a definite result is that proposed by Kutter, a German scientist, about 1868, in which the dominant element is a variable quantity designated as n, the value of which depends solely on the degree of irregularity in the wet surface bounding the cross section of the channel. In applying this formula to any channel the engineer must assume that value for n which has been determined by experiment to belong to a channel most nearly approaching in roughness the one under consideration, and from this he will be able to deduce with a very considerable degree of accuracy the value of c, and use this to determine the velocity and discharge.

Hydrodynamics or Hydromechanics.— These are terms applied to the science which treats of the dynamic effect produced upon other substances by the arrest of the movement of fluids coming in contact with them. A stationary column of water exerts a pressure only; a moving column exerts a dynamic pressure proportional to the velocity with which the mass is moving. If an obstacle is interposed to water flowing in a channel of any kind, the force exerted by the water in removing that obstacle can be utilized in such a way as to produce a mechanical energy or work. The simplest form of this is the undershot wheel, where the pressure of the water flowing in a stream causes vanes or paddles attached to a shaft to revolve the shaft, and from this, by mechanical appliances, the circular motion can be directly utilized to exert energy either by revolving or reciprocating movement of machines. The breast-wheel and the overshot wheel utilize the power generated by a fall or head of water of from one half to two thirds of the diameter of the wheel. The turbine wheel invented in France by Fourneyron in 1833 revolutionized water-power engineering, utilizing as it does nearly the entire energy of any great head or fall of water by discharging the fluid from a pipe against revolving vanes so shaped as to afford the greatest resistance to the attacking current and the least to the discharging current. When the impulse of movement of machines. When the impulse of the moving liquid, which is that due to the product of its weight by its velocity, is at right angles to the interposing surface, it is equal to double the pressure exerted by the fluid in a state of rest. As the angle between the current and surface becomes oblique the pressure diminishes. The same rule holds good with reference to submerged surfaces exposed to the impact of waves and currents in deep water, so that the hydrodynamic forces present to the naval architect, as well as to the hydraulic engineer, innumerable problems delicate and difficult of solution.

Hydraulic Engineering.— The improvement of natural watercourses on the face of the earth is the most ancient and the most extensive of the works which have called for the exercise of hydraulic engineering. The remains of works for restraining the flood-waters of rivers, antedating all historical records, have been discovered in Egypt and China. In countries where the rainfall is so distributed throughout the year that alternate periods of extreme wetness and drought of long continuance occur, the retention of the excess of water in the wet season and its gradual delivery for irrigation purposes during the season of drought was extensively carried on at an early date. In Egypt, 2,320 years before the Christian era, Lake Mœris was constructed as a storage reservoir for retaining the waters of the Nile, and the prosperity of that country has ever since depended upon the maintenance and progressive improvement of its system of irrigation. The earlier works, while remarkable for their extent and magnitude, were not characterized by any particular skill in design or economy in construction. During the latter part of the 19th century and since the beginning of the present, under the control of French engineers, some very fine examples of dams and irrigation canals have been constructed. The Assuan dam is 90 feet high at the deepest point of the valley it crosses; 6,400 feet long, of granite, founded on solid rock; and it impounds water for the irrigation of 2,500 square miles of land 350 miles farther down the stream, where another dam, 48 feet high and 3,030 feet long, diverts the water on to the lands to be benefited.

In India, from very early ages, irrigation has been practised on an extensive scale, and enormous reservoirs were constructed for the storage of water at least as far back as 500 B.C. There are about 90,000 such reservoirs or their remains which were constructed before the British occupation of India, and 2,000 were built by English engineers in the last half of the 19th century. In Italy about 4,000,000 acres of land are under irrigation, and it is to the Italian engineers of the 18th century that hydraulic engineering is largely indebted for the elucidation of principles and the application of the same to practice so as to produce the greatest efficiency at the least expense.

For the successful conduct of irrigation works there is needed not only a knowledge of the laws of hydraulics, but also a thorough study of the meteorological conditions which have prevailed in the region under consideration for a long series of years, and likewise of the topography and geology of the region.

In the United States the importance of this has been fully recognized only within the last 20 years; but during that period the general government has devoted a good deal of attention to the subject, and has caused surveys, both topographical and geological, to be made of the arid region lying west of the 100th meridian of longitude; while a series of measurements of the rainfall and the run-off of the streams is being instituted, which will furnish the engineer with data necessary to an intelligent designing of irrigation works. This will undoubtedly prove of great benefit, inasmuch as not more than 7 per cent of the 70,000,000 acres in the United States susceptible and in need of irrigation are now supplied with it. In the works so far constructed are seen numerous efforts at improvement in design and methods of construction, some of which have not yet stood the test of time long enough to determine whether they will be effective. The careful observations which have been made and are still being made have resulted in a decided advance in knowledge of hydraulic principles.

In passing to the consideration of the next oldest class of hydraulic works, that for the regulation of rivers to protect and reclaim the riparian lands, the questions to be considered by the hydraulic engineer are materially changed. Large storage reservoirs are needed as in irrigation projects, but their capacity and arrangement with reference to the fluctuations of the natural flow of the stream must be very different. The channels, too, for the conveyance of the water are differently proportioned, and are likely to be required to be constructed of different material. In irrigation canals a low velocity of flow is desirable to avoid abrasions of the banks, and the sizes of the channel are proportioned to convey definite quantities of water steadily. In river regulation the channels must be designed to carry constantly varying quantities of water at different speeds of current, and the banks must be fortified against injury from sudden fluctuations of level in the water surface and from abrasion by floating material or accretion by deposit. The construction of levees or embankments along the banks of a river and parallel to its current is the earliest and simplest of the methods of river improvement; but it is only within the last 200 years that this has been reduced to a science, and the most effective and economical methods of design and construction formulated. If the stream improved is of sufficient size to be navigable, the conditions of the problem are again changed. The course of the channel in places may have to be altered to avoid rapids of too steep descent for passage of boats, and a sufficient depth of water must be maintained at all times and in all places for boats of definite dimensions and draft. Where such artificial channels are necessary it is important that they should be so proportioned that the passage of the largest boat at the maximum permissible speed should not create a wave which would injure the banks or retard the progress of the boat.

River improvements of this class led to the construction of entirely new artificial channels or canals connecting different navigable streams or bodies of water. There are some very ancient examples of such structures. The Royal Canal of Babylon was built 650 B.C., and about 102 B.C. the Fossa Mariana, connecting the River Rhone and the Mediterranean Sea, was built. In the 8th century was built the Grand Canal of China, about 650 miles long, utilizing several canalized rivers on its way, and thus creating an inland navigation system of 1,000 miles. On this canal there were several inclined planes, up and down which loaded boats were passed from one level to another. Locks were first invented in 1439 by Philip Visconti, an Italian engineer. Prior to this time there was but one method of overcoming differences of elevation in navigable channels which had been constructed so as to afford long and nearly level stretches on which boats could pass in either direction, with approximately the same motive power, and with sudden changes of elevation at the ends of such levels. That method was the transhipment of cargoes, the Chinese method of inclined planes not being economical in the then state of the mechanic arts. Between 1750 and 1830, however, a number of inclined planes were built in England and America in cases where the lift of locks was so great as to necessitate a great wastage of water and loss of time. Since 1876 several vertical lifts have been constructed where very great heights had to be overcome, compressed air being the power medium. The invention of locks gave a great impetus to canal construction, and all over Europe large systems of internal navigation were constructed. Indeed the improvement of river channels was neglected for a long time, and canals were built parallel to rivers, and the opinion was expressed by an eminent English engineer, near the end of the 18th century, that "rivers were created for the purpose of feeding canals."

During the first half of the 19th century about 3,000 miles of canals were constructed in the United States. Much experience in hydraulic construction was thus had, and many improvements in methods of construction were introduced; but there cannot be said to have been much advance in hydraulic science in this direction. In the matter of river improvement, however, the work done by the United States government on the Mississippi, and the records kept of the results attained, were of great scientific value, and enabled the Mississippi River Commission of 1879 to formulate the principles which should be observed in the regulation of large rivers of that class. Both in Europe and America during the last 30 years there has been great advance made in careful observation of the phenomena of rainfall, evaporation, seepage, and infiltration as affecting the run-off of rivers and the fluctuations in their flow at different seasons of the year and for periods of years. The action of flowing water on different materials and modes of construction has been also observed more systematically than ever before, with the result of a decided advance in hydraulic science and its practical application to the economical and effective improvement of river regulation in the interest of water transportation.

The question of the regulation of smaller non-navigable streams, so as to prevent injury to the territory along them from escaping floods, has of late been receiving attention. It is considered by some engineers that it will be practicable, by the construction of large storage reservoirs with restricted outlets, so to restrain the discharge at points along the course of a stream that sudden and great floods may be prevented. Experience has not yet proved the practicability of such an automatic regulation of the flow, but there is little question that before long efforts will be made to accomplish this object, or at any rate to acquire data from which a practicable scheme may be devised.

It is in the application of hydraulic science to the comfort and convenience of the individual rather than of the community that the most striking progress has been made during the last few generations. The fostering of agriculture and the improvement of means of transportation of heavy freights are of benefit to the public at large, but the furnishing of pure and wholesome water for household consumption in large quantities and at reasonable cost affects the health, the comfort, and the general condition of the individual directly. There are remains of structures which were evidently designed to supply water to large communities in the oldest partly civilized nations, but these are of crude design and display evidences of lack of knowledge of hydraulic principles. The Romans, about 500 B.C., built numerous aqueducts to convey water from distant sources, not only to the Imperial City itself, but also to the larger cities in their provinces; but for several hundred years after the fall of the Roman empire there did not appear to have been any works built for supplying water to communities. It was not until 1582 that London was furnished with water by Peter Morrys, who pumped it from the Thames and supplied a portion of the city. The grant under which he did so is still held by his successors.

There has been steady progress in the art of supplying water to towns during the last 300 years and now the questions which the hydraulic engineer is required to consider in the design and construction of any waterworks embrace a great variety of subjects. It is necessary to consider:

1. The quantity of water likely to be needed. There is not yet any consensus of opinion among engineers on this point, the estimates varying from 100 to 150 gallons per day for each resident of the district to be supplied, at the expiration of 20 years from the inauguration of the supply. The prospective population is estimated from the records of the past growth of the district and the growth of districts of similar character of occupation.

2. The possible sources whence the required quantity of water can be obtained.

3. The character of the water obtainable from each source, as regards its chemical constituents, in order to judge of its economical as well as its sanitary value. It sometimes happens that a water otherwise acceptable is so charged with certain chemicals that the amount of soap required for washing with it is greatly in excess of that required by another water more difficult to procure, so much so that the cost to individual consumers for its constant use will be greater than the cost to the community of the introduction of the other supply.

4. The character of the water biologically; the number and nature of the organisms which are found in it. This is most important from the sanitary point of view. The identification of certain organisms as pathogenic or disease-producing is of recent origin; it marks a decided advance in sanitary science and is of great interest to the hydraulic engineer, since it is found that the removal of the injurious organisms from water can be effected by filtration, and it is the engineer's function to design or construct works for filtration through sand or other material which experiment proves to be adapted to the purpose.

5. The quantity of water obtainable from each source which appears generally suitable, the area of the watershed, the amount of annual rainfall upon it, the distribution of the rainfall through the year, the geological and topographical features of the surface, the range of temperature of the air, and the amount of evaporation must all be taken into consideration. Whenever the minimum rate of daily run-off from the watershed exceeds the maximum daily consumption to be provided for, reservoirs must be constructed to retain the stream-water in times of excessive flow, and deliver the excess gradually as required. The location of such reservoirs requires a thorough acquaintance with the topography of the district, and their construction demands a high order of both theoretic and practical acquaintance with the action of water on various materials and with the form and method of their collocation. The construction of dams of earth and masonry has been the subject of careful study within the last few years, and the general principles have been pretty well established: but there still remain a number of unsettled problems due largely to the progress of the mechanical arts and the introduction of new modes of construction. Just how far, for instance, combinations of metal and masonry, which assure strength with a reduction in amount of material and cost, can be depended upon for durability under the action of water in motion, can only be learned after the lapse of more time from the introduction of this class of construction.

6. The means of conveying the water from the source to the point where it is to be used. The conditions of this problem are unlike those which are encountered in rivers, or in canals for either irrigation or navigation. A nearly uniform quantity of water must be continuously carried a long distance at as great a velocity as is consistent with safety and economy. It must be protected from loss by evaporation and by leakage of the channels, and protected from pollution on its route. These conditions are best fulfilled by an enclosed conduit or pipe of masonry or metal, with a smooth interior surface, laid on a uniform grade so that there will not be any upward pressure tending to lift the covering of the conduit. The relations between different values of n, which can be obtained by using different classes of material and of construction, and values of c, obtainable by using different grades and alignments, have been for more than 30 years the subject of carefully conducted experiments by scientists, and it is the function of the hydraulic engineer to apply to the special case he has in hand the use of the materials which are available and the mode of construction practicable in the case, in accordance with the latest results of scientific research. Up to the present time the best form and material for large conduits seem to be masonry conduits of horseshoe form, with smoothly plastered interior surface; or steel-plate circular pipes with as few irregularities caused by rivet-heads as possible, laid on uniform grades, which will ensure a velocity of two miles per hour in the water flowing in the conduit.

7. On reaching the point of distribution an entirely different set of conditions is encountered. The water heretofore concentrated in large masses has to be distributed over a wide area in a great number of small pipes in which orifices are opened and shut at irregular intervals of time, these pipes, moreover, being under a great head of water producing a pressure of 50 to 100 pounds per square inch, and consequently a high velocity of efflux from any orifice. The problem to be solved is so to arrange the connections and sizes of these pipes that, under the ordinary conditions of use, the pressure in the pipes will not be materially altered at any time, and a constant supply may be kept up in the entire system. As illustrating the magnitude and complication of the distribution system in a large city, the conditions existing on Manhattan Island alone, in the city of New York, may be cited. There were there, in 1900, an area of 12,576 acres, 682 miles of pipes for the delivery of water, with 130,000 taps or orifices from which water is drawn at irregular intervals. The development of such a system as this involves the exercise of not only theoretical knowledge of the principles governing the flow of water under all conditions, but also a thorough acquaintance with materials of construction and the methods of using them to produce the best results at the least expenditure.

An interesting and important branch of hydraulic engineering is that which deals with larger masses of water than any of those so far considered. The water of the ocean, when agitated by the winds and by terrestrial forces not thoroughly comprehended as yet, exerts a dynamic force which must sometimes be restrained and sometimes guided so as to produce results in a desired direction. Along the seacoasts of all countries there are places where the conformation of the shore and the nature of the contiguous lands render the creation of harbors desirable, but where the tidal waves and littoral currents come in conflict in such a way as to make the approach from the sea dangerous to vessels. To lessen the destructive effects of the great masses of water in motion, impelled by either the wind or the tidal currents, breakwaters or piers of stone projecting from the shore are built with good results. The massiveness which such structures are required to possess may be judged from the fact that it has been learned that the foundation for a breakwater must extend out to where there is from 18 to 20 feet of water at low tide; that the height of the waves by which it is likely to be assailed may be from 10 to 20 feet; and that the impact of the wave on the opposing structure may be as high as 6,000 pounds to the square foot. In the open sea it is not likely that waves as high as this are formed, or that the force exerted by them is nearly as great, but the problem of the form and resisting power of the hull of ships has to be considered from the standpoint of the dynamic effect of the water which is impelled by the wind and waves against the hull, as well as the resistance offered by the water to the passage of the hull through it.

The problem of the resistance of the water to a vessel passing through it enters into the consideration of the navigation of canals and inland waters as much or possibly even more than it does into ocean navigation. The more rapidly a vessel passes through a small channel, the greater is the work to be done in the displacement of the bulk of water occupied by the hull. The displaced water is prevented from flowing off by the adjacent banks and shallow bottom, and the pressure required to propel the boat is so increased that it is found that a greater velocity than three miles per hour is not economical.

Hydromechanics, as already stated, relates to the mechanical effects which may be produced by utilizing the force exerted by water in motion to generate power. In hydraulic works, distinctively so called, the effort is constantly made to diminish the mechanical effect of the moving water so as to avoid injury to surfaces and substances unprepared to resist it. In hydrodynamic works the effort is made to concentrate all the power obtainable from the moving water and transmit it to machines which do effective work. The difficulty of transmitting the power long distances without great loss has hindered utilization in many cases where a great head of water is available in some out-of-the-way spot, but recent improvements in electrical transmission have made such water-powers available for use, and many developments of hydraulic generation of electricity have been made, while others are now in course of construction. The utilization of Niagara Falls is a prominent instance of work of this class, and the latest installation in progress there is noteworthy for its boldness and promise of economical effectiveness, the head on the turbine wheels being obtained by sinking a vertical shaft on the shore a short distance above the falls and discharging the water through a tunnel run under the bed of the river to the precipice behind the Horseshoe Fall.

In the present state of hydraulic science more attention is being paid than ever before to the obtaining of closely accurate results of experiments conducted by skilled observers, in which the aid of electricity is used to register all phenomena in a manner never possible heretofore. Great as the advances have been during the last 25 or 30 years, equal or greater progress in the elucidation and practical application of principles may be expected within the next quarter of a century.

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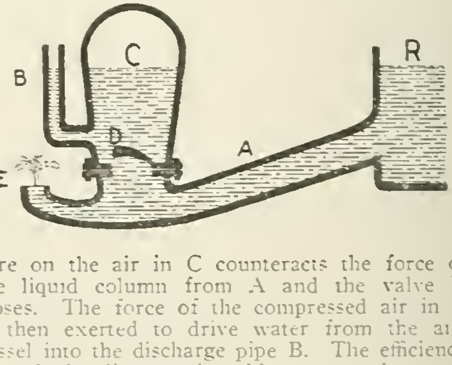
Hydraulic Press. See HYDROSTATIC PRESS.

Hydraulic Ram, a machine for raising water, the force being a greater body of water at a lower level. It consists primarily of two pipes, one, A, leading from the reservoir, spring, pond or other source of supply into C, an air-vessel, the opening being by a valve D; and the other pipe, B, leading out of this air-vessel. In the pipe A, or an extension of it is a ball valve E, smaller than the inside of the pipe. This ball valve E is forced shut by the free flow through A; the growing pressure forces D the valve into the air-vessel open; and the water flows into C the air-vessel and, to a less degree because of the smaller diameter of the pipe, into the discharge pipe B. The greater pres-



sure on the air in C counteracts the force of the liquid column from A and the valve D closes. The force of the compressed air in C is then exerted to drive water from the air-vessel into the discharge pipe B. The efficiency of a hydraulic ram is seldom more than two thirds, so that 150 units of water falling 15 feet will lift 15 units only 100 feet, instead of 150 feet, as it theoretically should. The ram was invented in 1797 by Montgolfier and is commonly used where there is no regular water-works but a plentiful supply of water.

Hydraulics, the branch of mechanics dealing with liquid flow in pipes and channels. The particles of fluids flow over each other with less friction than over solid substances; and as each particle is under the influence of gravitation no quantity of homogeneous fluid having its surface free can be in a state of rest unless every part of the surface is level. When water flows in a current, as in rivers, it is in consequence of the inclination of the channel, but all such motion is affected by the form of the channel and the friction of its sides. Experimental investigation gives various coefficients, whereby the resistance to the flow of water in pipes or channels can be calculated. As water in descending follows the same laws as other falling bodies its motion is accelerated; in rivers, however, the velocity and quantity discharged at different depths is not as the square roots of those depths, the friction against the bottom diminishing the rapidity of the flow. But the law of the proportionality of the velocity of discharge to the square root of the depth applies, however, to the spouting of water through jets. Thus, if a hole be made in the side of a vessel of water, the water at this orifice, which before was only pressed by the simple weight of the perpendicular column above it, will be pressed by the same force as if the water were a solid body descending from the surface to the orifice.

Machines to raise water may be divided into four classes. Machines in which water is lifted in vessels by the application of some mechanical force to them were the earliest hydraulic engines; a type is the Persian wheel, a large vertical wheel, turned by animal power or by running water, and having buckets attached to the rim, and moving in a reservoir of water. The buckets are filled at the bottom and emptied at the top, so that the water is raised a height equal to the diameter of the wheel. The common dredges for rivers and harbors are modifications of this kind of machine. The Archimedian screw, the screw-pump and the bucket-engine or chain-pump are all on the same principle. The chain-pump usually consists of a succession of long links of metal rods revolving like an endless rope over two wheels, one under water. On this chain, between each joint, is fixed a flat piece of wood or metal, usually square, supported and kept in place by the projecting arms of the wheels; the wheel not under water is turned by a winch, which causes the whole chain to move, one side of it passing upwards, while the other side is continually descending in the same direction. The ascending side of the chain is made to pass through a box or pipe, one end of which is immersed in the water, the other end nearly reaching the upper wheel; this box corresponds in shape with the size of the plates, which fit pretty closely and form the pump. The succession of plates passing upward through the trunk forms a succession of cavities which are filled with water and are constantly discharged at the top. This pump will only work in deep water, and cannot drain a reservoir to the bottom; but it has the advantage of not becoming choked with sand or weeds. If the top and bottom wheels of this machine be retained, while the tube or trunk is taken away, and a number of small boxes or buckets be attached to the chain instead of the plates the machine then becomes a bucket-engine, which is only another form of the Persian wheel already described.

In the next class, more commonly called pumps, the water is raised by the pressure of the atmosphere. These act by removing the air from the surface of the water, which may thus be raised to the height of about 32 feet. Whenever it becomes necessary to raise water to greater heights, the third class of machines, or those which act by pressure on the water, are employed. The common suction-pump consists of a hollow cylinder A, of wood or metal, which contains a piston B, stuffed so as to move up or down in the cylinder easily, and yet be air-tight: to this piston there is attached a rod which reaches at least to the top of the cylinder when the piston is at the bottom. In the piston there is a valve C, and at the bottom of the cylinder there is another valve D also rising upwards, which covers the orifice of a tube fixed to the bottom of the cylinder, and reaching to the well from whence the water is to be drawn. This tube is commonly called the suction-tube, and the cylinder the body of the pump. When the piston is at the bottom of the cylinder there can be no air, or very little between it and the valve D. But the air in the cylinder being very much rarefied, the pressure of the valve D on the water at the bottom will be much less than that of the external atmosphere on the surface of the water in the well; therefore the water will be pressed up the pump

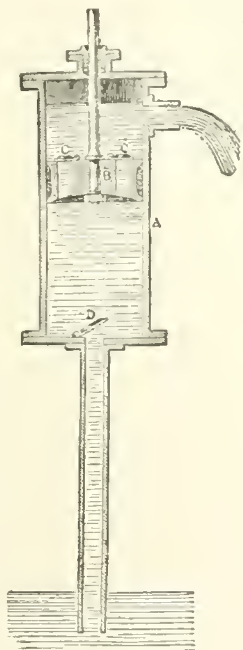


Fig. 1.—Suction Pump.

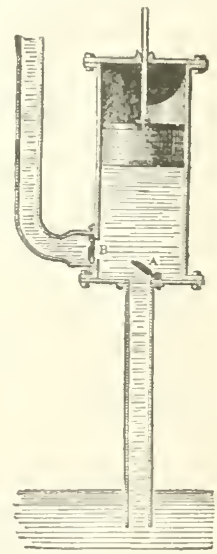


Fig. 2.—Forcing Pump.

to a height not exceeding 32 feet. As the valves shut downward, the water is prevented from returning. The quantity of water discharged in a given time is determined by considering that at each stroke of the piston a quantity is discharged equal to a cylinder whose base is the area of a cross section of the body of the pump, and height the play of the piston. Thus if the diameter of the cylinder of the pump be 4 inches, and the play of the piston 3 feet, then by mensuration we have to find the content of a cylinder 4 inches diameter and 3 feet high, the area of the cross section of the cylinder will be .08733 square feet; hence $.08733 \times 3 = .26199$ the content of the cylinder in cubic feet and the quantity of cubic feet of water discharged by one stroke of the piston.

The lifting-pump, like the suction-pump, has two valves and a piston, both opening upwards; but the valve in the cylinder, instead of being placed at the bottom of the cylinder, is placed in the body of it, and at the height where the water is intended to be delivered. The bottom of the pump is thrust into the well a considerable way, and when the piston is at the bottom as its valve opens upwards, there will be no obstruction to the water rising in the cylinder to the height which it is in the well, for water will always endeavor to come to a level. Now when the piston is drawn up the valve in it will shut, the water in the cylinder will be lifted, the valve in the barrel will be opened, and the water will pass through it, and cannot return as the valve opens upward; another stroke of the piston repeats the same process, and in this way the water is raised from the well. But the height to which it may be raised is not in this, as in the suction pump, limited to 32 feet. To ascertain the force necessary to work this pump, we are to consider that the piston lifts a column of water whose base is the area of the piston, and height the distance between the level of the water in the well and the spout at which the water is delivered.

The forcing-pump constitutes the third class. It can raise water to any height. The piston of this pump has no valve, but there is a valve at the bottom of the cylinder, as is shown at A. In the side of the cylinder, and immediately above the valve A, there is another valve B opening outward into a tube, which is bent upward to the height at which the water is to be delivered. When the piston is raised the valve in the bottom of the pump opens, and a vacuum being produced, the water is pressed up into the pump on the principle of the suction-pump. But when the piston is pressed down the valve A at the bottom shuts, and the valve B at the side which leads into the ejection-pipe opens, and the water is forced up the tube. When the piston is raised again the valve B shuts and the valve A opens. In this form the discharge is not continuous. To make it so an air-vessel is fastened to the top of the eduction pipe. The air-vessel is a box, with a valve opening upwards into it and covering the top of the pipe. A tube is fastened into the top of the box, and reaches nearly to the bottom; it rises out of the box, and is furnished with a stop-cock. If the stop-cock be shut, and the water be sent by the action of the pump into the air-vessel, it cannot return because of the shutting of the valve at the bottom of the box; and because of the space occupied by the water, the air in the box is condensed, and will consequently exert a proportionate pressure on the water in the air-vessel, and force it up through the tube. The stream of water issuing will therefore be continuous, the pressure being continuous.

The fourth class of hydraulic machines for raising water consists of such engines as act either by the weight of a portion of the water which they have to raise, or of any other water that can be used for such purpose, or by its centrifugal force, momentum, or other natural powers. The centrifugal pump consists of a drum or wheel containing a series of curved vanes; this wheel is encased in a circularly-shaped casing, gradually enlarging toward the outlet. The wheel with its vanes being rapidly rotated causes the water to be impelled outward into the casing and ultimately discharged from the outlet. This machine is very similar in form to the vortex-wheel or turbine, the direction of flow of the water being, however, in the reverse direction.

An ingenious form of pump called the *pulsometer* has lately been devised and extensively employed. It consists essentially of a double chamber, having a ball-valve at top, and clack-valves at bottom. Steam is admitted to one of the chambers and presses out the water contained there. Condensation then taking place a vacuum is formed, and the ball falls over and closes the opening through which the steam entered, and water flows up through the clack-valves and again fills the chamber. The steam in the meantime acts upon the water contained in the adjoining chamber. Condensation then taking place there the ball falls back to that side, and the operations go on alternately, the result being a steady stream of water sucked into one chamber after another, and then forced out and upward by the steam pressure. The water is drawn into the machine from the centre. To the fourth class also belongs the hydraulic ram (q.v.).

Water-wheels are either vertical or horizontal. The former class is undershot, overshot, or breast-wheel, as the water is fed to it from below, above or at the middle of the wheel.

The undershot wheel, the oldest form, acts chiefly by the momentum of the water, the weight of the water being scarcely called into action, and so can be used where there is a great supply of water always in motion. It is the cheapest of all water-wheels, and is more applicable to rivers in their natural state than any other form of the wheel; it is also useful in tide-currents, where the water sets in opposite directions at different times, because it receives the impulse equally well on either side of its floats. In the overshot wheel the circumference is furnished with a series of buckets, into which the water is delivered from above. The buckets on one side being erect, will be loaded with water, and the wheel will be thus set in motion; the mouths of the loaded buckets being thus turned downwards by the revolution of the wheel, will be emptied, while the empty buckets are successively brought under the stream by the same motion and filled. The breast-wheel differs from this in receiving the water a little below the level of the axle, and in having floats instead of buckets. In these two wheels the weight of the water is used as well as its momentum, and a much greater power is therefore produced with a less supply of water than is necessary for the undershot wheel. In order to permit these wheels to work with freedom, and to the greatest advantage, it is necessary that the back or tail water, which is discharged from the bottom of the wheel, should have an uninterrupted passage off; otherwise it accumulates and forms a resistance to the float-boards.

Turbines or horizontal water-wheels are very suitable for high falls of water, as the action of such wheels depends upon the impulse of the water and not upon its direct weight as in the overshot wheel. Turbines have been divided into three classes: parallel-flow, where the water is supplied and discharged vertically; outward-flow, where the water acts from the centre outward; and inward-flow, where the water acts from the outside, the currents flowing inward toward the centre. In all cases the greatest efficiency is obtained when the water acts upon the blades of the wheel without causing a shock, and leaves the wheel without having any whirling motion. See HYDRODYNAMICS; HYDROSTATICS.

Hy'drazine, or Di-Amidogen, a substance having the formula N_2H_4 (or $H_2N.NH_2$), obtained (together with oxalic acid, $H_2C_2O_4$,) by heating an aqueous solution of the complicated substance known as triazoacetic acid $(C_3H_3N_6)_3(COOH)_3$. It is a gas with a peculiar penetrating odor, but the properties of the pure substance are imperfectly known, on account of the avidity with which it combines with water to form the hydrate, $N_2H_4.H_2O$, and the consequent difficulty of isolating it. Hydrazine is a powerful base, combining with acids to produce numerous definite crystalline salts. Among these the sulphate, $N_2H_4.H_2SO_4$, and the two hydrochlorids, $N_2H_4.2HCl$ and $N_2H_4.HCl$, are important. The hydrate may be prepared by boiling the sulphate with a solution of caustic soda. It is a fuming liquid, somewhat oily in appearance, and boiling at 245° F. The hydrate reduces cold ammoniacal solutions of silver nitrate, and also reduces Fehling's solution. It attacks glass, cork and india rubber, but may be kept in silver vessels.

(2) The substances derived from hydrazine by replacing one or more of its hydrogen atoms by compound radicals are also called "hydrazines." If only one hydrogen atom is replaced the hydrazine is said to be "primary." If two hydrogen atoms are replaced, the hydrazine is said to be "secondary." The radical which replaces the hydrogen may belong to the fatty series, or to the aromatic series. One or more of the hydrogen atoms may also be replaced by a metal, such as sodium. The most important of the organic hydrazines is phenyl hydrazine, in which one of the hydrogen atoms is replaced by the aromatic radical phenyl, C_6H_5. This substance, which has the formula $(C_6H_5)HN.NH_2$, is an oily liquid, which solidifies to monoclinic tablets at 73° F. It mixes with alcohol, ether, benzene and chloroform, but hardly at all with water. It reduces Fehling's solution in the cold, and is very poisonous. A secondary hydrazine is "symmetrical" when the two substituted radicals are attached to different nitrogen atoms; it is "unsymmetrical" if they are attached to the same nitrogen atom. Thus $(C_6H_5)HN.NH(C_2H_5)$ is the symmetrical secondary hydrazine of phenyl (C_6H_5) and ethyl (C_2H_5), while $(C_6H_5)(C_2H_5)N.NH_2$ is the unsymmetrical secondary hydrazine of the same radicals.

Hy'dride, a chemical substance consisting of hydrogen combined with a metal, or some simple or compound metallic base.

Hydriod'ic Acid, an acid composed of hydrogen in combination with iodine, and having the formula HI. Hydriodic acid is analogous to the more familiar hydrochloric acid, both in its chemical structure and in its general properties. It may be prepared by the direct union of hydrogen and iodine at a red heat. A more convenient method, however, consists in passing sulphuretted hydrogen gas (H_2S) through water in which a little pulverized iodine is suspended. The reaction is $H_2S + 2I = 2HI + S$. Fresh supplies of iodine are added from time to time, and the liberated sulphur is finally removed by agitation and filtration, the sulphuretted hydrogen remaining in solution being also removed by the application of a gentle heat. The aqueous solution so prepared possesses strongly acid properties, and combines with bases to form salts called iodides. From it, or by other methods that are given in the larger treatises on chemistry, pure hydriodic acid, free from water, may be prepared. The pure acid is a colorless gas, with an odor similar to that of hydrochloric acid gas. It has a density about 63 times as great as that of hydrogen, and at a temperature of 32° F. it condenses to a liquid when subjected to a pressure of four atmospheres; the liquid so obtained freezing to a solid mass at about 67° F. below zero. The specific heat of the gas, at ordinary temperatures, is about 0.055 (at constant pressure), and the ratio of its specific heat at constant pressure to its specific heat at constant volume is 1.397. It dissolves freely in water, the specific gravity of a saturated aqueous solution, at 32° F., being about 2.00. The aqueous solution is colorless when pure, but it is slowly decomposed by sunlight, becoming dark from the liberation of iodine.

Hydriodic Ether (more correctly known as "iodide of ethyl"), a heavy, colorless liquid with a sharp, pungent taste and a penetrating ethereal odor, obtained by acting upon pure ethyl alcohol ($C_2H_5.OH$) by iodine, in presence of phosphorus. It has the formula C_2H_5I, boils at 162° F. (under ordinary atmospheric pressure), and has a specific gravity of about 1.946. When not quite pure it becomes brownish upon exposure to light, from the liberation of iodine. In chemistry, hydriodic ether (or ethyl iodide) is largely used as a fundamental substance in the preparation of the various other compounds of ethyl.

Hydrobro'mic Acid, or Hydrogen Bromide, a compound having the formula HBr, and analogous in its general properties to hydrochloric and hydriodic acids. Hydrogen and bromide do not combine directly, even in strong sunlight; but when hydrogen that is charged with bromine vapor is burned, hydrobromic acid and water are formed. Hydrogen and bromine may also be made to combine by electric sparks, or by passing the mixed gases over hot platinum. The most convenient way of preparing the acid, however, is by the action of bromine upon water, in the presence of phosphorus, the reaction being $4H_2O + 5Br + P = 5HBr + H_3PO_4$. Phosphoric acid, it will be seen, is formed at the same time; but the two are easily separated by heat. Pure hydrobromic acid, when free from water, is a colorless gas, having a density about 39.1 times as great as that of hydrogen. Under ordinary atmospheric pressure it condenses into a liquid at 99° F. below zero, and at a slightly lower temperature it crystallizes. It dissolves freely in water, a saturated solution, at 32° F., having a specific gravity of 1.78. A concentrated aqueous solution of hydrobromic acid fumes strongly in the air, but does not decompose. Hydrobromic acid is a powerful acid, forming, with metallic bases and with organic radicals, definite salts called "bromides." The bromides of the alkalies are greatly used in medicine as sedatives. Bromide of silver is also extensively used in photography, in the manufacture of sensitive dry-plates.

Hydrocar'bons, compounds consisting solely of carbon and hydrogen. They are exceedingly numerous, and many of them occur in nature, both in petroleum, asphaltum, and other similar minerals, and in the essential oils of plants. The hydrocarbons can be broadly divided into two general classes, according to the way in which the carbon atoms that they contain are connected to one another. In the fatty series, the atoms are all connected in open chains, while in the aromatic series the carbon atoms are connected with one another in such a manner as to form closed rings. (See FATTY COMPOUNDS and AROMATIC COMPOUNDS.) As a class, the hydrocarbons are insoluble in water: they cannot be saponified; and they are neutral, and do not combine with acids to form salts.

The classification of the hydrocarbons is as yet incomplete; but the greater number of those that are known can be included in one or another of the following groups:

1. The *Paraffins*, having the general formula C_nH_{2n-2}. The lowest member of this series is methane, or marsh gas, CH_4, and many other members of the series are known, each containing one carbon atom and two hydrogen atoms more than its immediate predecessor. (See PARAFFINS.)

2. The *Olefines*, having the general formula C_nH_{2n}. Ethylene, C_2H_4, is the simplest member of this series.

3. The *Acetylene* series, having the general formula C_nH_{2n-2}. Acetylene gas, C_2H_2, is the simplest representative of this series.

The foregoing all belong to the fatty subdivision. To them we may add:

4. The *Benzene* series, having the general formula C_nH_{2n-6}, and

5. The *Terpenes*, a class of substances having the general formula $C_{10}H_{16}$. Both of these latter series belong to the aromatic subdivision of the general hydrocarbon group.

The known hydrocarbons having any one general formula may be ranged in a series, whose members exhibit a sort of regular progression in their properties. For example, the first eight members of the normal paraffin group may be arranged as follows:

		Boiling point.
Methane	CH_4	(Gaseous)
Ethane	C_2H_6	"
Propane	C_3H_8	"
Butane	C_4H_{10}	34° F.
Pentane	C_5H_{12}	100° F.
Hexane	C_7H_{16}	158° F.
Heptane	C_6H_{14}	210° F.
Octane	C_8H_{18}	255° F.

A series of this sort is said to be «homologous.»

The paraffins are said to be «normal» when they contain but two methyl groups, (CH_3). Thus normal propane, C_3H_8, has the constitutional formula $CH_3.CH_2.CH_3$; and it is not possible to arrange its atoms in any other way. In proceeding from this hydrocarbon to the next in the same series (that is, butane, C_4H_{10},) we may substitute the methyl group, CH_3, for a hydrogen atom in the CH_2 of the propane, or for a hydrogen atom in one of the CH_3 groups. Hence we may have either of the two following constitutional formulas for the hydrocarbon butane:

$$
\begin{array}{c}
CH_3 - CH - CH_3 \\
| \\
CH_3
\end{array}
$$

or

$$CH_3 - CH_2 - CH_2 - CH_3.$$

The latter compound, which contains only two CH_3 groups, is called «normal butane»; while the former, which contains three such groups, is known as «isobutane.» Two butanes, each having the empirical formula C_4H_{10}, are therefore possible, and both are actually known. When we pass to the higher members of the paraffin group we find that a far greater number of isomeric forms can exist, according to the way in which the new CH_3 group is introduced, in generating the new hydrocarbon from the one next below it in the general series. Thus octane, C_8H_{18}, can exist in 18 different isomeric forms, and tridecane, $C_{13}H_{28}$, in no less than 802.

Hydrochlo'ric Acid, an important compound of hydrogen and chlorine, which under the names «spirit of salt» and «muriatic acid,» has been known in aqueous solution from very early times. It has the chemical formula HCl, and may be formed by exposing a mixture of equal volumes of hydrogen and chlorine to diffuse daylight, the combination taking place quietly under these circumstances, but explosively under the influence of direct sunlight. A more convenient and usual method of preparing hydrochloric acid is by treating common salt («sodium chlorid,» NaCl) with strong sulphuric acid (H_2SO_4). The reaction is as follows: $NaCl + H_2SO_4 = HNaSO_4 + HCl$. Pure hydrochloric acid is a colorless gas, 1.269 times as heavy as an equal volume of air at the same temperature and pressure. At a temperature of 50° F. it condenses, under a pressure of 40 atmospheres, to a colorless liquid, which boils, under ordinary atmospheric pressure, at 171° F. below zero, and solidifies at a temperature about 6° below the boiling point. The specific heat of the gas at constant pressure (compared with water) is about 0.19; and the ratio of its specific heat at constant pressure to its specific heat at constant volume, at ordinary temperatures, is 1.389. Hydrochloric acid gas was first prepared, in an approximately pure state, by Priestley, in 1774; but it was believed to be an oxid of a new element (provisionally called «murium») until Davy, in 1810, showed that it is a compound of hydrogen and chlorine.

Hydrochloric acid gas is exceedingly soluble in water. If a dry glass flask, which is completely filled with the dry gaseous acid, be brought mouth downward under water, and the stopper is then removed, solution takes place with such extreme rapidity that the water is often drawn into the flask suddenly enough to break it. By passing a stream of the gaseous acid into water, an aqueous solution may be prepared which has a specific gravity, when saturated, of 1.21. The commercial acid is commonly known, to the present day, as «muriatic acid.» Large quantities of it are obtained as a by-product in the manufacture of sodium carbonate from common salt; but the acid so produced is not entirely pure, and the traces of iron and other impurities that are present give it a yellowish tinge. Aqueous hydrochloric acid is largely used in the laboratory, and also in the arts in the manufacture of a great variety of substances.

Hydrochloric acid combines with metallic bases to form salts which are known as «chlorids.» Common salt (chlorid of sodium, NaCl) is the most familiar and the most abundant example, in nature, of this class of substances. The chlorids of silver, gold, mercury, barium, aluminum, platinum, and ammonia are also important, and are described under MERCURY, ALUMINUM, etc.

Hydrocyan'ic Acid, or **Prussic Acid,** an exceedingly poisonous substance, discovered by Scheele in 1782. It has the chemical formula HCN, and may be formed by passing a series of electric sparks through a mixture of nitrogen and acetylene (q.v.). The reaction in this case is $2N + C_2H_2 = 2HCN$. The pure acid is more conveniently prepared by passing sulphuretted hydrogen gas, H_2S, over dry mercuric cyanide, $Hg(CN)_2$, hydrocyanic acid and mercuric sulphid being formed, according to the equation $Hg(CN)_2 + H_2S = 2HCN + HgS$. As thus prepared, hydrocyanic acid is a volatile liquid, boiling at 80° F. and freezing at 5° F., and possessing a peculiar smell of bitter almonds. It is so intensely poisonous that a single drop of the anhydrous acid produces instant death when swallowed, and its vapor, even when mixed with considerable quantities of air, is also exceedingly poisonous. It mixes readily with water, ether, and alcohol. Although it is called an acid, and forms salts that are known as «cyanides,» it is very weak in its acid properties. It does not redden litmus paper, and its salts are readily decomposed by other acids.

Among the more important compounds of hydrocyanic acid are potassium cyanide and mercuric cyanide. Potassium cyanide, KCN, may be formed by passing nitrogen gas over a white-hot mixture of charcoal and potassium carbonate, the reaction being:

$$K_2CO_3 + 2N + 4C = 2KCN + 3CO.$$

It is more conveniently prepared, however, by strongly heating potassium ferrocyanide (see below), which breaks up into potassium cyanide, carbide of iron, and free nitrogen. Potassium cyanide is a white salt, soluble in water and in alcohol, and exceedingly poisonous. It is much used in electroplating as a solvent for gold and silver, and also in the extraction of gold from certain ores by the process known as «cyaniding.» It melts without decomposition, and in the molten state it is a powerful reducing agent. For this reason it is often used as a flux in welding, and in other metallurgical operations.

Mercuric cyanide, which is also very poisonous, is used in medicine, and is prepared by dissolving mercuric oxid in an aqueous solution of hydrocyanic acid.

Allied to hydrocyanic acid are two other acids, known respectively as «ferrocyanic acid,» $H_8Fe_2(C_3N_3)_4$, and «ferricyanic acid,» $H_6Fe_2(C_3N_3)_4$, which are not of any importance in the arts in the free state, but whose potassium salts are much used. Potassium ferrocyanide, or yellow prussiate of potash, $K_8Fe_2(C_3N_3)_4 + 6H_2O$, is prepared on a large scale by heating a mixture of nitrogenous organic matter and caustic potash, and treating the mass with freshly prepared ferrous carbonate. Crude cyanide of potassium is formed in the first instance, and this combines with the ferrous carbonate to form the yellow prussiate of potash and potassium carbonate, from which the yellow prussiate may be obtained in large crystals, by evaporation. When pure, the yellow prussiate is not poisonous. It is used, in the arts, as a source of Prussian blue, and also for the manufacture of potassium cyanide, which is liberated when the yellow prussiate is strongly heated.

Potassium ferricyanide, or red prussiate of potash, $K_6Fe_2(C_3N_3)_4$, is prepared by passing chlorine gas through a solution of the yellow prussiate, two molecules of potassium being thereby abstracted from it, with the formation of potassium chlorid as a secondary product. The red prussiate is used in the manufacture of sensitive paper for making blue-prints.

Hydro-ferricyanic (fĕr-ō-sī-ăn'ĭk) **Acid,** and **Hydro-ferrocyanic Acid.** See HYDROCYANIC ACID.

Hydrocele, hī'drō-sēl, a collection of serous fluid forming tumors around the testicle or spermatic cord. During fœtal life the testicle pushes the peritoneum before it as it descends from the abdomen into the scrotum. Along the spermatic cord the sac is usually obliterated, but if it is not it may become distended with fluid. The pouch of the peritoneum normally remains alongside of the testicle, and is called the tunica vaginalis. Distentions of these pouches may be congenital, but ordinarily they begin after maturity and probably are due to some fault in the blood-vessels, allowing the escape of the serum. Symptoms are due to the weight of the tumor, and the only danger lies in the possibility of the injury and rupture of the sac. Aspiration of the fluid, followed by the injection of a few drops of carbolic acid, may accomplish a cure, but partial removal of the sac may be necessary.

Hydrodynamics (ὕδωρ, water; δύναμις, force), or *Hydromechanics*, is that part of Dynamics which treats of the motion or rest of fluids under the action of forces. A perfect fluid is defined as a body whose parts are perfectly free to move under the action of the smallest forces, or otherwise, as a body such that the reactions between any two portions of it are normal to the surface separating them. If there is any tangential drag tending to prevent the one portion of the substance from slipping past the other, the fluid is said to be *viscous*. A perfect fluid is an abstraction, like the material particle or the rigid body, but many of the ordinary fluids, like water, alcohol, air, and other gases, are so slightly viscous that for many purposes they may be considered as perfect. The normal reaction, which alone we suppose to be present, is called the *pressure*, and is measured by the limit of the ratio of the force exerted on an element of surface to the area of the element, when both diminish without limit. The usual gravitational unit of pressure is the pound-weight per square inch, the usual scientific, absolute unit (see MECHANICS), is the dyne per square centimeter. The pressure of the atmosphere may be considered as equal to one million dynes per square centimeter.

The fundamental theorem of hydrodynamics is that the pressure on an element of surface is independent of the direction of the normal to the surface. This may be proved by considering the equilibrium of a small tetrahedron $ABCD$, Fig. 1, and resolving the forces on its

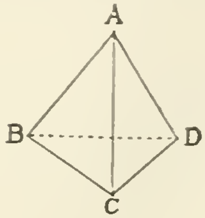


FIG. 1.

faces in the direction BD. The pressure being normal, the forces on ABD, BCD have no component along BD, while if the pressures on ABC, ACD, and the areas of those sides are respectively p_1, p_2, S_1, S_2, their normals n_1, n_2, we have for equilibrium $p_1S_1 \cos (n_1, BD) = p_2S_2 \cos (n_2, BD)$. But $S_1 \cos (n_1, BD)$, $S_2 \cos (n_2, BD)$ are the projections of the areas on a plane perpendicular to BD, which are equal, therefore $p_1 = p_2$. If there are other forces applied to the fluid besides the pressure, such, for instance, as its weight, these will be proportional to the volume of the tetrahedron, and when its size is diminished indefinitely, the volume vanishes to the third order of small quantities, and may thus be neglected in comparison with the area, which is of the second order, so that the result is not affected.

HYDROSTATICS.—We will first consider hydrostatics, or that part of our subject which deals with fluids at rest. Suppose that the fluid is subject to the action of forces whose components along the coordinate axes are equal to X, Y, Z per unit of mass. These we call bodily forces. Now consider the equilibrium of an infinitesimal rectangular parallelopiped, Fig. 2, whose edges, parallel to the coordinate axes, have lengths dx, dy, dz. Suppose

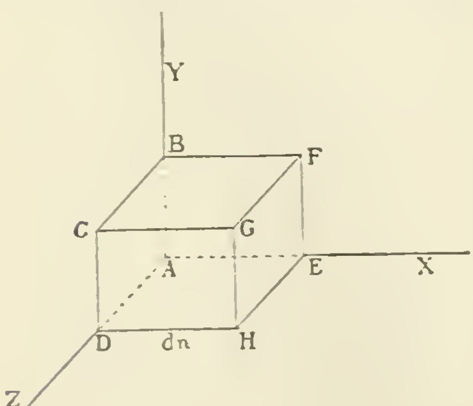


FIG. 2.

that the mean value of the pressure on the side $ABCD$, which is at a distance x from the origin, is p, then the X-component of the force on this side is $p\,dy\,dz$. On the side $EFGH$, which lies at a distance dx farther from the origin, the mean pressure will be $p + \frac{\partial p}{\partial x}dx$, and the component on the face $EFGH$, acting on the parallelopiped, being in the opposite direction will be $-\left(p + \frac{\partial p}{\partial x}dx\right)dy\,dz$. Now if the density of the fluid is ρ, the amount of matter in the parallelopiped, being the product of the density and volume, will be $\rho\,dx\,dy\,dz$, and the force exerted upon it in the X-direction will be $X\rho\,dx\,dy\,dz$. We must therefore have for equilibrium

$$p\,dy\,dz - \left(p + \frac{\partial p}{\partial x}dx\right)dy\,dz + \rho X\,dx\,dy\,dz = 0,$$

and passing to the limit by decreasing the dimensions, p will be the pressure at any point, and dividing by $dx\,dy\,dz$, we have

$$\rho X = \frac{\partial p}{\partial x}.$$

In a similar manner we have

$$\rho Y = \frac{\partial p}{\partial y}, \qquad (1)$$
$$\rho Z = \frac{\partial p}{\partial z}.$$

Thus the fluid can be in equilibrium only under the influence of bodily forces such that the components of the bodily forces, multiplied by the density, are the derivatives of the same function of the coordinates. Now there is in general a physical relation between the pressure of a fluid and the density at any point. If we put

$$P = \int \frac{dp}{\rho}, \quad \frac{dP}{dp} = \frac{1}{\rho},$$

we have

$$\frac{\partial P}{\partial x} = \frac{dP}{dp}\frac{\partial p}{\partial x} = \frac{1}{\rho}\frac{\partial p}{\partial x}, \quad \frac{\partial P}{\partial y} = \frac{dP}{dp}\frac{\partial p}{\partial y} = \frac{1}{\rho}\frac{\partial p}{\partial y},$$
$$\frac{\partial P}{\partial z} = \frac{dP}{dp}\frac{\partial p}{\partial z} = \frac{1}{\rho}\frac{\partial p}{\partial z},$$

and our equations (1) become

$$(2) \qquad X = \frac{\partial P}{\partial x}, \quad Y = \frac{\partial P}{\partial y}, \quad Z = \frac{\partial P}{\partial z}.$$

Now this is the condition that the bodily forces are *conservative* (see MECHANICS). In that case the potential energy for unit mass is called the *potential* of the forces, and will be denoted by V. Thus we shall have $P = -V + \text{const.}$, and $dV = -dP = -\frac{dp}{\rho}$. If two fluids of different densities are in contact, we have at their common surface

$$-dp = \rho_1 dV = \rho_2 dV,$$

so that

$$(\rho_1 - \rho_2)\,dV = 0,$$

and since $\rho_1 - \rho_2$ is not zero we must have $dV = 0$, $dp = 0$. Consequently the surface of separation is a surface of constant potential and constant pressure. In the case of gravity we have, if the Z-axis is measured vertically upward, $V = gz$, so that the surfaces of constant V are horizontal planes, and a surface where water is in contact with the atmosphere must be a horizontal plane, or level surface, the pressure being the constant atmospheric pressure. If we suppose the fluid to be incompressible, we have ρ constant, $P = p/\rho$,

$$(3)\qquad \frac{p}{\rho} = -V + \text{const.} = -gz + \text{const.},$$

$$(4)\qquad p = -g\rho z + \text{const.},$$

so that, if we neglect the atmospheric pressure, and count the depth from the plane $z = 0$, we have the fundamental theorem for heavy liquids, namely, that the pressure is proportional to the depth. This may be proved experimentally by placing a well-fitting plate under a tube, Fig. 3, communicating with a

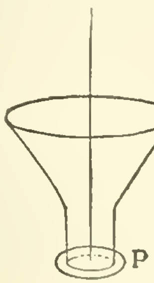


FIG. 3.

vessel of any shape, and holding the plate up by a wire hung from a balance, while water is poured in above. The weight required to hold the plate up is found to be independent of the shape of the vessel, and to depend only on the depth and the area of the plate. The vase and plate may also be immersed in liquid, while, instead of liquid within, weights are placed on the plate; the weight supported will then be proportional to the depth.

Consider now a gas, or compressible fluid, satisfying the law of Boyle and Mariotte,

$$p = a\rho.$$

Accordingly,

$$(5)\qquad P = \int \frac{dp}{\rho} = \int \frac{a\,d\rho}{\rho} = a \log \rho + \text{const.},$$

and

$$(6)\qquad V = gz = c - a \log \rho,$$

$$(7)\qquad \rho = \rho_0 c^{-\frac{gz}{a}}.$$

Thus as we ascend to heights in arithmetical progression the density decreases in geometrical progression, becoming zero at an infinite height. From equation (7) the barometric formula is obtained by which heights are found from barometer readings. The law of Boyle assumes constant temperature. It is, however, more likely that the temperature varies in accordance with what is called convective equilibrium, so that if a portion of air is hotter than the stratum in which it lies it will rise, and, cooling and expanding, will eventually find a layer of the same density and temperature as its own. The principles of thermodynamics give us the relation between pressure and temperature when the rarefaction is adiabatic, that is, when no heat is lost or gained by the air,

$$p = b\rho^{\kappa},$$

where κ is a constant for the gas, whose value is about 1.4. We then have

$$(8)\qquad V = gz = -\int b\kappa\rho^{\kappa-2}d\rho = c - \frac{b\kappa\rho^{\kappa-1}}{\kappa - 1}.$$

Since $\kappa > 1$, ρ diminishes as z increases, and is equal to zero when $gz = c$, so that on this hypothesis the atmosphere has an upper limit.

Let us now consider the equilibrium of a solid body floating in a liquid. If we consider the body removed and the space that it occupied filled with water, since this water is in equilibrium, its weight is borne up by the pressure of the surrounding water, the effect of which is accordingly to apply to each portion of the water in question an upward force just equal to its weight. Now just the same forces must be the resultant of the pressures on the solid when it is substituted for the displaced water, so that it is borne up by a force equal to the weight of the displaced water. This is the Principle of Archimedes. Since the resultant of the weight of all the displaced water is a single force applied at its center of mass, the resultant upward thrust on the floating body is applied at a point coinciding with the center of mass of the displaced water. This point is called the *center of buoyancy* of the body. If the body is to be in equilibrium, according to the principles of statics of a rigid body, its weight must be equal to that of the displaced body, and its center of mass and center of buoyancy must be in the same vertical line. If the first condition is satisfied, but not the second, the body will float, but will be subject to a turning couple.

Suppose the body floats without being wholly immersed. A plane which cuts off from the body a volume equal to the volume of water having an equal weight is called a *plane of flotation*, and if we draw all such planes they will envelop a surface called the *surface of flotation*. For every plane of flotation there will be a center of buoyancy, and the locus of all these points is called the *surface of buoyancy*. Suppose the floating body is displaced from its position of equilibrium by rotation through a small angle $\delta\theta$ about an axis OX through O, Fig. 4, and let WL, $W'L'$ be the original and

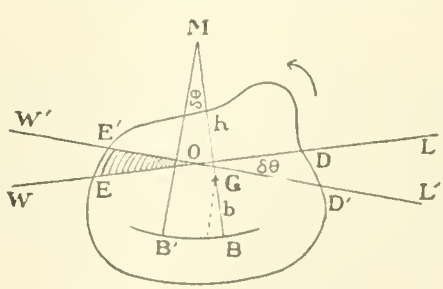


FIG. 4.

final planes of flotation. By turning the figure until either is horizontal both positions of the body may be shown. Let B be the original center of buoyancy, G the center of mass of the floating body. Then if B were the center of buoyancy in the second position, the body would be acted on by the couple of which either arm would be the weight $W=mg$, and the arm the horizontal projection of BG, $b\delta\theta$, where $b=BG$. The moment of the couple tending to further displace the body will then be $Wb\delta\theta$. But this is not the only couple, for the immersed part is not the same as before, the volume of the wedge EOE' having become immersed, giving rise to an upward thrust, and the wedge DOD' having emerged and lost its buoyancy, both these causes giving rise to a turning moment in the same direction, and opposite to that previously found. Since the volume under water is to be the same in both positions, the volume of the wedges of immersion and emersion must be equal. Since the wedges are infinitely thin, the thickness at any point x, y in the plane of flotation is $z=y\delta\theta$. The condition for equality of volumes is then

$$(9)\qquad \iint z\,dxdy=\delta\theta\iint y\,dxdy=0,$$

the integral being taken over the plane of flotation. This will be the case if the axis passes through the center of mass of the area of flotation. The thrust on any element of volume $d\tau=zdxdy$ being $g\rho d\tau$, the moment about the X-axis will be

$$(10)\qquad L'=\iiint g\rho y\,d\tau=g\rho\delta\theta\iint y^2dxdy$$
$$=g\rho\delta\theta S\kappa_x^2,$$

where κ_x is the square root of the mean of the squares of the distances of the elements from the X-axis, or the so-called radius of gyration of the area of flotation about the X-axis, and S is the area of flotation. In like manner the moment about the Y-axis is

$$(11)\qquad M'=-\iiint g\rho x\,d\tau=-g\rho\delta\theta\iint xy\,dxdy.$$

There are always two axes at right angles to each other, called *principal axes*, for which the integral above vanishes, and for such an axis a displacement about it gives rise only to a couple about that axis. Subtracting this couple L' from the one previously found we obtain for the magnitude of the *righting couple*

$$(12)\qquad L=g\delta\theta(\rho S\kappa_x^2-mb).$$

It is evident that in moving the point of application of the thrust from the center of mass of one wedge to that of the other, the center of buoyancy will be moved in a parallel direction, so that, in the limit, this direction being that of the plane of flotation, the line BB' will be parallel to that plane, or the tangent to the surface of buoyancy is parallel to the corresponding plane of flotation. It is also evident that the body is under the same forces that it would be if the surface of buoyancy were material and rested on a horizontal plane, for the reaction would be vertical and equal to the weight of the body.

If B' be the new center of buoyancy, and we draw verticals from B and B', they will be normals to the surface of buoyancy and will intersect at M, the center of curvature of the section of the surface of buoyancy. This point is called the *metacenter*, and its distance h_x above G the *metacentric height*. Evidently for stable equilibrium, or a positive righting couple, M must be above G. The arm of the couple being the horizontal projection of MG is equal to $h_x\delta\theta$ and we have $L=mgh_x\delta\theta$. Inserting this in equation (12) we obtain for the metacentric height

$$(13)\qquad mh_x=\rho S\kappa_x^2-mb,$$

and dividing by m and writing $V=m/\rho$ for the volume of displaced liquid,

$$(14)\qquad h_x=\frac{S\kappa_x^2}{V}-b.$$

The equilibrium is stable or unstable according as this is positive or negative.

For the displacement about the Y-axis we have in like manner a couple proportional to the angle of displacement, with a new metacentric height,

$$(15)\qquad h_y=\frac{S\kappa_y^2}{V}-b,$$

where κ_y is the radius of gyration about the Y-axis. It is evident that the metacentric height is greater for a displacement about the shorter principal axis of the plane of flotation. Thus it is easier to roll a ship than to tip it endwise. The above theorems concerning the surfaces of flotation and buoyancy are due to Dupin.

If the floating body is totally submerged, like a submarine boat, only the first moment $mgb\delta\theta$ comes into play, S being zero, and the center of buoyancy becomes the metacenter. The stability is in this case only secured by placing the center of gravity low.

Hydrokinematics.—We will now consider the motions possible to a fluid, without regard to the forces causing them. Let the velocity at a point be the vector q, with components u, v, w, and let us consider the quantity of fluid entering or leaving any closed surface in the unit of time. The amount of fluid which crosses the element of surface dS, Fig. 5,

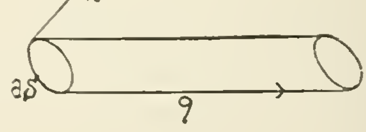


Fig. 5.

with a velocity q would in unit time, if q were constant, fill a prism on the base dS with a slant height q. If n is the normal to dS, the volume of this prism is $dSq\cos(qn)$, and the mass of fluid in it $dS\rho q\cos(qn)$, or using the formula for the projection of q on n (see Mechanics, equation (12)),

$$dS\rho q_n=dS\rho\{u\cos(nx)+v\cos(ny)+w\cos(nz)\}.$$

Consequently if we consider any closed surface, whose outward normal is n, we have for the whole outflow in unit time the surface integral

$$(16)\qquad \Phi=\iint\rho q_n dS=\iint\rho[u\cos(nx)$$
$$+v\cos(ny)+w\cos(nz)]dS.$$

But we may find a different expression for the same quantity, by considering the elements of volume. Consider the parallelopiped of Fig. 2, and let u be the mean velocity on the side $ABCD$, $u+\frac{\partial u}{\partial x}dx$ on the opposite side $EFGH$. Then the inflow on the first side will be $\rho u dy dz$, while the outflow through the second will be $\left\{\rho u+\frac{\partial(\rho u)}{\partial x}dx\right\}dydz$. The total outflow will thus be

$$\frac{\partial(\rho u)}{\partial x}dxdydz.$$

In a similar manner we find the outflow through the two remaining pairs of sides to depend on the other two components. From the whole surface we accordingly have the outflow

$$\left\{\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}\right\}dxdydz,$$

and for the outflow per unit volume we have

$$(17)\qquad \frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}.$$

On account of this kinematical interpretation, if we have any vector F, whose components X, Y, Z are functions of the coordinates of a point, the expression

$$(18)\qquad \frac{\partial X}{\partial x}+\frac{\partial Y}{\partial y}+\frac{\partial Z}{\partial z}$$

is called the *divergence* of the vector, and will be abbreviated div F. Summing up the outflow for all the elements of volume inside the surface S, it is evident that the volume integral thus found must be equal to the surface integral Φ. Thus we have

$$(19)\quad \iint \rho\{u\cos(nx)+v\cos(ny)+w\cos(nz)\}dS$$
$$=\iiint\left\{\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}\right\}dxdydz.$$

This may be taken as a kinematical proof of the *Divergence Theorem*, due to Gauss and Green, in which, for any vector function which is continuous and has a definite value at every point in the volume within S,

$$(20)\quad \iint\{X\cos(nx)+Y\cos(ny)+Z\cos(nz)\}dS$$
$$=\iiint\left\{\frac{\partial X}{\partial x}+\frac{\partial Y}{\partial y}+\frac{\partial Z}{\partial z}\right\}dxdydz,$$

or in more abbreviated notation,

$$(20)\qquad \iint F_n dS=\iiint \operatorname{div} F\cdot d\tau.$$

The surface-integral in (20) is called the *flux* of the vector F through the surface S. If we have any continuously distributed vector-function F, that is, one whose components X, Y, Z are continuous functions of the point x, y, z, we may draw curves having the property that at every point on a curve its tangent has the direction of the vector F. The differential equations of these curves are

$$\frac{dx}{X}=\frac{dy}{Y}=\frac{dz}{Z}=\frac{ds}{F},$$

and the curves are called *lines* of the vector F. For instance, lines of the vector q are called *lines of flow*. If we draw all the lines of the vector passing through a closed contour, we shall obtain a tubular surface called a *tube* of the vector, Fig. 6.

If the fluid is incompressible, as much fluid must flow out from as into any volume, so

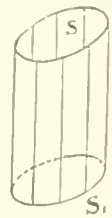


FIG. 6.

that the total outflow is zero. The density is then constant, and we have, dividing (17) by ρ,

$$(21)\qquad \operatorname{div} q=\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0.$$

A vector whose divergence is zero is said to be *solenoidal* ($\sigma\omega\lambda\dot{\eta}\nu$, a tube), for its tubes have the property that the flux across a cap, or portion of a surface bounded by the tube, is the same wherever the surface be drawn. Analytically, applying the divergence theorem to the portion of space bounded by a portion of such a tube and two caps forming ends, since along the sides of the tube the normal component vanishes that portion of the flux in (20) is zero. Accordingly the flux through both ends is zero, or the flux out through one is equal to that in through the other. Or, looking in the direction of the vector-lines, the flux across any cap is the same. If we consider a tube of infinitesimal cross-section, and S is the area of a right section, since the flux is FS, which is constant for the tube, the magnitude of the vector F is inversely proportional to the area of the cross-section.

If the liquid is not incompressible the total outward flux is equal to the time-rate of decrease of the mass inside the surface, S, so that, the mass in an element of volume $d\tau = dxdydz$ being $\rho d\tau$, we have

$$(22)\qquad -\frac{\partial m}{\partial t}=-\frac{\partial}{\partial t}\iiint\rho d\tau=\iint\rho q_n dS$$
$$=\iiint\operatorname{div}(\rho q)d\tau$$

Now since the volume over which we integrate is independent of the time, we may differentiate under the integral sign; also, both integrals being taken over the same volume, we may combine them into one,

$$(23)\qquad \iiint\left\{\frac{\partial\rho}{\partial t}+\operatorname{div}(\rho q)\right\}d\tau=0.$$

This equality holding for any volume whatever, the integrand must vanish, so that we have

$$(24)\qquad \frac{\partial\rho}{\partial t}+\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}=0.$$

This is the so-called *equation of continuity*, the term arising from the continuity of existence of mass, none being created or destroyed, but being conveyed without change from place to place.

Beside the surface- and volume-integrals dealt with above, we need to consider certain line-integrals. If we resolve the vector q along the direction of the tangent to a curve running from A to B, and multiply by the length of the arc ds, and integrate from A to B along the curve, the line-integral

$$(25)\qquad \int_A^B q_s ds = \int_A^B (u dx + v dy + w dz)$$

is called the *circulation* along the curve. If we describe the curve in the reverse direction, the integral changes sign. If the curve is a closed one, we shall prove the line-integral to be equal to a certain surface-integral over any surface S which has the contour in question as a boundary. Suppose first the contour is a plane curve and the surface is a plane. Let us divide the area up into infinitesimal rectangles by lines parallel to the axes of X and Y, Fig. 7. If we then find the circulation

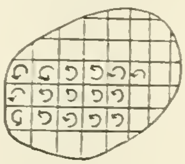


FIG. 7.

around each of the rectangles in the same direction, we shall have gone around all the sides common to two adjacent rectangles twice in opposite directions, so that those parts of the circulation will have destroyed each other, and there will remain only those parts which belong to the original contour. Accordingly the integral around the contour is equal to the sum of all these around the infinitesimal rectangular contours. Consider one of these, $ABCD$, Fig. 8. Along AC the

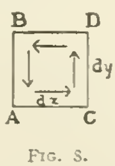


FIG. 8.

tangential component is u, and the contribution to the integral $u dx$. Along BD the value of u is $u+\frac{\partial u}{\partial y}dy$, and since we are going in the opposite direction the contribution to the integral is $-\left(u+\frac{\partial u}{\partial y}dy\right)dx$. Along AB the tangential component is v, and, since we are moving from B to A, the contribution to the integral is $-v dy$. Along CD the tangential component is $v+\frac{\partial v}{\partial x}dx$ and the contribution $\left(v+\frac{\partial v}{\partial x}dx\right)dy$. Adding these four we have

$$\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dx\,dy,$$

and summing for all the rectangles,

$$(26)\qquad \int q_s ds = \int\int\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dx\,dy,$$

which is a particular case of our theorem.

If the contour is not a plane curve, so that the surface S is not plane, let us by drawing a series of planes parallel to one of the coordinate planes divide it into infinitesimal strips, Fig. 9, and then by drawing planes alternately

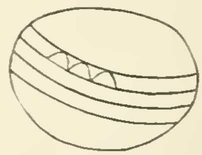


FIG. 9.

parallel to the two other coordinate planes divide each strip into infinitesimal triangles each having one side parallel to each coordinate plane. As before, the sum of the circulations around all the triangles is equal to the circulation around the contour. Let us consider one of these triangles, BCD, Fig. 10, and let A

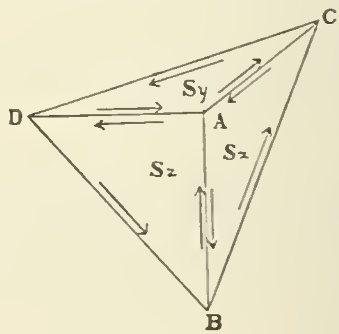


FIG. 10.

be the point from which lines drawn parallel to the coordinate axes will pass through B, C, D. Again, circulation around BCD is equivalent to the sum of the circulations around the triangles ABC, ACD, ADB, the projections of BCD parallel to the coordinate planes. Let the areas of these four triangles be respectively dS, $dS_x = dS\cos(nx)$, $dS_y = dS\cos(ny)$, $dS_z = dS\cos(nz)$, n being the normal to S. Then we have, applying (26) to the three contours,

$$\int_{ABCA} q_s ds = \left(\frac{\partial w}{\partial y}-\frac{\partial v}{\partial z}\right)dS_x,$$

$$\int_{ACDA} q_s ds = \left(\frac{\partial u}{\partial z}-\frac{\partial w}{\partial x}\right)dS_y,$$

$$\int_{ADBA} q_s ds = \left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)dS_z,$$

and consequently

$$\int_{BCDB} q_s ds = \left\{\left(\frac{\partial w}{\partial y}-\frac{\partial v}{\partial z}\right)\cos(nx)\right.$$

$$\left.+\left(\frac{\partial u}{\partial z}-\frac{\partial w}{\partial x}\right)\cos(ny)+\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)\cos(nz)\right\}dS$$

Summing up for all the infinitesimal triangles, we find the surface-integral over the surface S to be equal to the circulation around the contour.

$$(27)\quad \int (u\,dx + v\,dy + w\,dz) =$$

$$\iint \left\{ \left(\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\right)\cos(nx) + \left(\frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}\right)\cos(ny) + \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)\cos(nz)\right\} dS.$$

This is known as Stokes's theorem.

If we define a vector ω with the components ξ, η, ζ,

$$(28)\quad \begin{aligned} 2\xi &= \frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}, \\ 2\eta &= \frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}, \\ 2\zeta &= \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}, \end{aligned}$$

we have the integrand in the surface-integral in (27),

$$2[\xi \cos(nx) + \eta \cos(ny) + \zeta \cos(nz)] = 2\omega_n,$$

as the component of 2ω normal to the surface S. The vector 2ω is called the *curl* of q, for the reason that if the lines of the vector «curl» about in any region, so that the tangential component along a closed curve always has the same sign, the surface-integral, and hence the curl, cannot vanish. We may write Stokes's theorem in the abbreviated form

$$(27)\quad \int q_s ds = \iint (\text{curl } q)_n dS.$$

As an example of the kinematical significance of the curl, let us consider a portion of fluid which revolves like a rigid body about the Z-axis We then have $u = -ay$, $v = ax$, where a is a constant representing the angular velocity. We thus have

$$2\zeta = \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} = 2a.$$

Or applying Stokes's theorem to a circle with center on the axis of rotation, since $q = ar$,

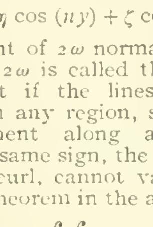


Fig. 11.

the line-integral is $2\pi r \cdot q = 2\pi r^2 a$, which is equal to the area of the circle multiplied by $2a$, which must represent the curl. Thus we

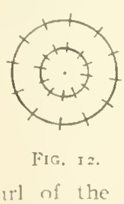


Fig. 12.

find that the curl of the velocity is twice the angular velocity with which an element of fluid is revolving. On this account the vector ω has received the name of *vorticity*, and fluid moving so that ω is not zero is said to move vortically. As the difference between vortical and non-vortical motion is very important, we may illustrate it as follows: It is possible that fluid may circulate in a region either vortically or non-vortically. Suppose that the fluid is filled with short straws represented by the short lines in Figs. 11 and 12; if, as the fluid moves about, these all remain parallel to their original direction, the flow is non-vortical, Fig 11; if they turn, the flow is vortical, Fig. 12. Thus it is impossible to tell by merely looking at a diagram of stream-lines whether the flow is vortical or not.

It will be shown later that the divergence and curl of a vector function are characteristic of it, and that if they are known everywhere the complete nature of the vector is known. They are quite independent of each other, as is illustrated in Fig. 13, which shows re-

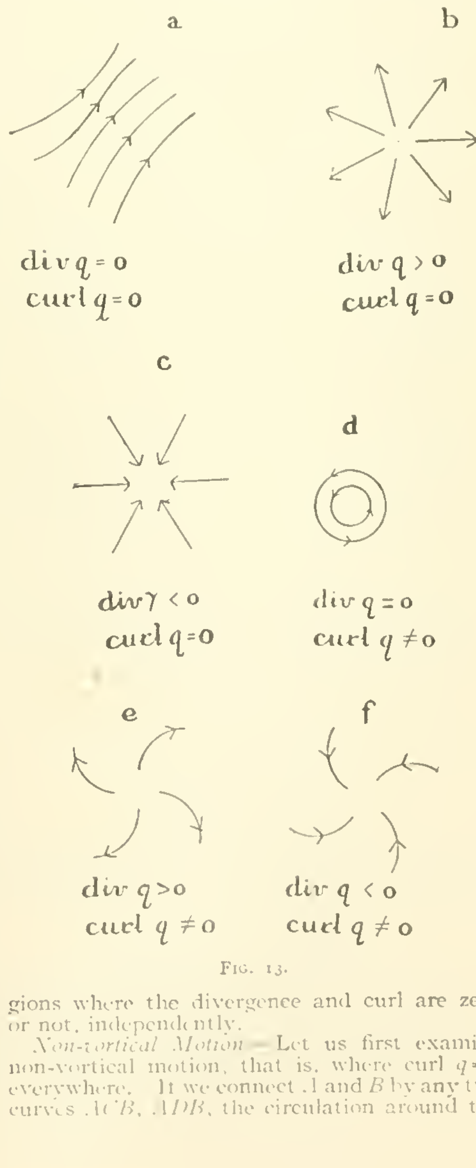


Fig. 13.

gions where the divergence and curl are zero or not, independently.

Non-vortical Motion.—Let us first examine non-vortical motion, that is, where curl $q = 0$ everywhere. If we connect A and B by any two curves ACB, ADB, the circulation around the closed path $ACBDA$ will be zero, hence the circulation from A to B will be the same by either path. Thus the circulation does not depend on the path, but only on the position of its ends, so that we have

$$(29)\qquad \int_A^B q_s ds = \phi_B - \phi_A,$$

which necessitates

$$q_s ds = u dx + v dy + w dz = d\phi = \frac{\partial\phi}{\partial x}dx + \frac{\partial\phi}{\partial y}dy + \frac{\partial\phi}{\partial z}dz,$$

and therefore

$$(30)\qquad u = \frac{\partial\phi}{\partial x},\quad v = \frac{\partial\phi}{\partial y},\quad w = \frac{\partial\phi}{\partial z}.$$

The function ϕ is called the *velocity-potential.* The direction of the velocity q is everywhere normal to the equipotential surfaces $\phi = \text{const.}$, for if we move along the equipotential we have

$$d\phi = u dx + v dy + w dz = 0,$$

which is the condition that the vectors u, v, w, the velocity, and dx, dy, dz, the displacement, are perpendicular. According to the relation $q_s ds = d\phi$, we have the component of velocity in any direction $q_s = \frac{\partial\phi}{\partial s}$, equal to the space-rate of variation of potential in that direction; and since the velocity itself is equal to the rate of change of ϕ in the direction of the normal to the surface $\phi = \text{const.}$, a vector related to a function ϕ by the relations (30) is called the *gradient* of the function. A vector which is thus derived from a potential function is called a *lamellar* vector.

As an example of lamellar flow, let us take the case in which the velocity is directed radially outwards from a given point a, b, c with a value depending on the distance $r = \sqrt{(x-a)^2 + (y-b)^2 + (z-c)^2}$ from that point, $q = f(r)$. The equipotential surfaces are concentric spheres, and we easily find the potential to be $\phi = \int f(r)dr$. For, since the direction cosines of r are $\cos(rx) = \frac{x-a}{r}$, $\cos(ry) = \frac{y-b}{r}$, $\cos(rz) = \frac{z-c}{r}$, we have the components of the velocity,

$$\begin{aligned} u &= f(r)\frac{x-a}{r} = \frac{d\phi}{dr}\frac{\partial r}{\partial x} = \frac{\partial\phi}{\partial x},\\ (30)\qquad v &= f(r)\frac{y-b}{r} = \frac{d\phi}{dr}\frac{\partial r}{\partial y} = \frac{\partial\phi}{\partial y},\\ w &= f(r)\frac{z-c}{r} = \frac{d\phi}{dr}\frac{\partial r}{\partial z} = \frac{\partial\phi}{\partial z}.\end{aligned}$$

The flux out through any of the concentric spheres is $M = 4\pi r^2 q$, so that if the fluid is incompressible we must have

$$(31)\qquad q = \frac{M}{4\pi r^2},\quad \phi = -\frac{M}{4\pi r},$$

where M is constant. The vector q is then solenoidal as well as lamellar, and the equation of continuity becomes

$$(32)\quad \operatorname{div} q = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = \frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} + \frac{\partial^2\phi}{\partial z^2} = 0.$$

This equation for ϕ is known as Laplace's equation, and the sum of the three partial derivatives of second order, which will be abbreviated as $\Delta\phi$, is called the *Laplacian* of q. Obviously the above flow cannot extend as far as $r = 0$, for there the velocity would be infinite. Suppose that in a small region of volume τ at the center liquid is being created just fast enough to supply the outflow, so that the volume M is created per unit of time. Such a region is called a *source*, and the whole system of flow is called a *squirt*. The quantity M is called the *strength* of the source, and the strength per unit of volume $M/\tau = \sigma$ the *source-density*. If we have several sources, and add their potentials, the resultant velocity will be obtained as the gradient of the sum. Thus a complicated vector-field may be represented by its potential function. The sources may be continuously distributed through a portion of space, then σ, the source-density, will be a function of the position of the point, and the total strength will be

$$(33)\qquad M = \iiint \sigma d\tau,$$

while the total potential will be

$$(34)\qquad \phi = -\frac{1}{4\pi}\iiint \frac{\sigma d\tau}{r},$$

where r represents the distance from the element $d\tau$ to the point where ϕ is calculated. The total flux through any closed surface will be

$$(35)\quad \iint q_n dS = \iint \frac{\partial\phi}{\partial n}dS = \iint (\text{grad }\phi)_n dS,$$

or by the divergence theorem,

$$(36)\quad \iint q_n dS = \iiint \operatorname{div} q \cdot d\tau = \iiint \Delta\phi \cdot d\tau = \iint (\text{grad }\phi)_n dS.$$

Since this flux must be equal to the strength of all the sources within the surface of integration, we must have

$$(37)\qquad \iiint \Delta\phi \cdot d\tau = \iiint \sigma d\tau.$$

Now as this equality holds for any volume whatsoever, the integrands must be equal; accordingly we have

$$(38)\qquad \Delta\phi = \sigma,$$

as a consequence of equation (34). The equation (38) is called Poisson's equation. We may also prove the converse, namely, that if σ is given as a function of the point, the integral of equation (38) is given by (34). This is done by means of Green's theorem.

In the divergence theorem (20) let us put for the vector F the value $U \cdot \text{grad } V$, where U and V are two functions, both of which, with their derivatives, are finite, singly-valued, and continuous in the region of integration. Then we have

$$X = U\frac{\partial V}{\partial x},\quad Y = U\frac{\partial V}{\partial y},\quad Z = U\frac{\partial V}{\partial z},$$

$$\frac{\partial X}{\partial x} + \frac{\partial Y}{\partial y} + \frac{\partial Z}{\partial z} = U\Delta V + \frac{\partial U}{\partial x}\frac{\partial V}{\partial x} + \frac{\partial U}{\partial y}\frac{\partial V}{\partial y} + \frac{\partial U}{\partial z}\frac{\partial V}{\partial z},$$

$$(39)\quad \iint F_n dS = \iint U(\text{grad } V)_n dS$$

$$= \iint U \frac{\partial V}{\partial n} dS$$

$$= \iiint \left\{ U \Delta V + \frac{\partial U}{\partial x}\frac{\partial V}{\partial x} + \frac{\partial U}{\partial y}\frac{\partial V}{\partial y} + \frac{\partial U}{\partial z}\frac{\partial V}{\partial z} \right\} d\tau.$$

Interchanging the functions U and V and subtracting from (39), we have

$$(40)\quad \iint \left\{ U \frac{\partial V}{\partial n} - V \frac{\partial U}{\partial n} \right\} dS$$

$$= \iiint \left\{ U \Delta V - V \Delta U \right\} d\tau.$$

The equations (39) and (40) are known as Green's Theorem. Let us apply it to two functions, one of which, U, is the reciprocal distance from a fixed point P, $U = 1/r$. Let us apply the theorem to the whole extent of space, bounded by the infinite sphere, with the exception of a portion bounded by a small sphere with center at P, which we exclude, on account of the infinite value of U at P. We must thus take the surface-integrals over the large and small spheres, the normals being in each case drawn away from the volume considered, or out in the first case, in in the second. Since the direction of the normal coincides with that of the radius of the sphere,

$$\frac{\partial(1/r)}{\partial n} = \pm \frac{\partial(1/r)}{\partial r} = \mp \frac{1}{r^2},$$

in the two cases respectively, while $dS = r^2 d\omega$, where $d\omega$ is the element of area of a sphere of radius unity, cut out by a cone of vertex P, having as base the element dS. Accordingly on either sphere

$$(41)\quad \iint V \frac{\partial(1/r)}{\partial n} dS = \mp \iint V d\omega,$$

and if V vanishes at $r = \infty$, the integral over the infinite sphere vanishes. If we now let the radius of the small sphere diminish without limit, the value of V to be taken is the value at P, so that

$$(42)\quad -\iint V \frac{\partial(1/r)}{\partial n} dS = -V_P \iint d\omega = -4\pi V_P.$$

On the other hand the surface-integral

$$\iint \frac{1}{r}\frac{\partial V}{\partial n} dS = r \iint \frac{\partial V}{\partial n} d\omega,$$

over the spheres vanishes for $r = \infty$, on account of the vanishing of $\frac{\partial V}{\partial n}$ to the second order, and for the small sphere in the limit, on account of the factor r. As for the volume-integrals we have seen in (31), (32), that any multiple of $1/r$ satisfies Laplace's equation, hence $\Delta(1/r) = 0$, so that finally

$$(43)\quad V_P = -\frac{1}{4\pi} \iiint \frac{\Delta V}{r} d\tau,$$

the integral being taken over all space. But this is the required theorem, the converse of (38).

Solutions of Laplace's equation can be found for the case of uniplanar flow, where the velocity is parallel to a given plane, and independent of the coordinate perpendicular thereto. A plane diagram then represents the flow. If the given plane is that of X, Y, Laplace's equation becomes

$$(44)\quad \frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0.$$

An infinite number of solutions are furnished us by the method of functions of a complex variable $x + iy$, where i is the imaginary defined by $i^2 = -1$.

If now we take any function $w = f(z)$ of the combination $z = x + iy$, on arranging it in powers of x, iy, all even powers of i will be real, all odd ones real multiples of i; accordingly w will be of the form $\phi + i\psi$, where ϕ, ψ are real functions of the two real variables x, y. Differentiating partially,

$$\frac{\partial w}{\partial x} = f'(z)\frac{\partial z}{\partial x} = f'(z), \quad \frac{\partial w}{\partial y} = f'(z)\frac{\partial z}{\partial y} = if'z = i\frac{\partial w}{\partial x},$$

$$\frac{\partial w}{\partial y} = \frac{\partial \phi}{\partial y} + i\frac{\partial \psi}{\partial y} = i\frac{\partial w}{\partial x} = i\frac{\partial \phi}{\partial x} - \frac{\partial \psi}{\partial x},$$

and equating real and imaginary parts,

$$(45)\quad \frac{\partial \phi}{\partial x} = \frac{\partial \psi}{\partial y}, \quad \frac{\partial \phi}{\partial y} = -\frac{\partial \psi}{\partial x}.$$

Differentiating the first equation by x, the second by y, and adding, we have

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0,$$

and similarly

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} = 0.$$

Thus either function ϕ or ψ derived from any function of a complex variable gives us a case of uniplanar flow of an incompressible fluid. From the equations (45) we obtain by cross-multiplication

$$(46)\quad \frac{\partial \phi}{\partial x}\frac{\partial \psi}{\partial x} + \frac{\partial \phi}{\partial y}\frac{\partial \psi}{\partial y} = 0,$$

which is the condition that the normals to the family of curves $\phi = \text{const.}$ and those of the family $\psi = \text{const.}$ intersect each other at right angles. Such families are called orthogonal. For instance, the function

$$(47)\quad w = \frac{1}{z} = \frac{1}{x + iy} = \frac{x - iy}{x^2 + y^2}$$

gives

$$(48)\quad \phi = \frac{x}{x^2 + y^2}, \quad \psi = \frac{-y}{x^2 + y^2},$$

and the curves

$$\frac{x}{x^2 + y^2} = \text{const.}, \quad \frac{y}{x^2 + y^2} = \text{const.}$$

are a set of circles tangent to the Y-axis and the X-axis respectively, the two sets intersecting each other at right angles.

The flux across any cylindrical surface whose generator has the length unity parallel to the Z-axis, and which intersects the XY-plane in a curve from A to B, is, if $\rho = 1$,

$$(49)\quad \Phi_{AB}=\int_A^B q_n ds=\int_A^B \frac{\partial\phi}{\partial n}ds$$
$$=\int_A^B \left\{\frac{\partial\phi}{\partial x}\cos(nx)+\frac{\partial\phi}{\partial y}\cos(ny)\right\}ds.$$

But if the normal lies on the right as we go along the curve, Fig. 14,

$$\cos(nx)ds=dy,\quad \cos(ny)ds=-dx.$$

Using these values and equations (45), we have for the flux

$$(50)\quad \Phi_{AB}=\int_A^B \frac{\partial\psi}{\partial x}dx+\frac{\partial\psi}{\partial y}dy=\psi_B-\psi_A,$$

so that the quantity of liquid crossing the surface does not depend on the curve joining

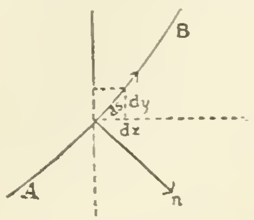


Fig. 14.

AB, but is the same for one as for another, as must be the case if the liquid is incompressible. The function ψ is called the *flux-function*, and since if $\psi_B=\psi_A$, no liquid crosses, it is evident that the curves $\psi=$const. are stream-lines. It is evident from equations (45) that either of the two functions ϕ, ψ may be taken for the velocity-potential, the other being taken for the flux-function. Functions satisfying equations (45) are called *conjugate functions*, and the two states of flow just described are called conjugate. In the case just investigated, the two conjugate flows happened to be identical; this is not generally the case.

For instance, consider the function $w=\log z$, and introducing polar coordinates r, θ,

$$(51)\quad w=\log z=\log(x+iy)$$
$$=\log\{r(\cos\theta+i\sin\theta)\}=\log\{re^{i\theta}\}=\log r+i\theta.$$

Thus we may put

$$(52)\quad \phi=\log r,\quad \psi=\theta,$$

obtaining a radial flow, or uniplanar squirt, with circular equipotentials, or

$$(53)\quad \phi=\theta,\quad \psi=\log r,$$

obtaining a circular flow with radial equipotentials.

Vortex Motion.—Let us now free ourselves from the restriction that the curl of the velocity vanishes. There will then be no velocity-potential in regions where there is curl. Lines whose tangent has everywhere the direction of the vector ω, the vorticity, are called *vortex-lines*, and tubes generated by such lines vortex-tubes, tubes of infinitesimal cross-section being termed vortex-filaments. The fluid within such a tube is called a vortex. Since the curl of any vector is solenoidal, as is seen by differentiating the equations (28) to find the divergence, the vorticity is a solenoidal vector and its tubes have the solenoidal property that the vorticity in any filament is inversely proportional to the area of the cross-section of the filament. The product $S\omega$, which is constant for the filament, is called the strength of the filament. Consequently the vorticity cannot vanish at any point on a tube, nor can the cross-section. The vortex-tubes must accordingly be closed, or end at a free surface of the liquid, as do those vortices formed by an oar at the surface of water.

The properties of vortex-motion were first investigated in an important paper by Helmholtz in 1858. Following him we shall now show that any continuous flow vanishing at infinity may be represented as the sum of a lamellar and a solenoidal part, and that the solenoidal part may be represented as the curl of another vector. Suppose that ϕ be the potential of the lamellar part, Q the vector with components U, V, W, whose curl represents the solenoidal part. Then we assume

$$(54)\quad \begin{aligned} u&=\frac{\partial\phi}{\partial x}+\frac{\partial W}{\partial y}-\frac{\partial V}{\partial z},\\ v&=\frac{\partial\phi}{\partial y}+\frac{\partial U}{\partial z}-\frac{\partial W}{\partial x},\\ w&=\frac{\partial\phi}{\partial z}+\frac{\partial V}{\partial x}-\frac{\partial U}{\partial y}.\end{aligned}$$

Finding the divergence of q we have

$$(55)\quad \operatorname{div} q=\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=\Delta\phi,$$

since the divergence of the curl vanishes. But by (43) we have

$$\phi=-\frac{1}{4\pi}\iiint\frac{\Delta\phi}{r}d\tau=-\frac{1}{4\pi}\iiint\frac{\operatorname{div} q}{r}d\tau.$$

Since q represents a continuous flow, $\operatorname{div} q$ is finite. Accordingly we find that the lamellar part of the flow is completely determined by the distribution of its divergence.

Secondly, find the curl of q.

$$(56)\quad 2\xi=\frac{\partial w}{\partial y}-\frac{\partial v}{\partial z}=\frac{\partial}{\partial y}\left\{\frac{\partial\phi}{\partial z}+\frac{\partial V}{\partial x}-\frac{\partial U}{\partial y}\right\}$$
$$-\frac{\partial}{\partial z}\left\{\frac{\partial\phi}{\partial y}+\frac{\partial U}{\partial z}-\frac{\partial W}{\partial x}\right\}$$
$$=-\Delta U+\frac{\partial}{\partial x}\left\{\frac{\partial U}{\partial x}+\frac{\partial V}{\partial y}+\frac{\partial W}{\partial z}\right\}.$$

Since the vector Q is as yet undetermined except as to its curl, let us assume it to be solenoidal, which will make the divergence in (56) vanish, giving

$$(57)\quad 2\xi=-\Delta U,\quad 2\eta=-\Delta V,\quad 2\zeta=-\Delta W.$$

As before, we find the integrals of these equations to be

$$(58)\quad U=\frac{1}{2\pi}\iiint\frac{\xi}{r}d\tau,\quad V=\frac{1}{2\pi}\iiint\frac{\eta}{r}d\tau,$$
$$W=\frac{1}{2\pi}\iiint\frac{\zeta}{r}d\tau.$$

The integrals are to be taken over all space, but as any part of space where the vorticity vanishes will contribute nothing to the integrals, we may suppose them restricted to the vortices. Thus we see that the solenoidal part of the flow q, which is due to the vortices, is completely determined by the distribution of curl q. Thus the statement is justified that a continuous vector-function is completely determined by its divergence and curl. Kinematically we may say that any flow is the resultant of squirts and vortices. The vector Q, whose components are formed in the manner of potentials from the components of 2ω, is called the *vector-potential* of 2ω.

Thus the velocity due to a vortex is the curl of the vector-potential of twice the vorticity. We may find this velocity by differentiation. Let us distinguish the point of integration from the point for which the potentials are calculated, and by which we differentiate, by attaching an accent to the coordinates of the former. We have

$$(59)\qquad u=\frac{\partial W}{\partial y}-\frac{\partial V}{\partial z}$$
$$=\frac{1}{2\pi}\left[\frac{\partial}{\partial y}\iiint\frac{\zeta'}{r}d\tau'-\frac{\partial}{\partial z}\iiint\frac{\eta'}{r}d\tau'\right]$$
$$=\frac{1}{2\pi}\iiint\left\{\zeta'\frac{\partial}{\partial y}\left(\frac{1}{r}\right)-\eta'\frac{\partial}{\partial z}\left(\frac{1}{r}\right)\right\}d\tau'.$$

Thus the portions of velocity contributed by the element of the vortex $d\tau'$ are

$$du=\frac{1}{2\pi r^3}\{\zeta'(y'-y)-\eta'(z'-z)\}d\tau',$$
$$(60)\qquad dv=\frac{1}{2\pi r^3}\{\xi'(z'-z)-\zeta'(x'-x)\}d\tau',$$
$$dw=\frac{1}{2\pi r^3}\{\eta'(x'-x)-\xi'(y'-y)\}d\tau'.$$

These are immediately seen to be, aside from the factor $1/2\pi r^3$, the projections of the parallelogram whose sides are the vectors ω', and r the vector from x', y', z' to x, y, z. If dq be the magnitude of the resultant, we accordingly obtain

$$(61)\qquad dq=\frac{\omega'\sin(\omega' r)}{2\pi r^2}d\tau',$$

the direction of dq being perpendicular to both ω' and r, as shown by (60).

Let us take for the element of volume $d\tau'$ a length ds of a vortex-filament of cross-section S. Then $d\tau'=Sds$, and since $S\omega'=\kappa$, the strength of the filament

$$(62)\qquad dq=\frac{\kappa ds\cdot\sin(\omega r)}{2\pi r^2}.$$

The velocity is connected with the vorticity in the same way that the magnetic field due to an electric current is connected with the current-density, equation (62) giving us the magnetic field produced by a current of strength $\kappa/2\pi$.

HYDRODYNAMICS.—We now arrive at the subject of Hydrodynamics proper, in which we take account of the forces that are capable of producing the states of flow that have been previously described. Suppose that the coordinates of a particle are x, y, z, then $u=\frac{dx}{dt}$, $v=\frac{dy}{dt}$, $w=\frac{dz}{dt}$. The principles of dynamics tell us that the product of the mass by the acceleration of any particle is equal to the resultant of all the forces applied to it. Taking the mass contained in the element of volume $d\tau$, and the resultant of the bodily forces and pressures, as found under the treatment of hydrostatics,

$$(63)\qquad \rho d\tau\frac{d^2x}{dt^2}=\rho d\tau\frac{du}{dt}=\left(\rho X-\frac{\partial p}{\partial x}\right)d\tau,$$

from which we obtain the equation with two similar ones,

$$(64)\qquad \frac{du}{dt}=X-\frac{1}{\rho}\frac{\partial p}{\partial x},\quad \frac{dv}{dt}=Y-\frac{1}{\rho}\frac{\partial p}{\partial y},$$
$$\frac{dw}{dt}=Z-\frac{1}{\rho}\frac{\partial p}{\partial z}.$$

By the derivative $\frac{du}{dt}$ is meant the rate of change of velocity of a particular particle as it moves about. If we have any function F of the position of a particular particle, we may write its derivative

$$(65)\qquad \frac{dF}{dt}=\frac{\partial F}{\partial t}+\frac{\partial F}{\partial x}\frac{dx}{dt}+\frac{\partial F}{\partial y}\frac{dy}{dt}+\frac{\partial F}{\partial z}\frac{dz}{dt},$$

where $\partial F/\partial t$ would be the rate of change of the function if the particle were at rest. The derivatives $\frac{dx}{dt}$, $\frac{dy}{dt}$, $\frac{dz}{dt}$ are the velocity-components u, v, w. Accordingly we have

$$(66)\qquad \frac{dF}{dt}=\frac{\partial F}{\partial t}+u\frac{\partial F}{\partial x}+v\frac{\partial F}{\partial y}+w\frac{\partial F}{\partial z}.$$

We call this mode of differentiation *particle differentiation*.

Introducing this terminology, our equations of motion become

$$\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}=X-\frac{1}{\rho}\frac{\partial p}{\partial x},$$
$$(67)\qquad \frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}=Y-\frac{1}{\rho}\frac{\partial p}{\partial y},$$
$$\frac{\partial w}{\partial t}+u\frac{\partial w}{\partial x}+v\frac{\partial w}{\partial y}+w\frac{\partial w}{\partial z}=Z-\frac{1}{\rho}\frac{\partial p}{\partial z}.$$

These equations are due to Euler. These three equations, with the equation of continuity, (24), and the physical relation between ρ and p furnish five equations for the determination of the five variables u, v, w, ρ, p as functions of x, y, z, t.

Subtracting from both sides of the first of equations (67) the quantity

$$\frac{\partial}{\partial x}\left(\frac{q^2}{2}\right)=\frac{1}{2}\frac{\partial}{\partial x}\{u^2+v^2+w^2\}=u\frac{\partial u}{\partial x}+v\frac{\partial v}{\partial x}+w\frac{\partial w}{\partial x},$$

we obtain

$$(68)\qquad \frac{\partial u}{\partial t}+w\left(\frac{\partial u}{\partial z}-\frac{\partial w}{\partial x}\right)-v\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)$$
$$=X-\frac{\partial P}{\partial x}-\frac{\partial\left(\frac{q^2}{2}\right)}{\partial x}.$$

If the bodily forces are conservative and derived from a potential V, the right-hand member is the derivative of the quantity $-(V+P+q^2/2)=U$, and inserting the values of ξ, η, ζ,

$$\frac{\partial u}{\partial t}+2(w\eta-v\zeta)=\frac{\partial U}{\partial x},$$
$$(69)\qquad \frac{\partial v}{\partial t}+2(u\zeta-w\xi)=\frac{\partial U}{\partial y},$$
$$\frac{\partial w}{\partial t}+2(v\xi-u\eta)=\frac{\partial U}{\partial z}.$$

If the motion is *steady*, that is, independent of t, the time-derivatives vanish. Then multiplying the equations (69) by dx, dy, dz respectively, adding and integrating along any curve, we obtain on the right the difference between the terminal values of $V+P+q^2/2$. If the curve is either a stream- or vortex-line, that is, if dx, dy, dz are proportional either to u, v, w, or to ξ, η, ζ, the sum on the left will also vanish, so that along a stream-line or a vortex-line we have $V+P+q^2/2=\text{const.}$ If the motion is non-vortical, the left-hand side of (69) vanishes, so that the above sum is constant throughout the fluid. In this case

$$(70)\qquad V+P+\tfrac{1}{2}q^2=\text{const.},$$

this result being called Daniel Bernoulli's theorem.

If the fluid is incompressible, $P=p/\rho$, and if there are no bodily forces $V=0$, so that (70) becomes

$$(71)\qquad \frac{p}{\rho}+\frac{1}{2}q^2=\text{const.}$$

Accordingly where the velocity is small the pressure is large and vice versa. By constricting the tube the velocity is made large and the pressure small. This is the principle of jet exhaust-pumps, like that of Bunsen, the air being sucked in at the narrow part of the jet. The same principle is used in the Venturi water-meter. The horizontal main being reduced in diameter in a certain portion and the difference of pressure at a point in that portion and in the main observed, the velocity is computed. If the pressure at the two cross-sections S_1 and S_2 is p_1, p_2, we have

$$(72)\qquad p_1-p_2=\frac{\rho}{2}(q_2^2-q_1^2).$$

But since the flow is solenoidal, $S_1q_1=S_2q_2$. Combining with (72),

$$(73)\qquad p_1-p_2=\tfrac{1}{2}\rho q_1^2\left\{\left(\frac{S_1}{S_2}\right)^2-1\right\},$$

which determines q_1 in terms of the pressure-difference. The efflux in unit time is $\rho q_1 S_1$.

For the adiabatic expansion of a gas,

$$(74)\qquad P=\frac{b\kappa\rho^{\kappa-1}}{\kappa-1}=\frac{b\kappa}{\kappa-1}\left(\frac{p}{b}\right)^{\frac{\kappa-1}{\kappa}}.$$

We may use Bernoulli's theorem to calculate the efflux of gas from a reservoir. If we consider a point in the reservoir where the pressure is p, so far from the orifice that the air may be considered at rest and if the velocity at the orifice is q and the atmospheric pressure p_0, we have

$$(75)\qquad q^2=2b^{\frac{1}{\kappa}}\frac{\kappa}{\kappa-1}\left\{p^{\frac{\kappa-1}{\kappa}}-p_0^{\frac{\kappa-1}{\kappa}}\right\},$$

which is the usual formula for the efflux of gases.

If the external force be gravity, $V=gz$, and we have for an incompressible fluid,

$$(76)\qquad \frac{p}{\rho}+gz+\tfrac{1}{2}q^2=\text{const.}$$

If we again consider efflux from a reservoir whose upper free surface $z=z_1$ is so large that q is negligible, the pressure being that of the atmosphere, the same above and at the orifice where $z=z_2$, the velocity of efflux is given by

$$\frac{p_0}{\rho}+gz_1=\frac{p_0}{\rho}+gz_2+\tfrac{1}{2}q^2,$$

$$(77)\qquad q^2=2g(z_1-z_2),$$

or the velocity of efflux is that acquired by a body falling freely from a height equal to that of the free surface above the orifice. This is the theorem of Torricelli, one of the oldest on hydrodynamics.

Wave-motion.—The case of uniplanar waves may be dealt with by the method of the complex variable. We shall find that the waves travel with constant velocity a and that it will simplify the problem if we impose upon the whole fluid a horizontal velocity equal and opposite to that of the waves. The waves then stand still, and the motion is *steady*, as in the case of waves about an obstruction in a running river.

Let us consider waves in deep water. At a great depth the vertical motion will disappear, so that

$$u=-a,\quad v=0,\quad \phi=-ax.$$

The function

$$w=-az+Ae^{-ikz}=-a(x+iy)+Ae^{-ik(x+iy)}$$

gives

$$\phi+i\psi=-a(x+iy)+Ae^{ky}(\cos kx-i\sin kx).$$

$$(78)\qquad \phi=-ax+Ae^{ky}\cos kx,$$

$$\psi=-ay-Ae^{ky}\sin kx.$$

When $y=-\infty$ this makes $\phi=-ax$, as required. The free surface of the water being composed of stream-lines is represented by one of the lines $\psi=\text{const.}$, and if we take the origin in the surface its equation is

$$(79)\qquad ay+Ae^{ky}\sin kx=0,$$

which shows that y is a periodic function of x with the wave-length $\lambda=2\pi/k$. The longer the wave-length, that is the smaller k, the more nearly does the exponential reduce to unity and the profile to a curve of sines. The velocity is given by

$$(80)\qquad u=\frac{\partial\phi}{\partial x}=\frac{\partial\psi}{\partial y}=-a-Ake^{ky}\sin kx,$$

$$v=\frac{\partial\phi}{\partial y}=-\frac{\partial\psi}{\partial x}=Ake^{ky}\cos kx,$$

$$(81)\qquad q^2=u^2+v^2=a^2+A^2k^2e^{2ky}+2Ake^{ky}\sin kx.$$

So far we have merely kinematics. The dynamical relation required is that for steady motion,

$$(82)\qquad \frac{p}{\rho}+gy+\tfrac{1}{2}q^2=C.$$

At the surface putting $p=0$ and making use of (79),

$$gy+\tfrac{1}{2}\{a^2+A^2k^2e^{2ky}-2a^2ky\}=C.$$

Since the surface passes through the origin, putting $y=0$,

$$C=\tfrac{1}{2}(a^2+A^2k^2).$$

$$(83)\qquad (g-a^2k)y+\tfrac{1}{2}A^2k^2(e^{2ky}-1)=0.$$

This equation can be only approximately fulfilled, but if the height of the waves is so small in comparison with the wave-length that the square of $2ky$ may be neglected, developing the exponential gives

$$(g-a^2k+A^2k^3)y=0,$$

giving the relation between the velocity and the wave-length.

$$(84)\qquad g-a^2k+A^2k^3=0.$$

If ky is small, the equation of the profile (79) is approximately

$$(85)\qquad y=-\frac{A}{a}\sin kx,$$

so that the height of the waves above the origin is $B = A/a$, inserting which in (84) gives

$$(86)\qquad a^2\left\{\frac{2\pi}{\lambda}\left(1-\frac{4\pi^2B^2}{\lambda^2}\right)\right\}=g.$$

For long waves we accordingly have $a^2 - g\lambda/2\pi$, or the velocity of long waves in deep water is equal to the velocity acquired by a body in falling freely from a height equal to one half the radius of a circle whose circumference is the wave-length.

In order to study the motions of the individual particles of water let us now impress upon the motion given by (80) a uniform velocity a in the X-direction. Equations (80) now give the motion with respect to axes traveling with the waves, so that in order to obtain the motion with respect to fixed axes we have to add a to the u of (80) and replace x by $x - at$, obtaining

$$(87)\qquad \begin{aligned} u &= -Akc^{ky}\sin k(x-at),\\ v &= Akc^{ky}\cos k(x-at).\end{aligned}$$

If the displacement of a particle which when at rest was at x, y is ξ, η, the above values are $\frac{d\xi}{dt}$, $\frac{d\eta}{dt}$, and if we neglect the small change of velocity from x, y to $x+\xi$, $y+\eta$, we may integrate with respec. to the time,

$$(88)\qquad \begin{aligned} \xi &= -Bc^{ky}\cos k(x-at),\\ \eta &= -Be^{ky}\sin k(x-at).\end{aligned}$$

Thus each particle performs a uniform revolution in a vertical circle of radius Bc^{ky} in the time $T=\frac{2\pi}{ka}=\frac{\lambda}{a}$. The rapidity of decrease of the motion as we go below the surface is seen by the fact that at a depth $y = -\lambda$ the amplitude has diminished in the ratio $e^{-2\pi} = .001867$. The form of the wave-profile is shown in Fig. 15, the crests being farther above the

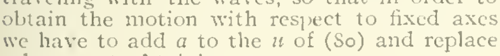


FIG. 15.

level than the troughs are below it. As the height increases the waves become sharper at the crest.

Vortex-motion.—Let us consider the change in circulation along a line that always contains the same particles. We have

$$(89)\qquad \frac{d\phi_{AB}}{dt}=\frac{d}{dt}\int_A^B(udx+vdy+wdz)$$
$$=\int_A^B\left\{\frac{du}{dt}dx+u\frac{d}{dt}(dx)+\frac{dv}{dt}dy+v\frac{d}{dt}(dy)+\frac{dw}{dt}dz+w\frac{d}{dt}(dz)\right\}.$$

Now consider an element ds which at a time later by dt has moved to a position ds', Fig. 16. Since one end has moved in the X-direction a distance udt and the other a distance

$$\left\{u+\frac{\partial u}{\partial x}dx+\frac{\partial u}{\partial y}dy+\frac{\partial u}{\partial z}dz\right\}dt$$

the new value of its X-projection is

$$dx' = x+dx+\left\{u+\frac{\partial u}{\partial x}dx+\frac{\partial u}{\partial y}dy+\frac{\partial u}{\partial z}dz\right\}dt - (x+udt),$$

from which we obtain the derivatives

$$(90)\qquad \begin{aligned} \frac{d}{dt}(dx) &= \frac{dx'-dx}{dt}=\frac{\partial u}{\partial x}dx+\frac{\partial u}{\partial y}dy+\frac{\partial u}{\partial z}dz,\\ \frac{d}{dt}(dy) &= \frac{dy'-dy}{dt}=\frac{\partial v}{\partial x}dx+\frac{\partial v}{\partial y}dy+\frac{\partial v}{\partial z}dz,\\ \frac{d}{dt}(dz) &= \frac{dz'-dz}{dt}=\frac{\partial w}{\partial x}dx+\frac{\partial w}{\partial y}dy+\frac{\partial w}{\partial z}dz.\end{aligned}$$

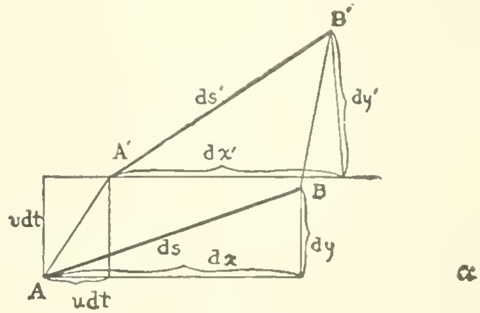


FIG. 16.

But the equations of motion (67) are, in abbreviated form,

$$(91)\qquad \frac{du}{dt}=\frac{\partial(U+q^2/2)}{\partial x},\quad \frac{dv}{dt}=\frac{\partial(U+q^2/2)}{\partial y},\quad \frac{dw}{dt}=\frac{\partial(U+q^2/2)}{\partial z},$$

where $U = -(V+P+q^2/2)$. Accordingly,

$$(92)\qquad \frac{d\phi_{AB}}{dt}=\int_A^B\left\{\frac{\partial(U+q^2/2)}{\partial x}dx+\frac{\partial(U+q^2/2)}{\partial y}dy+\frac{\partial(U+q^2/2)}{\partial z}dz+\left(u\frac{\partial u}{\partial x}+v\frac{\partial v}{\partial x}+w\frac{\partial w}{\partial x}\right)dx\right.$$
$$\left.+\left(u\frac{\partial u}{\partial y}+v\frac{\partial v}{\partial y}+w\frac{\partial w}{\partial y}\right)dy+\left(u\frac{\partial u}{\partial z}+v\frac{\partial v}{\partial z}+w\frac{\partial w}{\partial z}\right)dz\right\}$$
$$=\int_A^B\frac{\partial(U+q^2)}{\partial x}dx+\frac{\partial(U+q^2)}{\partial y}dy+\frac{\partial(U+q^2)}{\partial z}dz$$
$$=(U+q^2)\Big/_A^B,$$

which vanishes for a closed curve. Therefore if the bodily forces are conservative, the circulation around any closed curve moving with the fluid is independent of the time. If the circulation around a closed path is zero at one time, it remains zero, so that if the velocity-potential once exists, it always exists. This theorem is due to Lagrange.

From the equations (69), whose right-hand members are derivatives of the same quantity U, this quantity may be eliminated by differentiation. Differentiating the last equation by y, the second by z, and subtracting,

$$\frac{1}{2}\frac{\partial}{\partial t}\left(\frac{\partial w}{\partial y}-\frac{\partial v}{\partial z}\right)+\xi\frac{\partial v}{\partial y}+v\frac{\partial \xi}{\partial y}-\eta\frac{\partial u}{\partial y}-u\frac{\partial \eta}{\partial y}-\zeta\frac{\partial u}{\partial z}$$
$$-u\frac{\partial \zeta}{\partial z}+\xi\frac{\partial w}{\partial z}+w\frac{\partial \xi}{\partial z}=0,$$

or otherwise,

$$(93)\qquad \frac{\partial\xi}{\partial t}+u\frac{\partial\xi}{\partial x}+v\frac{\partial\xi}{\partial y}+w\frac{\partial\xi}{\partial z}=u\left\{\frac{\partial\xi}{\partial x}+\frac{\partial\eta}{\partial y}+\frac{\partial\zeta}{\partial z}\right\}$$
$$-\xi\left\{\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}\right\}+\xi\frac{\partial u}{\partial x}+\eta\frac{\partial u}{\partial y}+\zeta\frac{\partial u}{\partial z}.$$

On the right the coefficient of u, being the divergence of the vorticity, is zero, while that of ξ is by the equation of continuity equal to $-\frac{d\rho}{\rho\, dt}$, so that equation (93) becomes

$$\frac{d\xi}{dt} = -\frac{\xi}{\rho}\frac{d\rho}{dt} + \xi\frac{\partial u}{\partial x} + \eta\frac{\partial u}{\partial y} + \zeta\frac{\partial u}{\partial z},$$

which may be written, with its two companions,

$$(94)\qquad \begin{aligned} \frac{d}{dt}\left(\frac{\xi}{\rho}\right) &= \frac{\xi}{\rho}\frac{\partial u}{\partial x} + \frac{\eta}{\rho}\frac{\partial u}{\partial y} + \frac{\zeta}{\rho}\frac{\partial u}{\partial z}, \\ \frac{d}{dt}\left(\frac{\eta}{\rho}\right) &= \frac{\xi}{\rho}\frac{\partial v}{\partial x} + \frac{\eta}{\rho}\frac{\partial v}{\partial y} + \frac{\zeta}{\rho}\frac{\partial v}{\partial z}, \\ \frac{d}{dt}\left(\frac{\zeta}{\rho}\right) &= \frac{\xi}{\rho}\frac{\partial w}{\partial x} + \frac{\eta}{\rho}\frac{\partial w}{\partial y} + \frac{\zeta}{\rho}\frac{\partial w}{\partial z}. \end{aligned}$$

Thus the time-derivatives of $\frac{\xi}{\rho}$, $\frac{\eta}{\rho}$, $\frac{\zeta}{\rho}$ for a given particle are homogeneous linear functions of those quantities. By continued differentiation with respect to t and the substitution of the derivatives from these equations, we see that all the time-derivatives are homogeneous linear functions of the quantities themselves. Thus if at any time these quantities are zero, all their derivatives are zero, and developing by Taylor's theorem, we find that the function remains zero for all times. Thus if a particle is once not vortically revolving, it never can acquire such rotation under conservative forces.

Let us now consider two points A and B lying on the same vortex-line at a distance apart $ds = \varepsilon\frac{\omega}{\rho}$, where ε is a small constant. Since the particles lie on the vortex-line we have

$$(95)\qquad \frac{dx}{\xi} = \frac{dy}{\eta} = \frac{dz}{\zeta} = \frac{ds}{\omega} = \frac{\varepsilon}{\rho}.$$

For the difference of velocity at A and B we have

$$(96)\qquad \begin{aligned} u_B - u_A &= \frac{\partial u}{\partial x}dx + \frac{\partial u}{\partial y}dy + \frac{\partial u}{\partial z}dz \\ &= \varepsilon\left\{\frac{\xi}{\rho}\frac{\partial u}{\partial x} + \frac{\eta}{\rho}\frac{\partial u}{\partial y} + \frac{\zeta}{\rho}\frac{\partial u}{\partial z}\right\}, \end{aligned}$$

or, by equations (94),

$$(97)\qquad u_B - u_A = \varepsilon\frac{d}{dt}\left(\frac{\xi}{\rho}\right).$$

Now at an instant later by dt, when the particles are at A' and B',

$$(98)\qquad \begin{aligned} dx' &= dx + (u_B - u_A)dt = \varepsilon\left[\frac{\xi}{\rho} + \frac{d}{dt}\left(\frac{\xi}{\rho}\right)dt\right], \\ dy' &= dy + (v_B - v_A)dt = \varepsilon\left[\frac{\eta}{\rho} + \frac{d}{dt}\left(\frac{\eta}{\rho}\right)dt\right], \\ dz' &= dz + (w_B - w_A)dt = \varepsilon\left[\frac{\zeta}{\rho} + \frac{d}{dt}\left(\frac{\zeta}{\rho}\right)dt\right]. \end{aligned}$$

Therefore the projections of the arc ds' in the new position are proportional to the new values of the components of ω/ρ, as they originally were, so that the particles still lie on a vortex-line. Accordingly a vortex-line is always composed of the same particles of fluid. Also, since the components of ds have changed so as to be always proportional to the components of ω/ρ, if the liquid is incompressible the rotation is proportional to the distance between the particles. And whether ρ vary or not, if S is the cross-section of a vortex-filament, since the mass $\rho S ds$ of a length ds remains constant, so does $S\omega$, the strength of the filament. Accordingly the strength of a vortex-filament is constant, not only at all points in the filament, but at all times, consequently a vortex existing in a perfect fluid is indestructible, however it may move. It is from this remarkable property of vortices discovered by Helmholtz that Lord Kelvin was led to imagine atoms as consisting of vortices in a perfect fluid.

From the kinematical properties of flow due to vortex-motion (62), we see that the velocity at every point of a circular vortex-ring, Fig. 17, due to all the elements of the vortex,

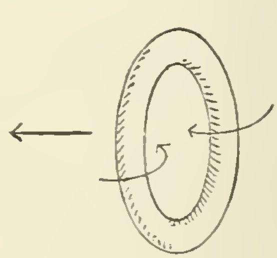


FIG. 17.

is in the same direction perpendicular to the plane of the ring, and in the direction in which the inside of the ring is turning; the ring therefore advances with a constant velocity, as if it were rolling in a tube which it just fits. We may verify this by an experiment due to Professor Tait, where smoke is suddenly forced out through a circular hole in a box provided with an elastic back. The smoky air rolling on the edge of the hole is endowed (by the friction, a *non-conservative* force) with a vortical rotation, and issues as a vortex-ring, which advances with approximately constant velocity for a considerable distance. That it consists always of the same air is seen by the smoke which it carries with it. Such a ring, on striking an edge or obstacle, is not destroyed or cut. Similar experiments can be performed with the rings formed by letting drops of ink fall into water. The loss of velocity finally obtaining in all these cases is due to the viscosity, that is, to non-conservative forces. The treatment of viscosity is beyond the scope of this article.

Bibliography. — Lamb, 'Hydrodynamics'; Bassett, 'Hydrodynamics'; Webster, 'Dynamics'; Tait, 'Dynamics.'

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Hydrofluor'ic Acid. See FLUORINE.

Hydrofluosilicic (hī"drō-floo"ō-sī-lĭs'ĭk) Acid. See FLUORINE.

Hy'drogen (Greek, "producing water," in reference to the fact that in burning in air or oxygen, hydrogen forms water-vapor), a gaseous element, discovered by Cavendish in 1766. It was at first called "inflammable air," the present name being due to Lavoisier. Hydrogen is the lightest known substance, and it also has the smallest known atomic weight. The atomic weight of hydrogen is often taken as unity in stating the relative atomic weights of the different elements (see ATOMIC THEORY), but it is now more usual to assume the atomic weight of oxygen to be precisely 16, which amounts to making the atomic weight of hydrogen 1.0076. According to Regnault's experiments, hydrogen has a density equal to 0.06926 of that of an equal volume of air, at the same temperature and pressure. In absolute measure, the mass of a cubic centimetre of hydrogen, at the freezing point of water and under a pressure of 76 centimetres of mercury at Paris, is 0.00008957 gram, or 0.08957 milligram. Hydrogen has the chemical symbol H, and is one of the most abundant elements known. It occurs in the free state in volcanic gases, and in the sun and in many of the fixed stars. Free hydrogen is also present in the earth's atmosphere in exceedingly small amount. Water (or hydrogen monoxid) is its commonest and most abundant compound, and it is an essential constituent of nearly all organic tissues. Hydrogen may be prepared very easily by many methods. One of the most convenient of these consists in acting upon metallic zinc with dilute sulphuric acid, the reaction in this case being: $Zn + H_2SO_4 = ZnSO_4 + 2H$. Hydrogen is chemically inert towards most of the elements, at ordinary temperatures, but it combines with chlorine when exposed to light,— quietly in diffused daylight, and explosively under the direct action of sunlight. At elevated temperatures it combines with other elements also, and it burns in air (or oxygen) with the development of an intense heat, but with very little light; water being produced as the result of the combustion. Hydrogen has been both liquefied and solidified. Its critical temperature is estimated, by Dewar, to be about 402° F. below zero, and the same authority gives 15 atmospheres as the critical pressure. (See CRITICAL POINT, and GASES, LIQUEFACTION OF.)

Hydrogen combines with oxygen in two proportions. The monoxid, or common water, H_2O, is formed, as already noted, when hydrogen is burned in air or in oxygen. It is also formed in many of the double decompositions that occur in chemistry, as when metallic oxids or hydrates are dissolved in acids. Sodium hydrate, for example, combines with sulphuric acid according to the equation $2NaOH + H_2SO_4 = Na_2SO_4 + 2H_2O$, sodium sulphate and water being formed.

Hydrogen peroxid (or dioxid), H_2O_2, may be prepared by acting upon barium dioxid, BaO_2, with dilute sulphuric acid; the reaction being: $BaO_2 + H_2SO_4 = BaSO_4 + H_2O_2$. The barium sulphate that is formed at the same time is a heavy, insoluble substance, which is easily removed from the solution by filtration, or by settling and subsequent decantation. The aqueous solution of the peroxid may then be concentrated by evaporation over strong sulphuric acid, under the receiver of an air pump. When the water has all evaporated, the pure peroxid remaining behind has a specific gravity of 1.452, and is a colorless, oily liquid, devoid of odor, but having a disagreeable, metallic taste. The peroxid does not freeze, even when cooled to 0° F. At 70° F. it slowly gives off half its oxygen, passing into watbr. At 212° F. this change takes place very rapidly. Owing to the facility with which hydrogen peroxid gives off oxygen, it is used quite largely as a bleaching agent, and also, in surgery, as a disinfectant in the treatment of wounds.

When hydrogen is passed through boiling sulphur, combination takes place, with the formation of hydrogen sulphid, or sulphuretted hydrogen, H_2S. This compound is more conveniently prepared, however, by treating sulphid of iron, FeS, with dilute sulphuric acid, ferrous sulphate ($FeSo_4$) being formed at the same time. The reaction is: $FeS + H_2SO_4 = FeSO_4 + H_2S$. Sulphuretted hydrogen is a gas, devoid of color, but possessing an overpowering odor, suggestive of rotten eggs. It burns with a bluish flame, and is poisonous when inhaled in any considerable quantity, even though largely diluted with air. Under ordinary atmospheric pressure, sulphuretted hydrogen gas condenses, at 80° F. below zero, to a colorless liquid, which freezes to an ice-like solid upon being further cooled to 121° F. below zero. Liquefaction may also be induced at the ordinary temperature of the air by the application of a pressure of from 17 to 20 atmospheres. Sulphuretted hydrogen is an invaluable reagent in the chemical laboratory, where it is greatly used for separating the metals into groups, in inorganic analysis. (See CHEMICAL ANALYSIS.)

With carbon, hydrogen forms a large number of compounds which are collectively known as hydrocarbons (q.v.). With carbon and oxygen, and with carbon, oxygen and nitrogen, hydrogen forms compounds past enumeration. For further information concerning these, consult any treatise on organic chemistry, and also, in this encyclopedia, the articles FATTY COMPOUNDS and AROMATIC COMPOUNDS.

Hydrogen Peroxid, Hydrogen Sulphid, etc. See HYDROGEN.

Hydrograph'ic Surveying. See SURVEYING.

Hydrography, hī-drŏg'ra-fĭ (Greek *hydōr* or *hudor,* water, *grapho,* to describe), meaning literally a "description of water." is the name applied to that branch of physical geography which describes the water on the surface of the globe, whether occurring on land, as in springs, rivers, and lakes, or in seas and great oceans. It is sometimes used in a more restricted sense, and confined to a description of the bearings of coasts, of currents, soundings, islands, shoals, etc., with a more immediate view to navigation, and the construction of charts and nautical tables. Henry the Navigator was the first who constructed a tolerably reliable sea-chart, and laid the foundation of hydrography as a science. This was in the 15th century. In France and other countries, institutions specially formed for teaching navigation are called hydrographical schools. The hydrographic office is now an important department of the naval administration, its officers consolidating into available maps the results of the observations sent to them from time to time by those engaged in exploring expeditions, and by navigators from all parts of the world. See SURVEYING.

Hy'drolite. See GMELINITE.

Hydrom'eter, an instrument for determining the specific gravity of fluids. When a solid body floats in a liquid, and displaces a quantity of the liquid, it is supported by the same upward pressure that formerly supported the liquid which it displaces. The weight of the solid body is thus equal to the weight of the liquid that it displaces. Hence, the depth to which

FIG. 1.— Forms of Hydrometer.

the same solid body is immersed in a liquid is greater as the density of the liquid is less, and less as the density of the liquid is greater. And, likewise, the weights required to immerse a given body equally deep in various liquids are inversely proportional to the densities of the liquids. On each of these principles a form of hydrometer is founded. One is called the constant weight hydrometer, the other the constant volume hydrometer. The first, usually made of glass, is shown in Fig. 1. It has a large hollow bulb, and below that a smaller bulb, weighted with mercury, to make the instrument float upright and it is surmounted by a cylindrical glass stem which is graduated, the divisions being usually marked on a piece of paper enclosed within the stem. The depth to which the hydrometer sinks in the liquid gives the density.

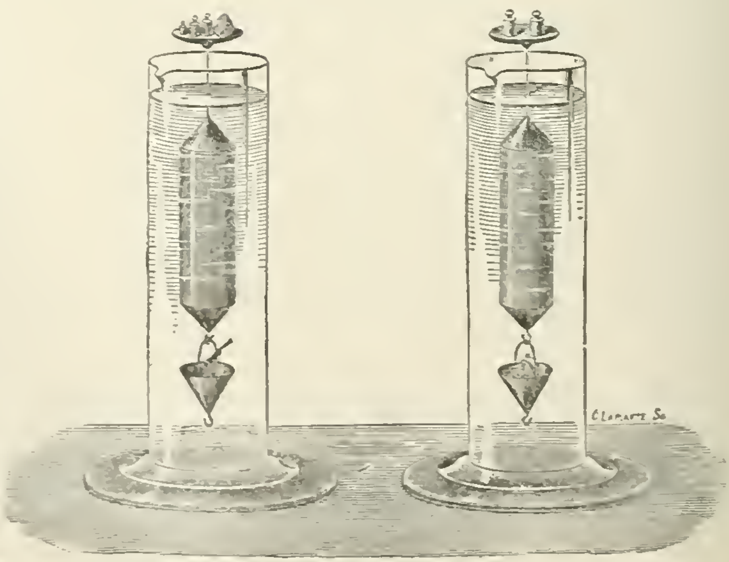

FIG. 2.— Nicholson's Hydrometer.

Of constant volume hydrometers, Nicholson's hydrometer, the best known, possibly, is adapted for determining the specific gravities not only of fluids, but of solids also. It is shown in Fig. 2. It consists of a hollow cylinder of metal, surmounted with a very fine metallic stem, to the top of which there is attached a plate or pan for weights. From the bottom of the metallic cylinder hangs a kind of cup or basket. The whole instrument is weighted so as to float upright. On the fine metallic stem there is a marked point: and by putting weights on the upper pan the hydrometer is always made to sink precisely to the point. If the weight of the instrument itself is known, and also the standard weight, or weight required to sink it to the marked point in distilled water, the calculation of the specific gravity of any liquid from an observation with the instrument is very easy. To determine the specific gravity of solids, the instrument is placed in distilled water and the solid body is put on the upper pan. Weights are then added till the hydrometer sinks to the marked point. But the standard weight of the instrument being known, it is plain that the difference between it and the weights that must be added on the upper pan to the weight of the body whose specific gravity is to be determined must be the weight in air of that body. The body is now transferred to the basket below the instrument, and the weight of the solid in water is similarly determined. From these data the specific gravity of the solid is calculated in the ordinary way. (See SPECIFIC GRAVITY.)

Hydrop'athy, a name for the treatment of diseases by the use of water. This name is now largely superseded by the term hydrotherapy (q.v.).

Hydrophobia (from Greek words meaning "fear of water"), an acute or subacute infectious disease, particularly of canine animals. It is usually communicated by a bite of the afflicted animal, and the contagion, the exact nature of which is unknown, is resident for the most part in the saliva, although it has been found in the peripheral nerves, the pancreas, and the suprarenal gland. It is frequently communicated to man, although the dog, wolf, fox, deer, cat, cow and skunk are the animals most frequently affected: it has been known to occur also in the horse, pig, birds, and other animals. Nine tenths of all the cases are contracted through the bites of rabid dogs. Hydrophobia may be produced, however, by wounds occurring during the dissection of rabid animals; it is said to have been caused by eating the flesh of animals that have died of the disease; and the milk of sucklings, animal and human, is thought to contain the virus. This poison has been found to be active in a dog 44 days buried, and in a rabbit buried 21 days.

In dogs the disease is comparatively common. In 1900 D. E. Salmon, chief of the United States Bureau of Animal Industry, determined that the disease was prevalent throughout the United States, and largely on the increase. The chief symptoms in dogs may be divided into two classes. Dogs suffer from furious rabies, and from dumb rabies. In the former Pasteur thought that the brain was involved; in the latter, the spinal cord. The furious form of the disease shows (1) a period of melancholy or depression; (2) a period of irritation; (3) a period of paralysis. The first varies from a few hours to two days. During this period the anxious and restless dog may also be cross. He hides from his master, obeys sullenly, and changes his position frequently. His appetite may not be at first affected, but it soon fails; he may lick everything in sight, or bite everything within reach, swallowing all sorts of foreign bodies. The period of irritation usually persists three or four days, during which the dog is spasmodically mad; restlessness increases, and the animal has an irresistible impulse to run away. During the running spells dogs may bite at everything in sight; at such times they usually seem fearless, and rarely avoid other dogs or people. If caged, they tear and chew on the bars, even breaking their teeth or fracturing their jaws. The bark is modified into a peculiar howl. During the third or paralytic period the dog is subdued and more sullen; the lower jaw becomes paralyzed and hangs down, saliva dripping from the mouth; the gait is staggering; from the fourth to the eighth day after the onset he dies of paralysis or exhaustion.

In dumb rabies the characteristic second stage may be entirely absent. The most persistent feature of dumb rabies is the dropped lower jaw, the paralysis of the jaw in the later stages preventing the dog from biting. Veterinarians see many cases of dumb rabies in dogs brought to them by owners who think that the trouble is caused by a bone in the throat. Beware of a dog that becomes listless and dull and hides away, is always on the go, prowling about and restless; one that is sullen and walks with his head down like a bear. A dog that scrapes incessantly and tears things up, and one that suddenly becomes excessively fond of its master, desiring to lick his hands and face, should be watched and guarded. A dog that has trouble in swallowing, that seems to have a bone in his throat, or, having wandered away from home, returns covered with dirt, exhausted and miserable, should be put under lock and key.

So far as the water-test is concerned, it is nonsense. The mad dog is often very fond of water; he is thirsty and rushes into water, thrusts his head into it; but he may have great difficulty in swallowing it, the act of swallowing usually bringing about severe convulsions.

In man the disease may go through somewhat similar stages, but the course is greatly modified; males are more likely to be affected than females, the difference in dress and exposure accounting for this; and two fifths of the subjects are below the age of 15. Bites on the face, neck, and hands are thought to be the most liable to develop the disease, and punctured wounds are more dangerous than lacerated wounds because of the difficulty in cleansing them. In man the period of incubation varies widely, from 20 to 60 days is the usual range, but six months may represent an extreme limit. In exceptional instances the period of incubation seems to have been greatly prolonged. The pathological changes recently discovered are found to be extremely characteristic, so that it is now even possible to diagnose rabies in a dog within a reasonable time after his death.

In all cases of suspected hydrophobia it is best not to kill the dog; but if, by accident or design, the death is accomplished the body should at once be sent to the health board authorities for a confirmation of the diagnosis. The characteristic changes, as described by Nélis in 1900, consist in minute alterations in the spinal ganglion cells, especially in a proliferation of the endothelial cells of the ganglionic cell capsule. These changes are considered characteristic of this disease, and are not known to occur in any other affection. The general treatment is both prophylactic and remedial. All stray dogs should be destroyed; or, if they have bitten anyone, they should be imprisoned and watched. It is best to have dogs muzzled or held in leash. In Germany muzzling has entirely eradicated hydrophobia. London in 1889 had 176 cases of hydrophobia. Muzzling was made compulsory, and in 1890 the number of cases of rabies had fallen to 44; in 1891 to 28; and in 1892 to 3. The muzzling was then allowed to lapse, owing partly to the sentimental agitation of many so-called lovers of dumb animals, and the cases of rabies increased, 25 persons dying of the disease in five years, while 174 patients were sent for treatment to the Pasteur Institute.

The direct treatment of the wound causing rabies is important. The poison seems to diffuse slowly, so that, if a ligature is promptly placed about the limb on the body side of the wound, a suction-cup or direct sucking may extract all of the virus. In the non-abraded mouth the virus is not very poisonous. If the wound is deep it is sometimes wise to make immediately a free incision, permitting the flow of blood to wash away the virus, and also allowing a more open surface for the actual cautery. One of the best cauterizing agents to use is strong nitric acid. The after-treatment will depend very largely on the promptness and thoroughness of the first treatment. If there is reason to believe that the early cauterization was ineffectual, the Pasteur method of treatment (see Pasteur, Louis) is advisable. This is a complicated method which was elaborated by Pasteur about 1880. He found that the virus was present in the spinal cord of a rabid animal; that its virulence slowly diminished after the death of the animal; that the virus could be artificially weakened by passing it through a series of monkeys until it was powerless; and that, conversely, this virulence could be restored by inoculating the attenuated virus in a series of rabbits. Thus Pasteur made a weak virus and a strong one at will, and he later produced immunity to the virus by the use of his attenuated material. The final plan that was adopted was to kill a rabbit by means of his strong virus, remove its spinal cord, cut this up into short sections, and dry it for varying periods of time. In this manner he secured a graded series of cord-sections of gradually decreasing virulence. These were emulsified in salt-solution and used to inject into animals or man, the weaker virus being first used and the stronger later. Two methods are now (1903) in vogue — the simpler method, for the less severe bites, in which 19 injections are given in 14 days; and the intensive method, for the severe bites about the neck and face and the large nerve-trunks, in which 28 injections are administered in 21 days. The serum-treatment of the disease is also rapidly becoming a possibility. Two Italian investigators, Tizzoni and Centanni, have made an anti-rabic serum that promises something for the future. For the present, however, the Pasteur method is the most reliable. It is certainly harmless, and is worthy of trial. The results are assuring, and the statistics, to most minds, convincing. It should not be forgotten that there is a false hydrophobia which is of purely hysterical origin, during an attack of which some patients have died. Consult: Bradford, 'Two Lectures on Rabies' ('Lancet,' 3 March 1900); 'Hydrophobia in Germany' ('Hygienische Rundschau,' 7 Nov. 1899); 'Report of Select Committee of the House of Lords on Rabies in Dogs' (Blue Book, 1887); Medical News' (15 Aug. 1903); Sixteenth Annual Report Bureau of Animal Industry (1899). See HYSTERIA.

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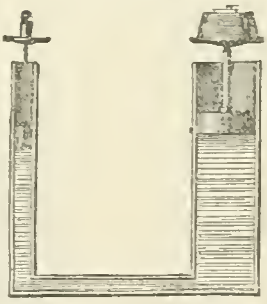
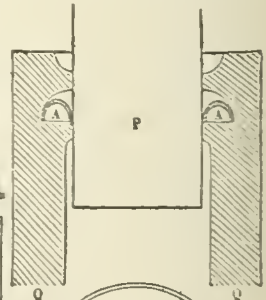
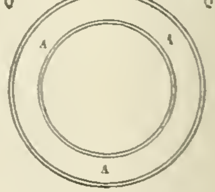
Hydrophytes, plants which grow in water or mud. They may be wholly submerged, completely without roots, and derive their sustenance wholly from the water; or may live amphibiously, rooted in soil and lifting some or all of their leaves into the air, and so differ only in a greater or less degree from land plants. Adaptations of water plants are especially to meet the difficulty of obtaining oxygen and of effecting pollination under water. In plants which grow wholly in or under water, roots, when present, are comparatively small and free from hairs, stems are slender and abound in air-spaces, and leaves are, as a rule, either long and narrow, or else greatly subdivided, so as to expose the greatest possible amount of surface. The cuticle of the leaf, also, is very thin, and lacks several of the structures, such as palisade cells and stomata, always present in aerial leaves. Water therefore enters easily into the tissues of the plant and carries with it a large amount, not only of oxygen, but of dissolved nutriment, so that in any oceanic plants, and plants of ponds and rivers, no roots whatever are developed, and these live practically independent of any connection with the land. The fertilization of submerged cryptogams is effected by the passing of generative elements through the water, but only a few submerged phanerogams make such use of the agency of the water. The pollen of the eel-grass (*Zostera*) has been modified for under-water efficiency. It does not form round grains, but elongated thread-like filaments which have the same specific weight as the water, and hence neither float nor sink, but move about at the level of eel-grass growth until they come in contact with the stigma of some neighboring flower. In the duckweeds and some other submerged plants, the male flowers break loose, rise to the surface and float away like little boats carrying pollen to the female blossoms, which at that time have risen to the surface but sink again as soon as fertilized. The hydrophytes show many examples of exceedingly wide distribution, as might be expected of oceanic plants, but is not so easily explained of those of fresh waters, many genera and species of which, nevertheless, are cosmopolitan.

Hydrostatic Press, a machine, sometimes called Bramah's press, from Joseph Bramah, its presumed inventor, which by the force obtained from water under pressure performs work, especially packing, as of cotton. Two tubes of unequal area are connected, and the whole vessel filled with water. Let the area of the smaller tube be one square inch, and let the piston that closes it be loaded with one pound. A pressure of one pound per square inch will be exerted on every part of the boundary of the fluid. There will thus be a pressure of one pound per square inch put upon the piston that closes the larger tube: and if we suppose the area of the piston to be 16 square inches, it is evident that it must



Principle of the Hydraulic Press.





Cup-leather.

be loaded with 16 pounds in order that the pressure to which it is exposed may be equilibrated. Thus a load of one pound on the smaller piston supports 16 pounds on the larger.

The principle of the hydrostatic press was pointed out by Stevinus; but it was Bramah who, in 1796, by an ingenious contrivance, gave the principle practical application. A Bramah's press, as ordinarily constructed and used to provide immense pressure, is a simple enough contrivance. By means of a small pump water is pumped from a cistern through a small horizontal tube into the space that receives a large piston. The goods to which pressure is to be applied are placed between the plate attached to the large piston and an upper plate that is kept in position by powerful iron rods. The water-tight stuffing of the piston is the great difficulty in the construction of the machine, and it was the invention of a water-tight collar by Bramah that made the use of the press practicable. The diagram shows a section AA of the collar surrounding the piston P. The collar consists of a circle of solid leather, which is stamped by means of a die into the half-ring, of which a section is seen. When pressure is applied the water fills the channel formed by the half-ring, and squeezes the inner side of the ring against the piston, and this takes place with greater force the greater the pressure to which the water is subjected.

Hydrostatics, the part of hydrodynamics that treats of the application of forces to fluids at rest. It is generally divided into two parts, one, hydrostatics proper, which deals with incompressible fluids, or liquids, and the other, which deals with compressible fluids, that is, with gases. The latter part of the subject is commonly called pneumatics.

The property of fluids which distinguishes them from solids, is want of rigidity. A fluid offers no permanent resistance to forces tending to change its shape. The particles of a fluid are mobile; and while in the case of liquids very considerable forces of cohesion are exhibited, yet the particles show great freedom to alter their relative positions, and to pass from place to place within the general mass. A very important property that follows from the nature of fluids is that of the equable transmission of pressure. Suppose a weightless liquid inclosed in a vessel A, which is fitted with a piston P. If pressure is applied to P it will be transmitted in all directions through the liquid. If other openings are made, and if they are fitted with pistons, it is evident that to keep each of these pistons in its place, pressure inward must be applied. The pressure that must be applied to any piston equal in area to the area of P is equal to the pressure on P; and if the area of one of the other pistons is greater or less than the area of P, the pressure required to keep it in its place is proportionately greater than or less than the pressure that is applied to P. This principle, which is the most important in hydrostatics, finds a practical application in the hydrostatic press (q.v.).

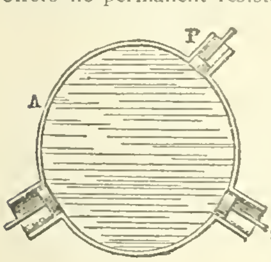


FIG. 1.

In measuring fluid pressure the area exposed to the pressure of the fluid is to be considered. If it were required to calculate the force that must be applied to the rod of one of the pistons in the figure in order to keep the piston in its place, it would be necessary to know the area of the piston and the pressure on it in grams per square centimetre. When the pressure over a given area is not uniform we must then know the law of variation, or at least the average pressure over the whole area, in order to calculate the whole pressure on it; and it will be readily understood that when, in such a case as this, the pressure per unit area at a point is spoken of, it is understood to mean the pressure which would be exerted on unit area were there found a unit of area pressed with a uniform pressure, the same as that at the point in question. Not only is pressure transmitted out to the surface or envelope of the liquid, as is shown in the figure, but within the fluid itself the particles are all pressed together. The pressure is transmitted to every point within the liquid and may be observed to be acting there. When a solid is immersed in the liquid it is pressed at every point of its surface in the direction perpendicular to the surface at that point, and, in the case of the hypothetical weightless liquid, with a pressure equal in amount per unit of the area to that applied from without to the liquid. The pressure about any point in a fluid is equal in all directions, and when any surface is exposed to the pressure, the direction of it is normal to the surface at every point.

In actual fluids, which have weight, it is evident, in the first place, that the lower layers of the fluid sustain more pressure than the upper layers. For whatever pressure the upper layers are exposed to is transmitted to the lower layers; and besides the lower layers have to support the weight of the superincumbent liquid. The most important case to consider is that of liquids having a free surface, that is, a surface exposed to the air. Here the surface itself is level. Otherwise there would be a tangential force which would make it flow down till the level state is reached. In every horizontal layer throughout the liquid the pressure per unit area is the same; and this is the case independently of the shape of any vessel in which the liquid may be contained. The pressure per unit area in any horizontal layer depends only on the height of the free surface of the liquid above the layer considered, and the specific gravity of the liquid; and it is equal to the weight of a column of the liquid of unit sectional area whose height is the height of the free surface. This principle gives rise to remarkable results. Take, for instance, an apparatus consisting of a pair of circular boards connected by a belt of pliable leather (like a pair of bellows), and having a small tube inserted into an opening near the bottom, and from it a tall tube rising perpendicularly. Heavy weights may be put on the upper circular board, and if water be then poured into the upright tube they will be raised up by the pressure from below of the water. For the pressure to which the under side of the circular board is exposed is equal to the weight of a column of water whose section is that of the circular board, and whose height is the difference of the heights of the under surface of the circular

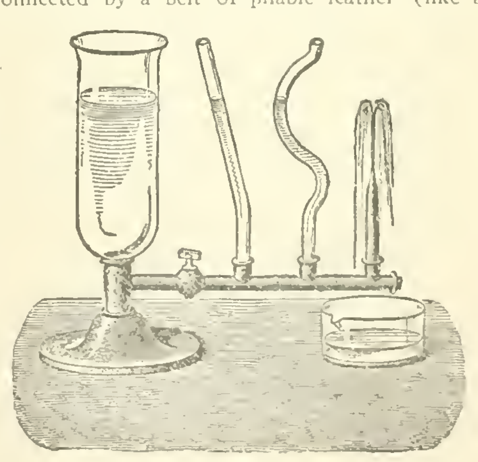


FIG. 2.

board and of the free surface of the water in the small upright tube. When shown in this form the principle here employed is often called the hydrostatic paradox, on account of the very great pressure that a very small quantity of water may be made to give rise to.

It is a well-known principle that liquids tend to find their own level. Thus, in the accompanying figure, showing a series of connected vessels, the liquid is seen to stand at the same height in the principal vessel and in the variously shaped tubes communicating with it, while from the short, narrow mouthed tube it spouts up to nearly the level of the water in the principal vessel.

When a solid is immersed either partially or wholly in a liquid a portion of the liquid is displaced. The solid is at the same time pressed at every point by the liquid, the pressure being always normal to the surface. The upward pressure on the solid is greater than the downward by an amount equivalent to the weight of the liquid displaced by the solid; for if, instead of the solid, the quantity of liquid displaced by it were present, its weight would be upborne by the pressure on every side. These pressures now act on the solid and whether or not the solid floats under their influence, as much of the weight of the solid as corresponds to this pressure is supported by the surrounding fluid. These considerations applied to the phenomenon of floating bodies illustrate the principle just explained; and the experiments that are made for the purpose of determining the specific gravity of bodies heavier than water also depend on that principle. See SPECIFIC GRAVITY.

If a body be immersed in water or other fluid, the resultant of the fluid pressures meets the surface at a point called the centre of pressure, which will coincide with the centre of gravity of the body if the body be horizontal, but will pass below it if the plane of the body is inclined to the fluid's surface.

The conditions of floatage and of stability of a body floating in a liquid are of great importance. A floating body displaces a certain quantity of the liquid, and the weight of the

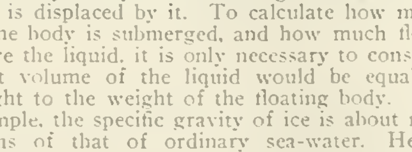


FIG. 3.

solid body is equal to the weight of the liquid that is displaced by it. To calculate how much of the body is submerged, and how much floats above the liquid, it is only necessary to consider what volume of the liquid would be equal in weight to the weight of the floating body. For example, the specific gravity of ice is about nine tenths of that of ordinary sea-water. Hence 9 cubic feet of sea water weigh as much as 10 cubic feet of ice. Thus in an iceberg nine tenths of the ice is under water, and one tenth is above the surface. In ships and other floating bodies the stability depends on the form of the body. A sphere of wood floating in water is indifferent as to position. The slightest force is sufficient to overturn it from any given position or to set it rotating in the water. With a ship or other body that must float with one side upward, the stability is quite as important as the floating power. The accompanying figure illustrates the conditions of stability. When a solid body is slightly displaced from its ordinary position of equilibrium, the forces that act upon it are seen to be twofold. First, there is the force of gravity on the solid acting vertically downward, which, if G be the centre of gravity, may be considered to act downward through that point; and secondly, there is

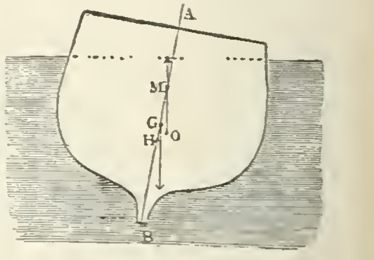


FIG. 4.

the resultant of the upward pressures of the various portions of the liquid, which, if O be the centre of these upward parallel forces, may be considered as equivalent to a single force acting vertically upward through that point. In the figure these two equal parallel forces are seen to form a mechanical couple whose tendency is to right the boat, and bring it back into its ordinary floating position. But if the upward vertical line through O were on the other side of the downward vertical line through G, it is plain that the effect of the couple would be to carry the boat away from the position in which it ought to float; and the boat would thus be unstable.

The metacentre is a point in a floating body of great importance, as its position determines whether the equilibrium is stable or unstable. Let A B in the figure be a line drawn through the points G and H, the centre of gravity of the floating body, and the centre of the figure of liquid displaced when the body is floating with A B vertical. Let the body be then slightly displaced, and let O be the new position of the centre of the figure of the displaced liquid, and let M be the point in which A B is cut by a vertical line through O: M is the metacentre when the displacement from the original position is infinitesimal. If the metacentre is above G then the equilibrium is stable; if it is below G the equilibrium is unstable, and the body being slightly displaced, it tends to fall farther and farther from its position of equilibrium.

Among the instruments and machines founded on the hydrostatic principles here laid down are the barometer, the siphon, the hydrostatic press, and the hydrometer (qq.v.).

Hydrotherapy (Greek, *ὕδωρ*, water, and, *θεραπεία*, cure), a method of treating diseases by the application of hot and cold water, which has come extensively into practice of late years, and is recognized by the medical profession as a very efficient therapeutic agent. The efficacy of water as a hygienic medicine has been recognized from the earliest times. Hippocrates, Celsus, and Galen regarded water as of especial value in the treatment of acute diseases; and during the Middle Ages the same view was advocated by many famous physicians. During the 18th century there was a growing belief in its virtue as a curative agent, though rather in acute than in chronic diseases. Some physicians used water for internal treatment, others for external treatment, but hydrotherapy, as now understood, combines both methods. It was originated by Vincent Priessnitz, a Silesian peasant. When a boy of 13, having sprained his wrist, he applied it to the pump, and afterward bound a wet bandage upon it. As this became dry he rewetted it, and thereby reduced the inflammation, but produced a rash on the surface of the skin. Shortly afterward he crushed his thumb, and applied the wet bandage as before, and again an eruption showed itself. He concluded that the rash was an indication of impurity of blood; and having instituted a series of observations in regard to various wounds and ulcers on the persons of his neighbors, he was led to form a pathological theory, according to which disease is caused by an accumulation of morbific matter, which must be eliminated from the system by cold water applications and the observance of a strict regimen. His views were confirmed by an accident to himself, in which, through a cart running over him, he received some broken ribs and severe contusions, and was given up by the physicians; but on learning their opinion he tore off their bandages, and applied others wet with cold water. He also replaced his ribs by inflating his lungs while pressing his abdomen against the window-sill. Either through or in spite of this treatment Priessnitz recovered and the carrying out of this cold-water theory became the object of his life. In rapid succession he invented the sponge-bath, the wet-sheet packing, the sitz, foot, and arm baths, the douche, the steam-bath, the dripping sheet, the plunge, the dry-blanket packing, and other appliances of the hydropathic system. In 1829 he established, at his native village of Gräfenberg, a range of baths, which speedily grew in reputation, and attracted visitors from all parts of Europe. The Austrian government lent him its patronage, and all the opposition of the medical faculty was unable to stem the popularity of the new system. The original establishment at Gräfenberg soon expanded into an extensive suite of buildings, stretching along the slope of one of the Sudetic Mountains, and resorted to by troops of invalids, who sought to regain health by bathing, exercise, simple diet, and agreeable society. Similar institutions soon sprung up in other parts of Germany, and were at length introduced into England, a hydropathic society having been formed in London in 1842. At the present time hydropathic institutes exist in great number throughout the world, and so universal have hydrotherapeutic procedures become that a large body of quacks thrive on the prestige given to hydrotherapy by regular physicians. The theories of Preissnitz are now known to be fallacious.

The work of Winternitz and his disciples has put the general principles of hydrotherapy on a rational footing; there is little doubt, however, that hydrotherapy, like any other therapeutic agent, may be greatly abused. It is by no means a universal panacea. There are a large number of ways of applying hot and cold water to the body. One enthusiastic advocate has described over 300 separate kinds of application. In general, however, the water may be applied in the shape of tub-baths, ablutions, packs, rain-baths, and douches. These may be divided and subdivided as indicated. *Tub-baths* may be full, half, or local baths, as to the pelvis, the feet, the hands, etc. The full tub-bath is usually given at a temperature of 55° F., unless special indications are to be met. If the patient's reaction is not of the best, the temperature should be about 60° F., and vigorous friction of the skin should be maintained. The time spent should be short, 10 to 20 seconds. The full tub-bath is a strong tonic. In severe illness the tub-bath should be given only by a trained nurse under the physician's orders. Half-baths are taken at a temperature of 60°–75° F. After wetting the face and chest the patient sits in a tub about one third to one half filled with water, sufficient at least to cover the legs and the pelvis. The attendant splashes the cold water over the patient's body, maintaining at the same time a vigorous friction by means of a flesh-brush. The time is from one to five minutes, but the bath should not be continued if the teeth begin to chatter or if there is any evidence of defective reaction, as blueness of the lips, or thin pulse. Local cold baths, such as sitz-baths and foot-baths are very important hydriatric measures. The cold foot-bath, plunging the feet for from one to three minutes in cold running water, is of service in sluggish circulation of the feet, neurasthenia and hysteria. Warm full baths at a temperature of 90°–98° F., for a period of from 5 to 20 minutes are very useful as sedatives to the nervous system, particularly so in insomnia and nervousness from overwork, especially when taken at night. The best effect is obtained if they are taken at the time of retiring and are followed by a brief application of cold water, either in the shape of a half-bath, or a douche. After the bath the patient should wrap up in a linen sheet and a blanket to keep up the dilatation of the blood-vessels of the skin. Perspiration is to be avoided, save in particular instances.

Ablution.— This is one of the simplest of hydriatric measures. It is a valuable skin and nerve tonic, and is particularly adapted for children and women. It consists in the application of water to the body at a temperature of 50°–60° F., from the hollow of the hand, or by means of a bath-glove or wash-cloth. The entire body is gone over, one part after another being systematically treated. One to two minutes' application followed by vigorous rubbing with a coarse towel or flesh brush, is sufficient. Ablution is particularly valuable for reducing temperature, often bringing about quiet, restful sleep in tossing and fretful children.

Affusion.— In this treatment a volume of water from a pitcher or a pail is poured over the entire body, or upon certain parts, the patient sitting or standing erect in a tub or bath. The temperature should be 50°–60° F., and the whole procedure should not consume over 10 or 15 seconds. The reaction is obtained by rubbing. In certain muscular tremors, in neurasthenia, etc., this procedure is of service.

Packs or Compresses.—These may be dry or wet, general or local. The dry and wet packs are applied in the same manner. The patient is placed on a narrow bed or couch with a rubber sheet, a blanket, and a linen sheet beneath him, the blanket and sheet falling on each side of the couch. The sheet is then brought up and, with the arms to the side, wrapped thoroughly about him, the face alone being exposed. The blanket is then wrapped about the patient in a similar manner. Cloths wrung out in cold water may be applied to the head. In a wet pack the sheet is first wrung out in cold water: in the dry pack it is frequently warmed. The object of the application is to bring about free perspiration, and this is the usual result. Hot drinks may be administered freely. The time given to the application will depend largely on the conditions to be met. If reduction of temperature alone is desired, the patient may remain in the pack until the perspiration is free, and he may then be wrapped up in a dry blanket. In certain uræmic states, and in infantile convulsions, a longer period may be necessary. The wet pack is an excellent procedure in the treatment of alcoholic excesses. The initial effect of a cold pack is constriction of the blood-vessels: this is soon followed by a dilatation which continues throughout the application and is the main cause of the free perspiration. The pulse-rate is reduced and the arterial tension falls. The stress of elimination is taken from the kidneys, the amount of blood within the brain diminishes, and sleep is encouraged. In the hot general pack a blanket only is used. This is wrung out in water at 140°–150° F., the temperature at the time of application not being over 105°–108° F. Local packs or compresses are of inestimable service in a variety of conditions. These are usually made of pieces of heavy muslin, canton flannel, or linen, varying in shape according to the site of application. They are wrung out in cold or hot water and applied to the head in headache, to the neck in sore throat, tonsillitis, diphtheria, earache; to the chest in pleurisy, pneumonia, neuralgias; to the heart in rapid overacting heart-action; to the stomach in indigestion; to the joints in sprains, rheumatism and gout; to the abdomen in gastroduodenal catarrh, irritable bladder, catarrhal appendicitis, colitis, peritonitis. Hot applications are particularly serviceable in painful menstruation. Hot water-bags have largely taken the place of hot compresses since they have been made so handy in shape and size and so reasonable in price.

The Douche.— This application is one of the best tonics, but requires special rooms for its use. These are found in the best appointed hydropathic institutes. The douche consists in the application of hot and cold water delivered through a hose. It combines the elements of the water, heat, cold, and force. The regulation of the pressure and temperature is an important feature in the scientific use of the douche.

Consult Cohen, 'Physiologic Therapeutics Hydrotherapy' (1902); Baruch, 'The Principles of Hydrotherapy' (1900); Kellogg, 'Hydrotherapy' (1902). See BATH AND BATHING.

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Hydrozo'a, a class of *Cœlenterata* (q.v.) embracing the polyps, all of which bear a general resemblance to *Hydra* (q.v.). There are two alternating generations, that is, (1) the sessile asexual polyp, which (2) gives rise to a jelly fish or medusa. The hydroid polyp is like hydra, a two-layered vase-like sac, with a circle of tentacles around the mouth. This gives off by a budding process a bell-shaped medusa, which is much more highly organized than the polyp, having a well developed digestive and nervous system, and sense-organs (eyes and ears, or otocysts). The *Hydrozoa* are at present divided into seven orders, the most important of which are, besides *Hydraria* represented by hydra; the *Hydrocorallinæ* of which *Millepora* (q.v.) is the type; the *Tubulariæ* comprising *Hydractinia*, *Tubularia*, etc.; the *Campanulari* of which *Campanularia*, *Clytia*, and *Obelia* are examples. Near this group belongs the extinct order of *Graptolites*, which were floating forms living in the Paleozoic seas. The last order (*Siphanophora*) comprises the Portuguese man-of-war (q.v.) and other forms, which are beautiful transparent pelagic animals, very brightly colored and highly specialized.

Hyena, hī-ē'nä, one of a family (*Hyænidæ*) of carnivorous mammals, having relations in structure to the bears, the cats and the civets, familiar in Africa and southern Asia. They are of moderate size, have large, rather short heads, powerful forequarters, feeble and drooping hindquarters and short tails. The eyes are large, and have longitudinal pupils; the ears are long, erect, very open, and directed forwards. The teeth are numerous, massive, tuberculated, and well adapted to aid the muscular jaws crunch the strongest bones, as hyenas are able to do. Hyenas are nocturnal animals which pass the day in solitude in caves or other hiding places, which they quit at night in order to seek their prey in bands. Carrion is a favorite food, and the stench attracts the hyena by night as it does the vulture by day. In some cases they dig up dead bodies and devour them. They also prey on living animals, and flocks of sheep and goats suffer severely from their ravages in some localities. The common or striped hyena (*Hyæna striata*) is a native of Northern Africa and parts of Asia, even eastward to Burma. It is about the size of a large dog, brownish-gray and marked with transverse bands of dark brown on the body, which become oblique on the flanks and legs. The hair upon the line of the back is much thicker and stronger than on any other part, forming a sort of mane, extending from the nape of the neck to the origin of the tail. This species was well known to the ancients, who entertained many absurd notions respecting it, believing that its neck consisted of but one bone; that it changed its sex every year; that it could imitate the human voice, etc. It was formerly supposed that the hyena was untamable, but that it can be completely tamed there is not the shadow of a doubt. The spotted hyena (*H. crocuta*) has a considerable resemblance to the former species, but is larger, and is marked with numerous round blackish-brown spots instead of stripes, nor is the mane so large. This species inhabits many parts of Africa, and used to be peculiarly numerous around the Cape of Good Hope. There is another species, the brown hyena (*H. brunnea*), which differs from the preceding by having stripes on the legs, the rest of the body being of a dark grayish-brown. It also inhabits the south of Africa. An extinct species, the cave hyena, was abundant in England, France, and Germany anterior to the glacial epoch, and has left its remains in many caves of these countries. Though named *H. Spelæa*, it seems practically identical with the existing *H. crocuta*.

The fossil ancestry goes back into the tertiary whence it seems to have sprung from the same stock that gave rise to the viveroids. Consult writers upon nature and sport in Africa and India.

Hyena-dog, an African canine animal (*Lycaon pictus*), which takes its name from its hyena-like appearance in shape and color, and is also called Cape hunting-dog because it hunts in packs. It differs from the typical dogs in having only four toes on both the fore and hind limbs, and in its dental fauna, and it seems to be a comparatively recent immigrant into South Africa, since its bones are found in British caves. It preys upon antelopes, cattle, etc., and was a scourge to the early settlements, when it was more numerous and bold than now.

Hy'giene, broadly, the science and art of preserving health; as currently restricted, not by curing disease but by its prevention, through the removal of its generating causes. As we cannot remove them until they are known or truly inferred, the science advances *pari passu* with that of medicine, and had no general basis till the past century, during which unprecedented progress was made in all branches of medicine, than which none is more important than that of preventive medicine (q.v.). Still, good sense had been applied to it for ages, especially in regions where ignorance was speedy death. The Mosaic laws recognize the three great principles of cleanliness, isolation, and wholesome diet, with a thoroughness that leaves little to be desired. Hence, the Jews were almost immune for many centuries from the plagues which swept away their Christian neighbors: this was one reason why they were often suspected of starting or spreading the plagues. As in most ancient religions, these sanitary principles were part of their religious observances. In the 18th century some elementary ideas of hygiene had become known: the prevention of scurvy by lemon-juice and vegetable diet, of jail-fever by less crowding and more cleanliness, and of smallpox by inoculation, were among the foremost advances. Our new scientific acquaintance with ultimate causes for the first time enables us to make hygiene a true science on a basis of exact knowledge.

The subject naturally divides itself into two main branches, those of environment and of the person; though there are some items which belong to neither, and the two cannot always be separated.

Environment.— This includes (1) climate; (2) private: the site, construction, elevation, warming, water-supply, and purification of dwellings; (3) public: the cleaning of streets, disposal of the dead, prevention of befoulment either by excreta or sputa, and other methods of public sanitation. The third will be dealt with under another title by an expert authority on public health. See SANITARY SCIENCE.

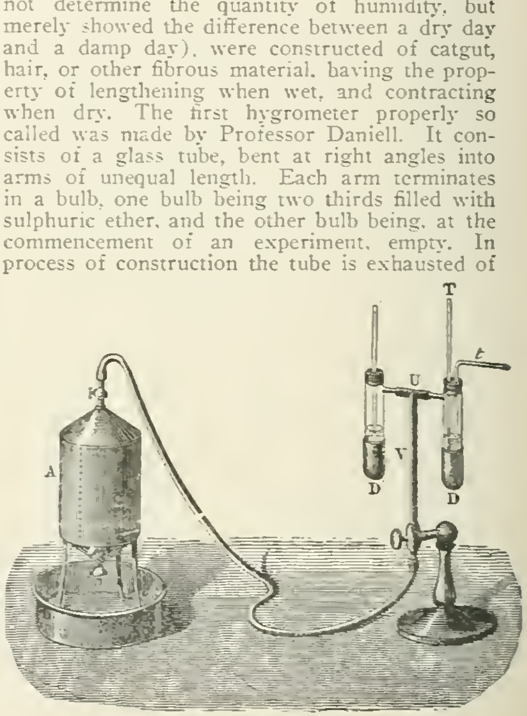
Climatic conditions cannot to any extent be modified: they must be neutralized, when unsanitary, by other conditions pertaining to hygiene. All nations have more or less adapted their habits to their climate, unless acclimated so that they become part of its working: the hours of work or travel, the character of dwellings, the sites selected, the diet found wholesome by experiment, all form part of a hygienic system built up by social experience and tradition. Those unacclimated may have personal advice from predecessors; too often nothing but personal experience can be of any avail, and frequently that is only acquired by fatal results.

The subject of *dwellings* includes a number of considerations. The site, if possible, should not be one where the ground-water is near the surface, or freshets or tides set back the drainage of closets, or where there are great fluctuations in the level of the ground-water, which it is better to have nearer the surface and steady than lower and more unstable. "Made" land in cities is often unhealthy, but tenants cannot in practice exercise much choice; the city authorities should prevent bad results by thorough sewerage with a good fall. The construction most important to have right is the plumbing; including the drains at the bottom: it is a commonplace which need not be dwelt on, that leaking sewer-pipes and clogged drainage mean the infection of a house with disease-laden air. Paint is better than paper for walls, as it can be washed; and old paper should be scraped off before new is laid on. When possible, rooms should be large enough not to need incessant change of air; when not possible, as is usual in cities, plenty of windows and the fullest possibilities of draft should make up; if this, too, is not available, the best systems of artificial ventilation. Unhappily, science is very backward in this class of invention, and small, close, unventilated rooms shorten millions of lives and prematurely break down working power in even the civilized cities of the world. The normal supply should be at least 3,000 cubic feet of air per head each hour, and this largely increased in work or sickness. The volume of consumption and other scrofulous diseases, bronchitis, pneumonia, etc., is directly dependent on foul air, which also increases the virulence of all zymotic diseases. The ventilation of public buildings rests on the same principles, and has the same results. The warming of houses is of great importance, and is generally ill done, with disregard of ventilation. The vast majority of houses in America are grossly overheated even when the air-supply is enough, giving a sensitive skin which "catches cold" as soon as it touches fresh air. Little children especially are literally killed by thousands from overheating and overdressing. The water-supply is a matter of public concern: where there is a flat price, people do not stint themselves. Where there are meters, they often do; but closets should be kept fully flushed at any cost. In country houses, where city water and sewerage are not available, it is not necessary to insist on the frequent cleaning and disinfection of receptacles for excreta. Advice on this point is obtainable gratis from physicians, apothecaries, and others. If the dry methods are carefully used, they have many advantages in healthfulness over the elaborate city systems.

Personal Hygiene.— This has very many divisions: the most obvious are considerations of food, and drink, nerve stimuli, clothing, cleanliness, natural necessities, work and rest, and moral self-control. In the matter of diet, there can be no one rule: "at forty," says the proverb, "one is either a fool or a physician"; and each must use his own experience as a guide to whether meat is a necessity or vegetarianism an advantage, what foods agree with him, whether dry meals give him heartburn or drinking with them impedes digestion, and whether he is eating so much as to make him heavy, impairing his capacity for work and enjoyment. or making his body gross. In general, probably professional and sedentary workers as a class overeat, and would find their minds more alert and their bodies freer from disorders with less gratification of appetite. Nerve stimuli, ranging from tea, coffee, and cocoa, to tobacco, alcoholic drinks, and opium, are hard to frame a general rule upon: they, too, have infinitely varied effects. Cocoa is most of a food; coffee with most is an agreeable stimulant, with many an active nerve-poison, producing heavy headaches and incipient stupor; tea is a real nerve-food on occasion and in small quantity, while taken steadily and largely it is a poison and a very mischievous one; tobacco sparingly used by grown men probably does little harm, and sometimes saves worse things, but should not be used by those under age, nor by those with weak nerves, and is highly injurious in heart disease, Bright's disease, and venereal diseases; alcoholic drinks suggest too many questions for discussion here; narcotics like opium, hashish, etc., as well as chloral and its like, should be used only on a physician's prescription. Clothing, if there is time and means, can be accommodated to changes of weather and occasion so as greatly to advance health; with most, there must be a rough average. Personal cleanliness within limits is a *sine qua non* of reasonable immunity from disease, and with delicate persons, of reasonably good ordinary health; but even this good thing can be irrationally overused and make mischievous. Too frequent hot baths in a northern climate are a great aggravator of lung-diseases, and one great city (Pittsburg) had a marked decrease of pulmonary complaints one winter when the water-supply broke down, and people resorted greatly to dry rubbing. Especially it is possible to use too much soap, and keep the natural oil of the skin washed away. Natural necessities should be attended to more constantly than they are: workmen especially often grudge the time, but the waiting till there is severe pressure often creates dangerous bladder and intestinal complaints. Work, for most, is not under their own control; but to some extent resting is, and the average American perhaps owes more to compulsory public holidays than he is aware. There is more temptation to overwork than to idle, for the average man. Exercise should be taken by the sedentary, even a homespun house-method being preferable to nothing. Grotius preserved his health in prison by whipping a top two hours a day. This should be one of the most rigidly imposed forms of self-control, which in all forms is all-important. Excessive sexuality, either of act or imagination, is simply destructive of will-power as well as bodily fibre; giving way to fits of anger or despondency is almost a recipe for entire nervous wreck. As to laziness, of mind or body, it is one of the worst and most incurable forms of this evil.

The management of children is really personal hygiene, only controlled by another than the subject, the care of the dead belongs to public hygiene; the prevention of disease belongs either to medicine, by the use of drugs like quinine or inoculations, or to house-hygiene as disinfection. The hygiene of the sick-room should be under the direction of the physician.

Hygrom'eter (Gr. «moisture-measure»), a meteorological instrument used to ascertain the quantity of moisture in the air. The first hygrometers, or rather hygroscopes (for they did not determine the quantity of humidity, but merely showed the difference between a dry day and a damp day), were constructed of catgut, hair, or other fibrous material, having the property of lengthening when wet, and contracting when dry. The first hygrometer properly so called was made by Professor Daniell. It consists of a glass tube, bent at right angles into arms of unequal length. Each arm terminates in a bulb, one bulb being two thirds filled with sulphuric ether, and the other bulb being, at the commencement of an experiment, empty. In process of construction the tube is exhausted of



Regnault's Hygrometer.

air, and is thus filled with vapor of ether through its entire length. A thermometer with a bulb immersed in the ether of the lower arm is inserted in the tube to register variation of temperature, and a second thermometer is attached to the stand of the instrument to show the temperature of the outer air. For use one bulb containing the sulphuric ether has a zone of polished gold, and the other bulb a muslin cover. If sulphuric ether be dropped on the latter, as it evaporates the bulb is cooled, and the vapor of ether is condensed within it from the other bulb; the temperature of which rapidly falls owing to evaporation from it. The operation is carried on, ether being dropped on the second bulb as is required, till the temperature of the first is so far reduced that dew from the surrounding air just begins to condense upon it. By means of the thermometer contained in the first bulb the temperature is read off at the instant at which vapor begins to condense, and the dew-point is thus obtained. The hygrometric condition, that is, the ratio between the quantity of moisture that the air actually contains and the quantity which it is capable of containing at the existing temperature is then easily deduced.

Regnault's hygrometer, shown in the above figure, is an important modification of Daniell's instrument. D and D' are two precisely similar cups or thimbles of polished silver; each is surmounted with a similar glass tube into which, by means of a cork, two thermometers are fitted, and the bulbs of the thermometers are covered with ether. Through the cork in one of the tubes a small glass tube *t* passes, and is carried down below the surface of the ether; while a side tube establishes communication with the vertical tube U V which is connected with an aspirator A (or vessel into which air is sucked at the top to supply the place of water which escapes at the bottom). There are no corresponding side tubes connecting the left-hand tube of the hygrometer D′. By means of the aspirator a current of air is drawn through *t*, it therefore bubbles through the ether, causing evaporation and cooling the ether till the dew-point is reached. This is observed with great nicety by means of the silver cap; for the instant the dew commences to deposit, the brilliant polish of the silver is dulled. The temperature of the air is at the same time read off by means of the other thermometer in D′. Regnault's hygrometer, both from its construction and from the use of the aspirator, avoids the too great proximity of the observer, which, from the nature of the experiments, is objectionable.

Mason's dry and wet bulb hygrometer consists of two thermometers arranged side by side as in the figure. The dry bulb gives the temperature of the air at the time of observation; and the other bulb, which is covered with muslin, and kept moist by filaments of cotton carried from it into a small cistern of rain or distilled water, reduces the height of the mercury in its tube in proportion to the capacity of the air for drying, or taking up additional vapor. This instrument does not give the dew-point directly. The difference between the readings of the two thermometers is multiplied by a special factor for every temperature of the dry bulb.

Hyksos, hĭk′sōz, according to the Egyptian annals, a conquering nomadic race from the East, who, under Salatis, their first king, took Memphis, and rendered the whole of Egypt tributary. Their name probably means "foreign kings," the explanation "shepherd kings" being of later origin. The date of their invasion and conquest was about 1700 B.C., of their expulsion about 1600 B.C. The seat of their rule was the strongly garrisoned fortress of Avaris, on the northeastern border of the Delta. They followed Egyptian customs, and their six monarchs took Egyptian names. It seems likely also that a great part of Syria was subject to them. The only detailed account of them in any ancient writer is an unreliable passage of a lost work of Manetho, cited by Josephus in his rejoinder to Apion.

Hymans, Louis, loo-ē ē-mäṅ, Belgian historian, journalist, novelist, and poet: b. Rotterdam 1829; d. Brussels 22 May 1884. He removed to Belgium in boyhood and rose rapidly to distinction as a Liberal journalist. He edited the Belgian 'Star' and the Parliamentary 'Echo' for some years, and was elected to Parliament in 1859. He wrote: 'History of the Marquisate of Anvers' (1848); 'Popular History of Belgium' (1860); 'Political and Parliamentary History of Belgium' (1869–70); two popular novels, 'André Bailly' (1861), and 'The Buvard Family' (1858); and some pleasing poems.

Hy′men, the god of marriage in Grecian mythology. The common legend is that he is the son of Apollo. No marriage took place without his being invoked to sanction it. He is described as having around his brows the flower of marjoram, in his left hand the flame-colored nuptial veil, and in his right the nuptial torch.

Hymenoptera, an order of Hexopoda or insects, considered by many entomologists to be the highest and most perfect expression of the insect type. The metamorphosis is complete and extensive. The larvæ are short, thick grubs, footless except in the saw-flies (*Tenthredinidæ*) and in most cases are carefully nurtured and fed in nests. The pupæ have nearly the form of the perfect insects. The imagos are of compact, highly complex construction, with the three regions well marked except that the first segment of the abdomen is united with the thorax. A considerable part of the large head is occupied by the conspicuous compound eyes besides which there are three ocelli. The jaws or mandibles are conspicuous biting organs, and the remaining mouth-parts usually form more or less of a proboscis with a large ligula or tongue. Although the wings are small they move with great rapidity and sustain the body in rapid and extended flight; there are two pairs (sometimes absent), membranous, veined and transparent. The genital appendages of the females are modified to form a sting or, more rarely, an ovipositor. Marked sexual dimorphism is very frequent especially among the social forms, in which a third class of individual, the worker or neuter, in reality imperfect females, also occurs. Many of the ant communities are still farther polymorphic. The order is one of great extent and exceptional interest, as it includes the ants, bees and wasps, the ichneumon-flies, gall-flies and saw-flies, divided into numerous families. Among the ants and bees are exhibited most remarkable and complex social states, which are described in the articles on these groups. The habits of the numerous species of wasps, and especially the varied architecture of their nests, are of nearly equal interest. A remarkable series of adaptations to special conditions are presented by the parasitic ichneumon flies and their allies, which lay their eggs within the bodies of the larvæ or even in the eggs of other insects, on the substance of which their own larvæ feed. Confining their parasitism to plants, the gall-flies produce by the irritation caused by their eggs or secretions deposited with them in the tissues of leaves, twigs or fruits, the familiar excrescences whose shapes are almost as numerous as the species which produce them. (See GALLS.) Finally, the saw-flies are least typical of the order but stand nearest to the main hexapod stem. Their larvæ have both thoracic and abdominal legs and closely resemble caterpillars; they are vegetarians and many of them are very destructive to plants.

Consult standard works of Entomology (see INSECTS), and the bibliographical list given by L. O. Howard in the appendix to his 'Insect Book' (New York 1902).

Hyndman, hĭnd′man, **Henry Mayers**, English socialist and author: b. London 7 March 1842. He was educated at Trinity College, Cambridge; and entered journalism. He was special correspondent for the *Pall Mall Gazette* in the war of 1866 between France and Italy, and wrote leading articles in favor of free education in the Melbourne 'Argus' in 1869. In

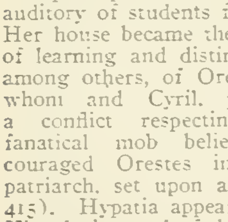
1881 he was one of the founders of the Social Democratic Federation, and has since been active in the Socialist movement, being the acknowledged leader of the Marxian Socialists in England. In 1884 he founded the paper 'Justice,' of which he is editor. His works include 'Historical Basis of Socialism in England' (1883); 'Socialism and Slavery,' a reply to Herbert Spencer; 'The Commercial Crises of the Nineteenth Century' (Social Science Series, 1892); and 'Economics of Socialism' (1896).

Hyne, Charles John Cutliffe, English novelist: b. Bibwry, Gloucestershire, 11 May 1866. He was graduated from Clare College, Cambridge, traveled widely both overland and by sea, and has published several rigorous stories, including: 'The Stronger Hand' (1896); 'The Adventures of Captain Kettle' (1898); 'Through Arctic Lapland' (1898); 'Further Adventures of Captain Kettle' (1899); 'The Filibusters' (1900); and 'Thompson's Progress' (1902).

Hypatia, hī-pā'shī-a, Greek philosopher of the eclectic school, daughter of Theon, a celebrated astronomer and mathematician, who was at the head of the Neo-Platonic school in Alexandria early in the 5th century. Such was her reputation that she became a preceptress in the school of Plotinus at Alexandria, and expounded the principles of his system to a numerous auditory of students from all parts of the East. Her house became the resort of all the persons of learning and distinction in Alexandria, and, among others, of Orestes the Prefect, between whom and Cyril, patriarch of Alexandria, a conflict respecting authority existed. A fanatical mob believing that Hypatia encouraged Orestes in his opposition to the patriarch, set upon and murdered her (March 415). Hypatia appears as the central figure of Kingsley's novel of the name (q.v.) (1853).

Hypatia, a work of historical fiction, by Charles Kingsley (q.v.), named from the principal character, the philosopher Hypatia (q.v.). The book presents a brilliant and stirring though not historically trustworthy picture of the 5th century of the Christian era, against the background of the learned city of Alexandria in Egypt.

Hyper'bola, in geometry, a curve formed by the intersection of a plane with two cones united at their apexes. The intersecting plane has such an inclination to the axis of the upper cone that it produces a similar section of the lower cone; the two branches thus formed are called opposite or conjugate hyperbolas. The two points where the branches approach nearest to each other are called the vertices, the straight line which joins them is called the major or transverse axis, and its middle point the centre of the hyperbola. A line of a certain definite length drawn through the centre and continued both ways at right angles to the major or transverse axis, is called the minor or conjugate axis. When the major axis is produced beyond the vertices two points called foci occur at equal distances from the centre, and the difference of their distances from any one point of the hyperbola is always equal to the major axis. Every line drawn from any part of the hyperbola to one of the foci is called a radius vector. If at one of the vertices a perpendicular to the major axis be erected, so as to be bisected by this axis and made equal in length to the minor axis, and if through the extremities of this perpendicular and the centre of the hyperbola two indefinite straight lines be drawn, these form what are called the asymptotes, which though they lie entirely outside the hyperbola, are always drawing nearer and nearer to it, but never actually reach it. The equation of the hyperbola referred to its centre and axis is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$



Hyperbola — D B E, G A H, are opposite hyperbolas; F f, foci; C, centre: A B, major or transverse axis; a b, minor or conjugate axis; N C P, a diameter.

Hyperion, hī-pē'rĭ-ŏn, in Greek mythology, a Titan: son of Uranus and Ge, and father of Helios, Selene, and Eos. Homer and later poets apply the name as a patronymic for Helios himself. The attribute of beauty has therefore been connected with the name, as in Shakespeare's comparison of "Hyperion to a satyr."

Hyperion, in astronomy, the name assigned to the 7th satellite of Saturn, discovered in 1848, at the Harvard Observatory by G. P. Bond. It is outside the satellite Titan, whose mass causes perturbations in the orbit of Hyperion, which have proved to be a difficult problem in celestial mechanics, and a unique case in the solar system. They apparently give large eccentricity to Hyperion's orbit, and cause the apparent line of apsides to follow the conjunction points of Titan and Hyperion, in a direction contrary to the usual motion of this line.

Hyperion, a romance, by H. W. Longfellow, published in 1839. It is the tale of a young man in deepest sorrow, wandering from land to land in search of occupation for his mind, and forgetfulness of grief. This motive forms the thread of a story which connects a series of philosophical discourses, and romantic legends and poems. Many of these last are Longfellow's translations of German poems, and have found a place in his collected poems.

Hyperpyrexia, hī-pėr-pĭ-rĕk'sĭ-ạ. See Fever.

Hyperspaces. *Dimensionality.*—In order to make quite intelligible the concept variously denoted by such terms as hyperspace, space of higher dimensions or dimensionality, multidimensional space, *n*-space, *n*-fold or *n*-dimensional space, it is in the first place necessary to explain the meaning of dimensionality and to indicate the way in which the dimensionality, or number of dimensions, of a given space in a given element is determined or ascertained. Because, in order to determine the position of a *point* in a curve or straight line, it is necessary and sufficient to know *one* fact about the point, as, for example, its distance (with algebraic sign) from a fixed point or origin, a line is said to be a *one*-dimensional space of *points*. But instead of the point, we may choose for element of the space (line) a *pair* or a *triplet*, . . . or an *n-set* of points. In such cases, in order to determine the element, *i.e.*, to pick it out or distinguish it from among all others of its kind, it is necessary and sufficient to know two or *three*, . . . or n *independent* facts about it. Hence a line is a *two*- or *three*-, . . . or n-dimensional space of *pairs* or *triplets*, . . . or *n-sets*, of points. In like manner a flat pencil (totality of lines of a plane that have a common point) is a *one*-dimensional space of *lines*, while its dimensionality is 2 in line *pairs*, 3 in *triplets*, and so on. For like reasons a plane is a *two*-dimensional space of *points* or of *lines*. In *circles* its dimensionality is 3, in *conics* 5, in *curves of third order* 9, and so on. It is at once seen that the dimensionality of a given space depends on the entity chosen for primary element, the element, *i.e.*, in terms of which we elect to study and express the properties of the given space. Illustrations abound. A curved surface, as, say, a sphere, regarded as the envelope of (its tangent) planes, is a *two*-dimensional space of *planes*, while, conceived as the assemblage of (its tangent) lines, it is a *three*-dimensional space. The reader will observe that the term space is employed generically to denote any unbounded continuum of geometric entities. The generalization is, however, a natural one, for, for geometric purposes, ordinary space is viewed primarily as an assemblage of elements of one kind or another. To determine the position of a point in ordinary space, three independent data (as the distances of the point from three mutually perpendicular planes of reference) are necessary and sufficient. Ordinary space is, therefore, *three*-dimensional in *points*, and that is what is meant, consciously or unconsciously, when, without specifying the element (point), it is simply said that space is three-dimensional. But tri-dimensionality is in no strict sense a *definitive* property of ordinary space. For some little understood, probably economical, certainly extra-logical, reason, the point recommended itself to primitive man as the element par excellence with which to geometrize, and so it has become traditional and proverbial that our space is essentially, uniquely, characteristically, intrinsically, exclusively three-dimensional. Such, however, it is not. It is indeed *three*-fold in *planes* as in points, but in *lines* it is *four*-dimensional. So, too, it is *four*-fold in *spheres*, but in *circles* its dimensionality is *six*. In general, it is possible by proper choice of element to endow any given space with any prescribed dimensionality however high. Accordingly, if by hyperspace is meant a space of dimensionality greater than 3, the notion is simple and near at hand, we need not go beyond ordinary space to realize it, we detect it in the line, in the plane, in ordinary space, here, there, and yonder. Well, such *is* one of the recognized significations of the term. But it has 'another,' namely, hyperspace usually means a space whose *point* dimensionality is four or more. Now this latter meaning is *logically* and *conceptually* quite consistent with the other, it is indeed a special case of it; but a hyperspace of *points* is difficult or impossible to *picture*, to realize in *visual imagination*, and it is this non-logical circumstance that renders the term hyperspace at once so tantalizing, mysterious, baffling, and fascinating to the non-mathematician. To the mathematician, however, whose activities, so far from being confined within the limits of the visual imagination, lie for the most part quite beyond them, the conception in question offers as such no difficulty whatever, and it has long since established itself among the most approved of orthodox scientific notions.

Definition of Hyperspace of Points.—What, then, is a *hyperspace* of *points?* How is the notion arrived at? And what is its utility? The values of a single continuous variable x are familiarly representable by the points of a right line; the ordered *pairs* of values of two independent variables x_1 and x_2, by the points of a plane; and the ordered triplets of values of three independents x_1, x_2, x_3, by the points of ordinary space. To the analyst with geometric bias or predilection, the suggestion immediately and forcibly presents itself that there *ought* to be a space whose points would serve to represent, as in the preceding cases, all ordered sets of values of n independent variables $x_1, x_2, \ldots, x_n$; and, not finding such a space present to *intuition*, *vision*, or *visual imagination*, he *posits*, or, if you prefer, he *creates*, one in *thought*. This done, it becomes immediately practicable to appropriate the terse, sensuous, stimulating language of geometry to the uses of analysis. Moreover, the hyperspaces serve as boundless playgrounds for the human spirit. They are immeasurable and immeasurably interesting fields for geometric research and exploration. In them light is found for the illumination of many otherwise dark or undiscovered properties of the lower, ordinary, spaces of intuition. By their study, the geometrician discovers how such higher and higher worlds would appear to a vision capable of beholding them.

Another Mode of Generating the Concept.—Another way, and, by virtue of its appeal to the intuition, possibly the best way, of arriving at the notion of hyperspaces of points, is the following: Posit two *points* (spaces of *zero* dimensionality in *points*). These determine a line, a space of dimensionality *one* in points. Next posit a point *outside* the line. The locus of all the points of all the lines determined by the posited point and the points of the given line is a plane, a space of *two* dimensions in *points*. Posit a point *outside* of the plane. The locus of all the points of all the lines (planes) determined by the posited point and the points (lines) of the given plane is a space (like our ordinary space) of *three* dimensions in *points*. Let the process continue. If intuition fail, reflect that in any case it is only a non-essential, extra-logical auxiliary, and hence proceed by positing *conceptually*, in *thought*, a point *outside* of the threefold space S_3, before obtained. The locus of all the points of all the lines (planes, 3-fold spaces) determined by the posited point and the points (lines, planes) of the given S_3 is a space of *four* dimensions in *points*. Obviously the principle of genesis here exemplified admits of endless application and leads directly to the concept of an n-fold space of points.

But we need not suffer ourselves to be dominated by the conception of point. Among possible elements, the point has no *logical* claim to preference or primacy, and the foregoing process is equally available for the generation of the concept of a space n-dimensional in any other element, *e.g.*, the line. Posit two intersecting lines (spaces of *zero* dimensionality in *lines*). These determine a flat pencil, a *one*-fold space, of *lines*. Posit a line *outside* the pencil, *i.e.*, not belonging to it but going through its vertex. The assemblage of all the lines of all the pencils determined by the posited line and the lines of the given pencil is a hyperpencil (sheaf of lines), a *two*-dimensional space of *lines*. Next posit a line outside the sheaf (but cutting all of its lines). So is determined a 3-fold space of lines, the assemblage of lines of which each with the posited line determines a pencil. The next step leads to a 4-fold line space; the next, to a 5-fold line space; and so *in infinitum*.

It is clear that the lower spaces are contained in the higher, as points in lines, lines in planes, etc., or as lines in pencils, pencils in sheaves, etc., etc. It should be noticed, too, that any space S is *zero*-dimensional in such spaces S taken as *elements*. The complete understanding of the geometry of a space of k dimensions demands a study of the like variety of space of $k+1$ dimensions, and so on. In particular the point geometry of ordinary 3-fold point space is quite as much illuminated by that of 4-fold point space as is the point geometry of the plane by that of 3-space.

Coordinates, etc.—In point space of n dimensions the simplest coordinates of the point are the distances $x_1, x_2, \ldots, x_n$ of the point from n mutually perpendicular point spaces of $n-1$ dimensions. These coordinate spaces, taken $n-1$ at a time, determine n coordinate axes. A linear equation $\xi_1 x_1 + \xi_2 x_2 + \ldots + \xi_n x_n + 1 = 0$ defines or represents an $\overline{n-1}$-dimensional space of order *one*, the analogue of the plane in ordinary space. The ξ's are the negative reciprocals of the axal intercepts of the $\overline{n-1}$-space. Holding the x's fixed and letting the ξ's vary, the foregoing equation will represent a point as envelope of its generating $\overline{n-1}$-spaces. Two such equations together define an $\overline{n-2}$-space as their intersection or a straight line as their envelope. Similarly, three such equations serve to represent an $\overline{n-3}$-space as locus of points or a plane as envelope of $\overline{n-1}$-spaces, and so on. A space that is n-fold in points is also n-fold in spaces of $\overline{n-1}$-dimensions. Its dimensionality is $2(n-1)$ alike in lines and in spaces of $n-2$ dimensions. In general, its dimensionality is $p(n-p+1)$ if the point space either of $p-1$ or of $n-p$ dimensions be taken as generating element. Not only, however, do he two last mentioned elements furnish the same dimensionality, but they are indeed reciprocal elements of n-fold point space, for the same system of equations which on proper interpretation defines one of the elements admits of a second (dual) interpretation defining the other. It thus appears that by taking as elements the various simple spaces of less than n dimensions for generating elements of n-fold point space, there arise κ geometries of this space; or, if we regard two reciprocal theories as but two aspects of one geometry, the elements in question yield $n:2$ or $1+(n-1):2$ geometries according as n is even or odd, the element having $(n-1):2$ dimensions being, in case of n odd, its own reciprocal, or *self-reciprocal*, like the line in ordinary space (see LINE GEOMETRY AND ALLIED THEORIES).

Remarks on Four-space.—Thus point space of 4 dimensions is also 4-dimensional in ordinary spaces (say *lineoids*), the point and the lineoid being reciprocal elements. It is 6-dimensional in *lines* and also in *planes*, which are also reciprocal elements of this space. It appears that this space, unlike ordinary space, does not admit of self-reciprocal construction. An equation of degree n in point (lineoid) coordinates x_1, x_2, x_3, x_4 ($\xi_1, \xi_2, \xi_3, \xi_4$) represents a locus (envelope) of *order* (*class*) n. If $n=1$, the locus (envelope) is a lineoid (point). Two linear equations define a plane as locus or a line as envelope; three, if independent, represent a line as locus or a plane as envelope; and four give a point or a lineoid. In general, two planes have, not a line, but only a point in common; reciprocally, two planes are not in general in a same lineoid. A lineoid being determined by four independent points, it appears that two arbitrary lines determine a lineoid. In 4-space a point can pass from the inside to the outside of a (two-dimensional) closed surface, such as an ordinary sphere, without going *through* the surface, just as in ordinary space a point can pass from the inside to the outside of a circle without *crossing* the circumference. Accordingly, in 4-space a 3-fold solid like the human body could be literally seen through, and no ordinary prison-house could confine.

Do hyperspaces exist? Undoubtedly they have *logical* existence, the *concept* of hyperspace being interiorly consistent and available for thought. More mathematics does not demand. The hypothesis of their 'physical' existence, 'natural' science may yet be compelled to employ. Indeed it has been conjectured that certain chemical phenomena (as of the carbon compounds) may be due to greater freedom of motion than ordinary space affords.

Bibliography.—The literature of the geometry (both pure and analytical) of hyperspaces is very extensive. It is, however, chiefly contained in the mathematical journals. All scientific nations have contributed to the subject, the Italians probably more than any other. The best work for the beginner is P. H. Schoute's 'Mehrdimensionale Geometrie' (1902). An excellent explanation, addressed to the non-mathematician, of the concept of 4-space is found in Hermann Schubert's 'Mathematical Essays and Recreations.'

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Hyphomyceteæ, hī-fō-mī-sē'tē-ē. See FUNGI.

Hypnotics are agents that induce sleep. They may be mental, physical, or medicinal. Thus certain kinds of music, the human voice, and suggestion may have power to induce sleep, which may also follow from eating, or from a warm bath before retiring. All such simple measures should be used before drugs are resorted to in the treatment of insomnia (q.v.). Hypnotics *per se* may be divided into two broad groups—those that induce sleep by alleviating pain and those that have no pain-relieving character. The latter are pure hypnotics. Combinations of the two are frequently employed in medicine. The pain-relieving drugs all come under the head of analgesics (q.v.). The pure hypnotics may be divided into a number of groups based on their chemical relationship, for in this class of drugs the relation between chemical composition and physiological action is peculiarly close. Alcohol is one of the most prominent of the hypnotics, but while it is extensively used to induce sleep, the practice of taking a "nightcap" cannot be regarded as a safe one. Substituted alcohols, however, yield some of the most widely employed of all hypnotics. Chloral, paraldehyde, amylene hydrate belong to this series, while from chloral as a basis a number of allied hypnotics have been made. These are chloralamide, chloralose, chloretone, urethane, etc. The fundamental action of these is to cause a peaceful sleep without leaving ill after-effects. They all dilate blood-vessels, relieve spasm, and induce sleep. In large doses they depress the heart-action. Another group of hypnotics includes substituted sulphur compounds. The most important of these are sulphonal, trional, and tetronal. They are all closely allied in chemical structure. Sulphonal is the weakest, tetronal the strongest, trional occupies a middle position. In poisonous doses, and even in small doses if long continued, hypnotics of this group cause a form of chronic poisoning in which the red blood-cells are disintegrated. This is shown by the appearance of a cherry-red, or purple-red discoloration in the urine. A third group of hypnotics depends on some form of bromine, as bromides. Sodium bromide, potassium bromide, bromal, bromoform, etc., are representatives. They depress the activity of the brain, and are useful hypnotics. If used very long the bromine compounds cause skin-eruptions, foul breath, and heart-depression. See ALCOHOL; CHLORAL; INSANITY; INSOMNIA; MELANCHOLIA; NEURASTHENIA; SULPHONAL.

Hypnotism, hĭp'nō-tĭsm (Greek *hypnos*, «sleep»), an artificial sleep. The nervous phenomena exhibited in hypnotism resemble those induced by animal magnetism, though they arise solely from the condition of the patient, and not from any influence proceeding from others. Mr. Braid, of Manchester, England, brought this subject prominently before the public in the 17th volume of 'The Monthly Journal of Medical Science' (1853), but it has been long known in India. The actual foundation of modern hypnotic suggestion was discovered by Liébault, of Nancy, France, the famous "father of the therapeutic application of suggestion." After several years of practical experience, in 1866 he wrote his first book on the subject. It was shelved and he was pronounced erratic. Hypnotism remained a curiosity and Liébault's book was not reproduced till six years after Charcot, in 1878, began his studies in hypnotism. In 1884 Bernheim wrote his charming book on suggestion, and this created a demand for Liébault's book which then gave him lasting reputation. He was Bernheim's teacher. Formerly a profound skeptic, Bernheim became unavoidably converted by seeing the results of Liébault's application of suggestion to invalids. Bernheim was a clever clinical professor in the great hospital of Nancy and in his wards he convinced himself of the great value of hypnotic suggestion.

The word hypnotism is generally and largely misunderstood and misused. For example, if a person seems to be wholly influenced by another, it is commonly said that he has been hypnotized. This is a great error. The word hypnotism means putting a person to sleep and means nothing else. If an individual seems to be subjected to another in the waking state it should be said that he is unduly influenced. He is not hypnotized. That would mean that he was asleep. The means by which hypnotism is used is "suggestion." A person may be influenced by suggestion in the waking state, for suggestion is a great force in daily life. As connected with hypnotism, however, suggestion is the expression of an idea or combination of ideas which becomes impressed upon the mind of the somnolent subject to whom it is addressed. Conscious or unconscious results are sure to follow. This explanation sums up the meaning, use, and results of suggestion as applied to hypnotism and the hypnotic state. If a subject be awake he can, according to the strength of his will and desire, control to a greater or lesser degree the effect of a suggestion which he has received.

In the hypnotic state this self-control is decreased in a degree corresponding to that of the increase of the degree of sleep. Nevertheless, if merely the first degree of hypnosis has been attained, the subject, conscious of all he hears, may be influenced by the suggestion of the operator. In this way a vast amount of relief has been given to individuals who may claim that they have not been affected at all. In the hypnotic state there are nine sharply marked degrees of somnolence. In the first six degrees, notwithstanding he has been perfectly quiet and apparently asleep, the patient remembers all that has been said. In the last three degrees the patient, on waking, remembers nothing. Strange as it may seem, however, a person may be more influenced by suggestion in the lighter degrees of sleep than in the more profound degrees, and *vice versâ*. This is due to the patient's suggestibility. For example, the writer treated by hypnotic suggestion a very severe and prolonged case of intemperance. The patient claimed that not for an instant had he been sleepy, but he so responded to suggestion that from that day to this, a period of eleven years, he has not once touched alcohol. He had been intemperate from boyhood. On the other hand, a person may fall into profound sleep and yet not respond markedly to suggestion. Generally, however, if the subject be made to reach any degree of somnolency he can be relieved by suggestion. In the majority of cases the relief endures. In the popular mind exists the belief that this form of treatment is attended by danger, that the patient once hypnotized is thereafter under control of the operator, even at a distance, that the will is weakened, etc. This is all a mistake. No person can be hypnotized unless he be willing. No person can be hypnotized at a distance, unless by telephone, or if he be a good and willing subject, by letter; and the patient must first have been hypnotized by the operator at some previous time. Otherwise the operator cannot influence him at a distance in the slightest degree. The will is not only not weakened, but there is no other existing treatment which can so strengthen the will as can hypnotic suggestion. If any physician object to the treatment we know that this physician, however intelligent he may be in other professional matters, is ignorant of this method of relief. This treatment is not peculiarly useful in hysteria, as is commonly supposed, but has accomplished greatest benefit in all cases attended by bodily distress, neuralgia, dyspepsia, headache, disturbance of menstruation, pains of rheumatism, mental unrest, sleeplessness in particular, intemperance, opium habit, and all drug habits, vicious propensities, lack of mental vigor, fear, illusions, stammering, and wherever calmness has disappeared. In short, it will give relief in many cases which it cannot cure. It can relieve, but cannot create. It can assuage pain, for instance, in heart ailments, while it cannot dispose of damages which the heart may have received.

It is an absolutely safe and beneficent form of aid. It may not always bring relief, but never in the hands of a competent operator has it done harm. The patient will always choose the operator as he would choose a surgeon. The object of all reliable operators in the use of hypnotic suggestion is the relief of the patient, and to the operator the treatment is a sacred thing.

The method of the operators of the school of Nancy is wholly verbal. The patient is talked to sleep, and on waking he is delighted by the changes in himself which are apparent, and he has become convinced of the agreeable effects of the treatment.

Formerly a bright object was held between and above the patient's eyes, and he was directed to fix his eyes upon it. This created sleep. But it was found that nervous distress was apt to follow this method, and it has been abandoned by followers of the school of Nancy. The rationale of the treatment is that a person whose mind is in a sleepy or sleeping condition offers no resistance to the suggestions of the operator and, just as in thirst, in the waking state, «the mouth waters,» just as a woman blushes, because of a personal remark, or turns pale if a pistol be pointed at her, so the suggestions of the operator made to a sleeping person will follow a nerve path which is in accordance with the quality or nature of the mental impression created by the suggestion. In other words, the suggestion is followed by changes in sensation, act, or idea on the part of the patient, which correspond with the nature of the suggestion. Thus, if a sleeping person be assured by the operator that he will lose his craving for alcohol, or opium, or cocaine, or, that his pain will cease, that he will sleep at night, that his nervous unrest will disappear, that his power of will or a mental concentration will increase, and so forth, in nine out of ten cases the desired result will follow. Lack of space forbids further mention of this phase of the subject.

Brief reference should be made to an influence, wholly unappreciated by the popular mind, which is exerted by what is nothing but suggestion. For example: The sick people who were aided by the «magnetized» tree of Marquis Puysegur thoroughly believed in the therapeutic power of the tree, and therefore were cured or relieved. This was suggestion. The benefit of the electro-magnetic belts and rings formerly so largely in vogue was derived from suggestion. The influence of the waters of Lourdes is due to suggestion. The benefits which occur from many, if not the majority, of the medicines given by regular physicians are due to suggestion and temporary unusual care of the health. Therefore, in the absence of better means they are wisely given.

The people who resort to these things thoroughly believe in their efficacy, and this belief, acting through the mind, so influences the nerve and blood supply of the part or organ for which relief is sought, that the ailment passes away.

There are indeed scores of popular forms of relief which act wholly through the patient's mind and in themselves literally have no value. The effect of the mind cure and Christian Science is due to a weak form of suggestion, behind which an intelligent knowledge of anatomy, physiology, and disease is wholly lacking. The results are owing to influences produced upon the minds of those who seek these forms of relief, which thus have accomplished a degree of benefit but are dangerous aids where serious disease exists. These forms of suggestion, exactly speaking, are auto- or self-suggestion, that is, a belief which creates a mental power over bodily ailments, and which, in a certain percentage of people, is capable of large development.

The wise choice of a source of needed suggestion would be to seek it at the hands of a cultivated physician who is familiar with the application of suggestion to a somnolent patient.

With reference to causation of crime by means of hypnotic suggestion: few or no scientific men believe it possible. Habit is as strong as death. If a man's habit of mind be honest, no suggestion, sleeping or waking, can cause him to commit crime of any sort. If he be dishonest, naturally or by inclination, the suggestion would be unnecessary. In so far as physicians are concerned they are not interested in this phase of the subject because they use the treatment wholly as a means of relief, and, as a class, physicians are reliable men who would not even attempt to misuse hypnotism any more than they would use ether for evil purposes. The so-called «laboratory crimes,» that is, imitation of crime in the presence of the operator who suggests it, would not occur unless he were present. The subject simply feels safe under the direction of the operator and, as has been proved many times, would not attempt suggested wrongs if he were alone.

The hypnotic sleep is a natural sleep. Those who claim that it is not natural are not intelligent in the matter, and their opinions are based upon pure and uninformed theory.

As has been shown by scores of thousands of cases, treated by brilliant and educated physicians, the treatment is absolutely innocuous. It either relieves or produces a neutral effect, and is useful in a multitude of ailments which baffle ordinary means of relief.

But the operator must be educated in the use of this valuable method of treatment. Hypnotism should be used only by physicians, and amateurs should by no means experiment with it as a means of amusement.

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Hypochlorites. See HYPOCHLOROUS ACID.

Hypochlo'rous Acid, an acid having the chemical formula $HClO$, which is formed when chlorine monoxid, Cl_2O, is dissolved in water.

The most convenient method of preparing it, however, is by distilling a mixture of dilute nitric acid and a salt of hypochlorous acid. The sodium salt of hypochlorous acid, known as sodium hypochlorite, $NaClO$, may be prepared by passing a stream of chlorine gas through a cold dilute solution of caustic soda, $NaOH$; the reaction being $2NaOH + 2Cl = NaClO + NaCl + H_2O$. Potassium hypochlorite may be prepared in a similar manner. Crude calcium hypochlorite, $Ca(ClO)_2$, known in the trade as "bleaching powder" (q.v.), is prepared by acting upon slaked lime with chlorine gas. Hypochlorous acid and the hypochlorites possess powerful bleaching properties, owing to the readiness with which they part with a portion of their chlorine or of their oxygen. (See BLEACHING.) Hypochlorous acid is only known in its aqueous solution, which is a colorless liquid, with a peculiar smell. It decomposes readily with the liberation of chlorine, and the formation of chloric acid, $HClO_3$, the decomposition proceeding rapidly in the sunlight. Hydrochloric and sulphuric acids also decompose it with liberation of chlorine, the reaction in the case of hydrochloric acid being $HClO + HCl = H_2O + 2Cl$. Heat decomposes the hypochlorites, with formation of the corresponding chlorates and chlorides.

Hypochondriasis, hī″pō- or hĭp″-ō-kŏn-drī′a-sĭs, a morbid condition of the mind in which an individual fears himself afflicted with various diseases. The name comes from the ancient belief that the symptoms of this disorder came from perversions of the vital force in the liver and pylorus of the stomach. The tendency to this condition is frequently inherited; it is more common in males, and is sometimes brought on by excesses. Patients afflicted with hypochondriasis are apt to watch for any expression of abnormality in their bodies, to connect various symptoms, and to reach the conclusion that they are sufferers from some disease. In conditions of perfect health any individual may have slight, temporary twinges of pain, or may show passing changes in the functions of the organs; but by the hypochondriac these abnormalities are seriously regarded, and efforts to disabuse him are usually futile. Such constant fear and worry divert the nervous energy from its proper course, and may cause actual disturbance of the bodily functions that are serious. The condition known as neurasthenia may follow; also, more rarely, true melancholia. The milder cases continue in actual good health, but become an unhappy burden to themselves and others. In the treatment it is to be remembered that mental occupation outside of the thoughts of self is essential to a cure.

Hypoder′mic Injection (Greek, *hypo*, under; *derma*, skin), a method of introducing medicines through the skin into the subcutaneous cellular tissue, sometimes deep into the fibres of a muscle by an instrument specially made for the purpose. This instrument is the hypodermic syringe, which is made of glass, with a graduated scale engraved on it, and fitted with a long, hollow needle-shaped point of steel. It must be filled before using, to prevent the possibility of introducing air into the veins. Hypodermic injection should never be resorted to excepting under the specific directions of a physician, and no patient should ever employ this method upon himself.

Hypodermic Medication, as opposed to endermic medication, means the administration of medicine by piercing the skin so as to throw the drug directly into the circulation, and bring it immediately in contact with the seat of pain, if pain is to be treated. There are some drugs which act on the system in a manner which differs in accordance with the method of their administration; thus podophyllin is a powerful cholagogue when administered through the mouth; when administered hypodermically it promotes the secretion of the kidneys. There are, however, distinct advantages of a general character in this method of administering drugs. The action of the drug is more rapid, sometimes instantaneous; the effect is concentrated and intensified; it takes a smaller dose to produce the desired effect; it is sometimes easier and pleasanter than administration by the mouth, and often obviates unpleasant or even dangerous complications. The process of hypodermic injection (q.v.) was invented and brought into vogue by Dr. Alexander Wood (q.v.) of Edinburgh.

Hypophosphites, salts of hypophosphorous acid (q.v.).

Hypophosphorous Acid, an oxyacid of phosphorus, having the formula H_3PO_2. The free acid is of no importance in the arts, but its salts, which are called "hypophosphites," are used in medicine. The acid is monobasic, only one of its hydrogen atoms being replaceable by a metallic atom. Sodium hypophosphite, $NaH_2PO_2 + H_2O$, may be prepared by acting upon caustic soda with phosphorus, phosphoretted hydrogen being given off, while sodium hypophosphite remains in solution. It crystallizes in small, rectangular tablets, which are easily soluble in water and in absolute alcohol. The evaporation of solutions of this substance is often attended by explosions. Barium hypophosphite, $Ba(H_2PO_2)_2 + H_2O$, may be prepared by heating baryta, BaO, with phosphorus and water until the elimination of phosphoretted hydrogen has ceased, the excess of BaO being then removed by a current of carbon dioxid, after which the solution is filtered and crystallized. Barium hypophosphite crystallizes in monoclinic needles, which are soluble in water, but insoluble in alcohol. Calcium hypophosphite may be prepared in the same manner as the barium salt. It has the formula $Ca(H_2PO_2)_2$, and crystallizes in thin, monoclinic tablets, which are soluble in six parts of water, but insoluble in strong alcohol. Free hypophosphorous acid may be prepared by decomposing the barium salt with sulphuric acid, and evaporating the solution at a temperature not exceeding 230° F. It crystallizes in large white tablets, which melt at 63° F., and are decomposed by heat, with the formation of phosphoretted hydrogen and ordinary tribasic phosphoric acid.

Hy′poscope (from Greek words meaning "to see under"), is the name given to an instrument adapted to be secured to the stock of a rifle near the breech, and intended to enable a marksman to fire with accurate aim without exposing his head to the fire of the enemy. The successful American contestants for the Palma trophy at Brisley, England, in 1903, brought back with them this device, which seems likely to play an important part in the warfare of the future. It was invented by William Youlton of Brighton, England, who conceived the idea of it after the battle of Colenso in the Boer war, during which it is stated that not a single Boer was to be seen. Later in the war it was employed with good results, its use at Mafeking receiving particular mention.

The hyposcope consists of a series of mirrors mounted in a tube of inverted L shape; the shorter arm lies across the barrel of the rifle, while the longer arm hangs down at one side. The first mirror reflects the light coming in along the barrel of the rifle to a second mirror at the elbow of the instrument, which directs the rays downward to a mirror at the lower end of the tube, and thence it passes out at right angles to the eye. Thus on looking in at the eyepiece one can see the sights of his rifle, and take accurate aim while holding the gun above his head. The vertical arm of the instrument comprises two telescoping sections so that, by means of a thumbscrew at the side, this arm may be extended to elevate the device for long-range shooting. The amount of elevation may be accurately determined by means of a fine scale on the upper section. In order to allow for windage, a thumbscrew at the end of the horizontal arm may be rotated to move the mirror contained therein slightly to one side or the other. A scale on this arm shows just how far the mirror must be moved for different velocities and directions of the wind. The entire instrument is very compact and light, weighing about a pound. It is provided with a holster, in which it may be encased to prevent it from sustaining any injury when not in use.

The advantages of this instrument in actual warfare will be apparent to all. Only the muzzles of the rifles are exposed to the enemy, and the soldiers are entirely concealed in the trenches. But aside from its advantages as a means of protection, the device will be found greatly to increase the effectiveness of the firing. The fear of being shot while taking aim makes the soldier fire hurriedly and at random; with the hyposcope attached to his rifle no fears will be entertained, and the soldier may fire deliberately and with perfect aim. By applying it to the end of a field-glass, an observer can watch the movements of the enemy without danger of discovery. It has also been designed for use on Maxim guns.

Hypostatic Union, the union of the divine and human nature in the one person of Jesus Christ.

Hypoth'esis, in mathematics the term denotes what is assumed in order that the conclusion may follow from it as a consequence. It has sometimes been applied in a disparaging sense to suppositions that have been made for the purpose of drawing foregone conclusions, and not with the view, as has been generally the case in physics, to supply probable antecedents to conclusions which have already been experimentally established. In some cases the hypothesis may only acquire a certain degree of probability; in others it may account for all the known circumstances, and it then acquires the name of a theory; and if subsequent observation reveals no exceptions to its application, it gradually amounts to certainty. The conjecture of Newton that the force of gravity, as exemplified on the earth, might extend to the moon was at first a hypothesis; but when it was found that it accounted for all the facts it became a theory. There has an attempt been made to institute a distinction between a hypothetical cause and a true cause, but it is practically of no value.

Hypsom'etry (Greek, «height-measurement»), the art of determining differences of elevation on the earth's surface. Three distinct modes of procedure may be adopted for measuring a given difference in level. The first and most accurate of these consists in running a «line of levels» between the two stations whose difference in height is to be determined. This operation is conducted as follows: Let A, B, and C be any three points on the earth's surface, such that the difference in level between any two of them is not more than a few feet; and let us suppose that B lies between A and C, and that it is not more than a few hundred feet distant from either of them. A precise spirit level is set up at B, so that its telescope is higher than either A or C. A graduated staff is then held in a vertical position upon the point A, and the observer at the level determines, by looking through the telescope, which division of the staff is of precisely the same height as the cross-hairs of his instrument. If the height of A is known, we have merely to add to it the known length of the graduated staff, from the ground up to the division that has been observed, in order to ascertain the exact height of the cross-hairs of the level. The staff is next carried forward to the point C, and a second observation of the same kind is made upon it at this point. The height above the ground of the division that is here found to be on a level with the instrument is then subtracted from the known height of the cross-hairs in the telescope, and the result is the height of the point C. The instrument is then carried forward to a point, D, situated beyond C, and the altitude of a still more remote point, E, is determined in the same manner, by observing the graduated staff at C and at E, and then calculating the height of E from the known height of C, as determined by the preceding operation. A chain of observations of this sort is called a «line of levels,» and it is obvious that the difference of elevation of any two points whatever may be determined with great precision by running such a line from one of them to the other.

The labor and expense of joining two distant points by a line of precise levels are often prohibitively great; and hence when a high order of accuracy is not essential, trigonometric or barometric methods are used instead. In determining the height of a mountain (for example) by the trigonometric method, a conveniently situated station is selected, from which the summit of the mountain can be well seen, and the horizontal distance from this station to the vertical line passing through the summit of the mountain is first determined by any of the methods used by surveyors for determining the distance of an inaccessible object. The apparent angular elevation of the mountain is next observed; that is, the angle included between the horizontal plane through the station and the line joining the station to the top of the mountain is measured.

If the earth were flat and devoid of any atmosphere, these data would enable us to compute the height of the mountain with considerable precision. For the vertical height of the mountain above the station, and its horizontal distance from the station, and the line joining the station to its summit, would constitute the three sides of a right-angled triangle; and the base of this triangle being known, as well as one of the adjacent angles, its vertical height (that is, the height of the mountain above the observing station,) could be easily calculated by the ordinary rules of trigonometry. In the actual case, however, the problem is complicated by the curvature of the earth's surface, and by the refraction effects due to the presence of the atmosphere. Corrections can be easily applied for the curvature, since that is constant in any given spot, and its value is well known. The refraction effects, however, are variable from time to time, according to atmospheric conditions; and it is impossible to determine them, at any given moment, with a precision sufficient to enable the trigonometric method to compete, in accuracy, with the method of leveling already described.

The third general method of determining elevations on the earth's surface depends upon the fact that the atmosphere possesses weight, so that its pressure diminishes as we pass upward. The difference in depth of two given points below the surface of the sea can be determined with a good deal of precision by noting the hydrostatic pressures at the two points. If these pressures are expressed in pounds per square foot, and their difference is divided by the weight, in pounds, of a cubic foot of the water, the quotient will be the difference in depth of the two points, expressed in feet. The same general principle applies to the determination of the differences of elevation in the atmosphere, only in this case the problem is far less simple in its actual application, because the air, instead of having a practically constant density as water has, is very elastic and compressible, and very sensitive to changes of temperature. The observations, therefore, have to be combined by means of a formula which will take these facts into account, so far as possible. In determining differences of height by this method (which is called "barometric hypsometry"), the difference in atmospheric pressure at the two points that are to be compared is usually determined by means of barometric readings, though the boiling-point method, to which reference will presently be made, is also used. The mercurial barometer gives the most accurate results, but the aneroid form is so much more convenient to manipulate and transport that it is commonly preferred for ordinary work. (See BAROMETER.) When the difference of elevation between two given stations is to be determined, it is preferable to make the barometric observations at both places simultaneously, simultaneous observations of the atmospheric temperature being also taken. This implies the co-operation of two observers, and the possession of two sets of instruments; and hence it is not always feasible. When the work is carried out by a single observer, or with a single set of instruments, the observations should be made first at Station A, then at Station B, and finally at Station A again; the average readings at Station A, both of barometric pressure and of temperature, being adopted as the definite observations at that station. In this way the effects of variations of temperature and pressure are eliminated as far as possible. If h is the average reading of the barometer at the lower station, in inches, and H is the reading of the barometer at the upper station, also in inches, and if t and t^1 are the temperatures observed at the two stations, on the Fahrenheit scale, then the difference in height between the two stations, as expressed in feet, is approximately

$$(\log h - \log H) \times 60384 \times \left(1 + \frac{t + t' - 64^\circ}{900}\right).$$

In place of the barometer, an instrument called a "hypsometer" is sometimes used for determining the difference in barometric pressure between the two stations. The hypsometer is essentially an instrument for determining the boiling point of water with a considerable degree of precision. Water, which at the normal atmospheric pressure boils at 212° F., boils at a lower temperature on the tops of mountains, where the atmospheric pressure is less. The change in the boiling point is approximately 1° F. for every 555 feet of ascent; though this relation is not exact. In the practical application of the method, the boiling point is observed, on the mountain top, by an accurate thermometer which should be graduated as fine as fiftieths of a degree on the Fahrenheit scale. The difference between the temperature so obtained and 212° F. is then multiplied by the constant factor 555, and the product is the desired estimate of the height of the mountain above the sea. This procedure, it will be seen, assumes that at the time the observation is made, the atmospheric pressure at the sea-level has its normal (or average) value, so that water would boil there at 212° F. precisely. This condition will seldom be more than approximately fulfilled, and hence the method by boiling points, as usually carried out, is more uncertain than the barometric method as described above. The thermometric method is very convenient, however, and for this reason it is in strong favor among travelers and explorers, who usually are content with a more or less rough approximation to the height to be measured. The method is capable of being refined further than has here been indicated; but when more accurate results are desired than are obtainable by the process as described above, it is better to make use of simultaneous readings of the barometer and thermometer, at the two stations to be compared.

Hyrax, hī'raks, the type-genus of a group of small rabbit-like animals forming the group *Hyracoidea*. There are two species, not very sharply defined, the daman (*H. Syriacus*), which spreads from the African shores of the Red Sea to Syria, and the Klipdas, or dassy (*H. Capensis*), which ranges from Abyssinia to the Cape of Good Hope. The former is the animal meant by the Scripture reference to "conies," as a "feeble folk." They are gregarious, plant-feeding, and make their homes among loose rocks, where they are little seen during the day. Hence English settlers call them rock-rabbits. The zoological position of these animals is astonishing in view of their size, appearance and rodent-like habits, for they are most nearly related to the elephant and rhinoceros. In west-central Africa live two or three small arboreal species (*Dendrohyrax*). The latest monographer of these singular animals is O. Thomas (Proc. Zool. Soc. of London 1892), who says that the rules of priority require that the family and genus should be called *Procaviidæ* and *Procavia*. They are believed to be little modified descendants of the *Condylarthra*.

Hyrcanus (hėr-kā'nŭs) **I.**, JOHN HYRCANUS, a Jewish high-priest and prince of the Asmonean family, who ruled in 135-105 B.C. He was the son and successor of Simon Maccabæus. At first dependent on the Syrians, he succeeded in throwing off their yoke, and also in subjugating the Samaritans. He next overcame the Idumæans, and obliged them to submit to Judaism. He afterward confirmed his power by an alliance with the Romans and made Judæa more powerful than it had been since Solomon's time. He was originally a Pharisee, but ultimately favored the Sadducees.

Hyrcanus II., high-priest of the Jews and prince of the Asmonean family, who ruled intermittently from 69 B.C. to 38 B.C. He was the grandson of Hyrcanus I. His younger brother, Aristobulus, seized the government, and finally Pompey removed Hyrcanus from the kingship, and made Antipater of Idumæa governor of the colony. In 47 B.C. Cæsar proclaimed Hyrcanus tetrarch and high-priest. Antigonus, son of Aristobulus, deposed Hyrcanus and removed him to Seleucia whence later, at the request of Herod, he returned to Jerusalem, where he was finally put to death (30 B.C.).

Hyslop, hĭs'lŏp, **James Hervey**, American scholar and educator: b. Xenia, Ohio, 18 Aug. 1854. He was graduated from Wooster University (Ohio), studied also at Leipsic and the Johns Hopkins University, taught successively in Lake Forest University, Smith College, and Bucknell University, and was appointed professor of logic and ethics in Columbia University. He became well known for his connection with the investigations of the Society for Psychical Research, and contributed extensively to its proceedings. His further work includes articles in prominent periodicals; an edition of Hume's 'Ethics' (1893) with introduction; a text-book on 'The Elements of Logic' (1892); one on 'The Elements of Ethics' (1895); 'Democracy: A Study of Government' (1899); 'Logic and Argument' (1899); and 'A Syllabus of Psychology' (1899).

Hyssop, hĭs'ŭp (*Hyssopus*), a genus of plants of the natural order *Labiatæ*, with four straight diverging stamens, and a 15-ribbed calyx. The common hyssop (*H. officinalis*) is a perennial shrubby plant about two feet in height. The leaves stand in pairs without footstalks. The flowers are blue, growing chiefly on one side, in short verticillated spikes. It is a native of the south of Europe and the East, and is naturalized in the United States. The leaves have an agreeable aromatic color, and an extract from them is produced by water and spirits. The hyssop of Scripture (that is, the plant whose Hebrew name *ezob* has been translated "hyssop") has not been ascertained. As it "grew out of the wall," it must have been a diminutive plant, and may have been one of the mosses. The most probable and most widely accepted view is that it was the caper-plant (*Capparis spinosa*), but it is not unlikely that the name was applied to several plants of somewhat similar properties. The name of hedge-hyssop is applied to species of plants of the genus *Gratiola*, belonging to the natural order *Scrophulariaceæ*.

Hysteria, a morbid state of the nervous system in which the clinical manifestations present a wonderful variety of symptoms closely simulating some forms of organic disase. There is often increased physical irritability; the condition is frequently manifested by neuralgic pains, hyperæsthesias, hallucinations, and convulsive and paralytic phenomena. It may be regarded as a brain affection — a mild insanity.

Among the causes of hysteria heredity plays a most important part. There may be direct transmission of the hysterical temperament from parent to child, or other nervous manifestations in the family and its branches, such as epilepsy, chorea, neuralgia, insanity, etc. It occurs more frequently in women, but it is much more common in men than is ordinarily believed; it occurs in boys and girls at a tender age or about the time of puberty. Briquet found that one eighth of his cases were in children under ten years of age. Anything which lowers the general tone of the nervous system may give rise to it in predisposed persons. Hæmorrhages, severe illness, poor food, anæmia, overwork in uncongenial occupations, anxiety, fright, jealousy, disappointments make a profound impression; so does an education which fosters and stimulates inherited instability. The enforced social restrictions of women, which they often inflict upon their young children, with lack of proper exercise for physical development and an artificial and premature education and habits heighten this predisposition. Accidents are a frequent cause of the first appearance of hysteria, as has been clearly pointed out by Charcot. The disease may, at times, occur in young girls who have witnessed attacks in others.

To understand the symptoms of hysteria, it must be borne in mind that there are two classes of phenomena. These have been termed the *mental stigmata* and the *mental accidents*. The stigmata are anæsthesias (loss of sensation), amnesias (forgetfulness), abulias (loss of will power), motor disturbances, and modifications of character. These are the cardinal symptom-groups that characterize the mental state of the hysteric. Any or all of the mental accidents may likewise be noted — suggestibility and sub-conscious acting, fixed ideas, ecstasy, automatism, convulsive movements, sleep-walking, deliriums, etc. The occurrence of these constitutes important corroborative evidences of hysteria and while not found in all hysterics, they may be very common symptoms.

Hysterical persons often complain of some of the symptoms found in neurasthenia — neuralgic pains in various parts and hyperæsthetic areas about the abdomen, chest, or back, frequently in the neighborhood of the ovary, mammary gland, etc. There may be anæsthetic patches in various parts of the body, or there may be complete loss of sensation on one side associated with anæsthesia of the mucous membranes. The special senses on that side are involved — sight, taste, and hearing.

There may be irritations of the bladder and urethra; pain in the joints, which may be mistaken for joint disease.

In some cases the senses are exceedingly acute. Persons notice odors imperceptible to others; are often made sick by odors which do not affect normal individuals; may have a liking for odors and substances disagreeable to others. Perverted sense is shown in an abnormal taste, in eating soap, slate-pencils, etc. Hysterical manifestations in some are simply emotional exaggerations; they laugh and cry without cause. In serious attacks there are likely to be various hysterical manifestations. Occasionally tactile sensibility is disturbed, and the muscular sense may be abolished. The anæsthesia may affect the mucous membranes of mouth, pharynx and nose, abolishing the reflexes of the parts. The secretions may be diminished or arrested.

Spasmodic convulsions and paralytic phenomena may occur. The spasmodic attack may be rhythmic; may simulate the trembling of organic disease; may be confined to one member or involve the entire half of the body; may be coarse, as in disseminated sclerosis, or a fine tremor, as in paralysis agitans, or the tremor may simulate the trembling of organic brain disease. It may occur in any muscle or group of muscles; may manifest itself as contracture, which may be intermittent or may last continuously for months or years. Contracture may be confined to the strong muscle of the jaw and other muscles in their neighborhood, causing trismus. Spasms of the glottis may take place, giving rise to severe difficulty in breathing; or of the pharynx, causing difficulty in swallowing. Globus hystericus is a constant symptom, but is not as frequent as it is often thought to be. Persistent and severe vomiting often occurs, but the nutrition rarely suffers materially from these attacks. Retention of urine is frequent, owing to spasm of the sphincter, and the catheter may have to be used for months.

Paralysis occurs in these cases; it is variable in distribution, and may come on suddenly after a convulsive attack or without it; it may be flaccid or associated with contracture; it may come on slowly; it may be confined to one limb or be hemiplegic in type.

Hysterics are easily affected by pleasurable or painful impressions, and there is often a morbid craving for sympathy and attention. They may show moral perversion; may lie, steal, quarrel with and intrigue against their own family; may form and change attachments and dislikes without obvious reason; may manifest aversions, as to frogs, spiders, mice, cats, etc.; may deceive for deception's sake or to excite wonder. Some are painfully depressed; they have forebodings, or are compelled to do certain acts. Here the hysterical insanities are approached on the one hand, and the imperative conceptions and neurasthenias, on the other.

Hystero-epileptic attacks in their greatest severity are often preceded by general discomfort, or by hallucinations of vision and hearing. Usually sudden, they may be preceded by an «aura,» globus hystericus, singing in the ear, etc. Breathing is spasmodic; consciousness is obscured; the convulsion may be similar to those of mild epilepsy. In some cases the body is thrown into all sorts of contortions. An extreme opisthotonos may be present, the body being bent backward, resting on the head and heels. Gestures and noises are made. Sometimes religious ideas have an influence over the attitudes assumed; at other times, ideas of demoniacal possession.

From milder forms, recovery is the rule. In graver cases, and when there is a strong neuropathic tendency, the persons will probably pass from one hysterical manifestation to another.

Treatment.— In cases where there is deterioration of the physical health, tonics and nutritious diet should be given. Hydrotherapy improves nutrition and also the mental state. Many drugs have been recommended, but they are all uncertain in their action, at one time giving a result, and failing at another. Convulsive attacks may at times be stopped by the cold douche to the spine. Isolation from the family circle is of the utmost importance in the treatment of these cases. Every effort should be made to discover the psychic shock which has produced the attack. Only the patient may have knowledge of this, and he will not often reveal it. There is no disease the treatment of which it is more difficult to describe. Suggestion-therapy gives by far the best results, but the great difficulty is that good results are rarely permanent.

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Hysterophytes, hĭs'tē-rō-fīts. See FUNGI.

Hyvernat, hē'vĕr-nat, **Eugene Xavier Louis Henry**, American scholar: b. St. Julien-en-Jarrêt, Loire, France, 30 June 1858. He was graduated from the University of France at Lyons in 1876, studied divinity at the St. Sulpice Seminary, Issy, in 1877–9, at Paris in 1879–82, was Oriental interpreter to the Propaganda at Rome in 1885–9, and taught in the Roman Seminary in 1885–8. In 1889 he was appointed professor of Oriental languages and archæology in the Catholic University of America at Washington, D. C. His writings include: 'Les Actes des Martyrs de l'Egypte' (Vol. I. 1886); 'Album de Paléographie Copte' (1888); and 'Du Caucase au Golfe Persique' (with Muller-Simonis 1892).

I

I the ninth letter and third vowel of all the alphabets of western Europe, came into the Latin alphabet from the Greek. It is named in Greek iota, which is the yod of the Hebrew and the corresponding letter of the Phœnician alphabet from which the Greeks derived it. Iota and yod (whence jot) being the smallest letter in the Hebrew and Greek, gave occasion for the New Testament phrase «one jot or one tittle.» In ancient Latin the i appears to have stood for a semi-vowel like y as well as for the vowel i: thus the Latins would write Ianus, Iulia, pronouncing them Yanus, Yulia. And till a comparatively recent date words beginning with I and J were in English dictionaries classed together.

The dot over the i appears first in MSS. of the 13th century. The sound value of i in all languages except English is constant and is equal to e in he and to i in him. What is called the long sound of English i as in hide is a diphthong made up of the two vowels a and i: this value of i in English is believed to have been given to the letter not earlier than the 16th century: till then the letter had the same sound in English as in other languages.

In the standard alphabet of philologists the values of the vowels are about as in the languages of continental Europe, in which i is sounded as English e.

It is the general rule in English pronunciation that i followed by two consonants in the same syllable is short: yet when the two consonants are ld or nd the i is nearly always long and diphthongal, for example, mild, rind: in wind (noun) it is short, but in wind (verb) it is long. Combined with o it forms a true diphthong oi as in oil: or mere digraphs representing sounds in which often the i has no part: examples: bail, rein, seize, pier, friend. Usually a final e indicates that the i in a word is to be pronounced as the diphthong: for example, fine, fin: yet genuine is genuin: or the i is pronounced as e long, — marine, quinine, Augustine.

In Pope's time and long after oblige was pronounced obleege and rhymed with besiege: the i in oblique is pronounced either e or i.

Ian Maclaren. See WATSON, JOHN.

Iba, ē'bä, Philippines, pueblo and capital of the province of Zambales, Luzon, situated on a river two miles from its mouth, 85 miles northwest of Manila. It has a good anchorage and is on the south coast road. It is a well built town, and has several fine public buildings. In 1901 a United States meteorological station was established there. Pop. 3,500.

Ibach, Lawrence J., American astronomer: b. Allentown, Pa., 17 Jan. 1816; d. Newmanstown, Pa., 9 Oct. 1888. He learned the blacksmith's trade and followed it throughout his life, chiefly at Sheridan, Lebanon County, Pa. He studied with the astronomer, Charles F. Engleman, who, on his death in 1860, bequeathed all his charts, books, and instruments to Ibach. His benefactor having promised to make several series of astronomical calculations for almanacs Ibach filled the first order (1863), and thereafter till his death made annual calculations for almanacs in the United States, Canada, South America, and Cuba. He was commonly known as the «blacksmith-astronomer.»

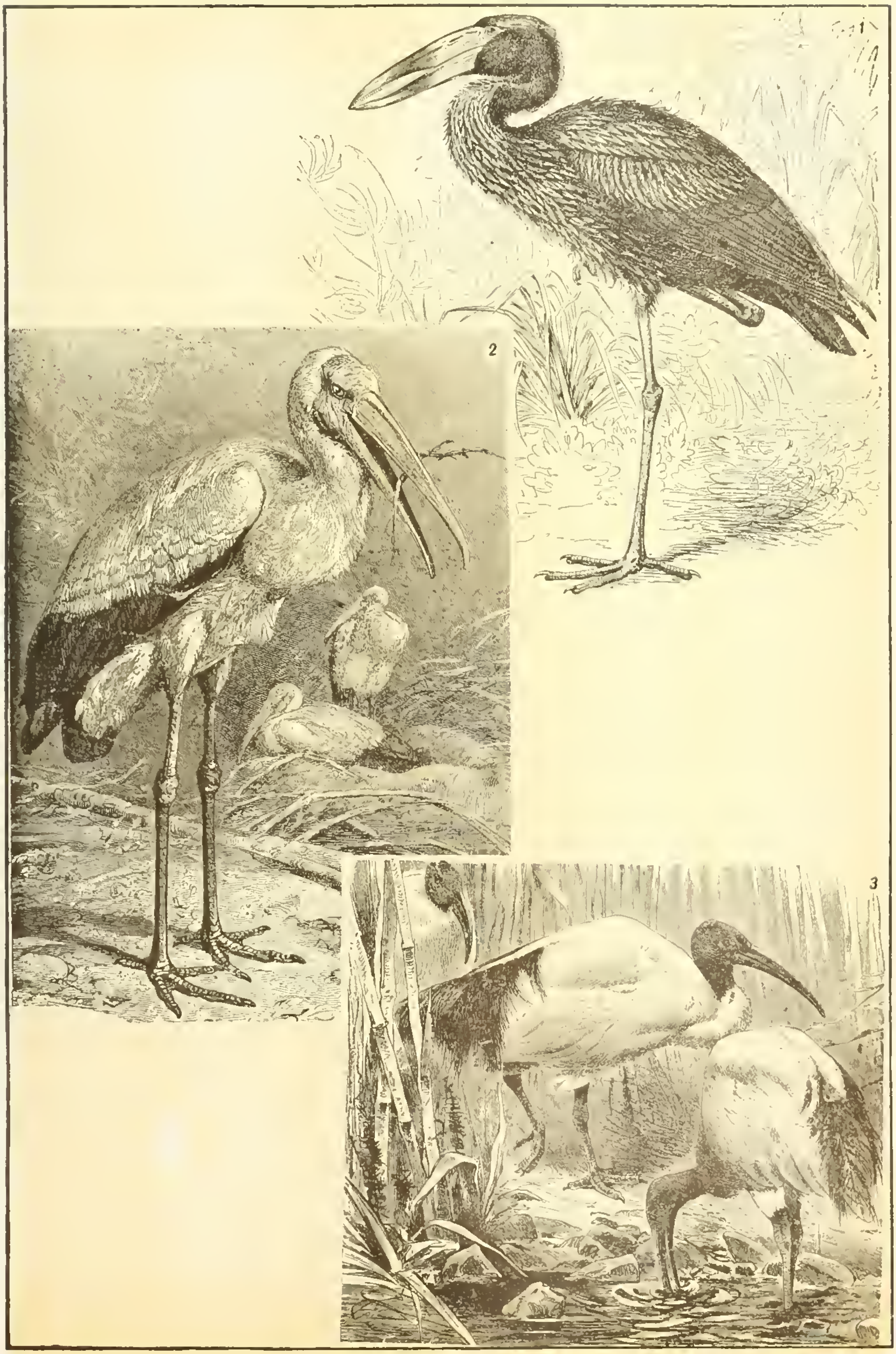
Ibajay, ē-bä-hī', Philippines, pueblo of the province of Capiz, island of Panay, situated on the Ibajay River, 42 miles northwest of Capiz, the capital of the province. Pop. 11,350.

Iberia, ī-bē'rĭa. (1) The ancient name of a district of Asia, between the Euxine and Caspian seas. It now forms part of Russian Georgia, and consists of an extensive fertile plain, surrounded by mountains traversed by four passes. It probably belonged to Persia, until subjected by Pompey and Trajan to the Roman empire, under which it remained till after the time of Julian. (2) The ancient name of Spain, the Ebro, the principal river, being called Iberus. The Iberian language still lives in the Basque. See BASQUES and CELTIBERI.

Iberville, Pierre le Moyne, pē-är lė mwän ē-bër-vēl, SIEUR D', French-Canadian naval and military commander: b. Montreal 16 July 1661; d. Havana, Cuba, 9 July 1706. He entered the French navy, in 1686 took part in the expedition for the capture of the English forts on James' Bay, in 1690 in that for the destruction of Schenectady, N. Y. He took Fort Nelson, on Hudson Bay; captured and demolished Fort Pemaquid, built for the protection of the New England settlements; laid waste all the British posts on the island of Newfoundland; and, having defeated three English vessels with his one, reduced Fort Bourbon, the last station of the Hudson's Bay Company. In 1699 he ascended the Mississippi for some distance, and built Fort Biloxi at the head of Biloxi Bay. This post he removed to Mobile in 1701. In 1706 he captured the island of Nevis. He was considered the ablest officer in the French naval service of his time, and is generally called the founder of Louisiana

I'bex, any of several species of wild goat (q.v.), sometimes placed apart in a sub-genus *Ibex*, distinguished by the form of the horns of the ram, which are large (30 to 50 inches long),

THE IBIS FAMILY.



REPRESENTATIVE IBISES.

1. Open-bill (Anastomus lamelligerus). 2. Wood Ibis (Tantalus ibis). 3. Sacred Ibis (Ibis religiosa).

backward curving, compressed, and marked on the front with bold cross-ridges or knot-like protuberances. The ibexes are larger than other goats, that of the Himalayas standing 40 inches high at the withers. Their coats are harsh, uniformly brown, becoming much grayer in winter, whitish on the under surface and buttocks, and with darker tints on the face and fore-legs. These animals inhabit the most precipitous and inaccessible heights of lofty mountains, where they assemble in flocks, sometimes consisting of 10 or 15 individuals. During the night they feed in the highest woods, but at sunrise they again ascend the mountains, till they have reached the most perilous heights. They are remarkably swift, and display amazing agility and dexterity in leaping. They are objects of the chase, and the hunter must have great skill and hardihood to succeed. Several species are distinguished by locality and minor differences. The typical ibex, bouquetin or steinbock (*capra ibex*), once numerous throughout the European Alps, now exists only as a semi-domesticated animal in certain valleys on the Italian border.

Three other species are recognized: The Arabian ibex (*C. sinaitica*) of Palestine, Arabian and northern Egypt (see BEDEN); the Abyssinian ibex or walie (*C. walie*); and the great Himalayan ibex (*C. sibirica*); which ranges over the high mountains and plateaus of all central Asia, keeping as near the snow-line as possible, and affording the best sport known to that region of game.

Ibicuhy, ē-bē-kwē', or **Ibicui, Brazil**, an affluent of the Uruguay River, which rises in the Serra de Santa Anna, province of Rio Grande do Sul, and after a westward course of about 400 miles joins the Uruguay at Yapeyu opposite St. Martin in Argentina.

Ibilao, ē-bē-lä'ō, a head hunting Philippine tribe inhabiting the border lands of the provinces of Nueva Ecija and Nueva Vizcaya in the central part of the island of Luzon. They are heathens, of the Malay race, with an infusion of Negrito blood. See PHILIPPINE ISLANDS.

I'bis, a family of wading-birds (*Ibididæ*) inhabiting warm regions. They are related to the storks on the one hand and to the spoonbills and flamingoes on the other. Their bills are long, weak, curved, and the nasal grooves are very long. The legs are long, the tibia partly naked, and the toes long with small webs. In size they are like herons, rather less than storks; and in color present a great and beautiful variety of tints, often with a metallic sheen; the sexes are similar. Ibises are shy birds, which inhabit not only watery and wooded country, but dry plains and rocky gorges. They perform a powerful and elevated flight, extending their neck and legs, and uttering a hoarse croak. They ordinarily wade for their food, poking in the mud with the long bill for aquatic insects, worms and small shellfish; they also catch fish, and on land eat insects, especially locusts, frogs, newts and crustaceans. Some species breed in communities, like herons, others apart, but the nest is always a rude cradle of sticks on a tree or ledge of rocks and occasionally on marshy ground, and the eggs are usually green, with or without markings. There are 12 or 15 genera and a large number of species scattered throughout the whole tropical zone. The typical genus, *Ibis*, contains the sacred ibis (*I. æthiopica*), called by the natives of upper Egypt *abu Hannes*, or "Father John," which arrives in Egypt about the time that the inundation of the Nile commences, its numbers increasing or diminishing with the increase or diminution of the waters; and it migrates southward about the end of June. This species is about the size of a fowl; the head and neck are bare; the body white; the wing tipped with shining, ashy black, among which the white forms oblique notches; the secondaries and scapulars, which in summer curve gracefully over the hinder parts, are bright black. This was one of the birds adored by the ancient Egyptians, and of which numerous mummies are found. The Greek and Roman writers give many fabulous stories relating to ibis, which Savigny has gathered in 'Histoire Naturelle et Mythologique de l'Ibis.' He concludes that the reverence for this ibis was not due to its alleged destruction of snakes, which, in fact, does not occur, but arose from the birds' return at the time the Nile began to rise, the commencement of the season of abundance. Modern writers on Egyptian customs and antiquities may be consulted further on this point. Many other interesting species occur in Africa, Asia and the Australian region; and many species reside in the American tropics,— two, the white ibis (*Eudocimus albus*) and the scarlet ibis (*E. ruber*), flocking in summer in the southern United States. Both are birds of extreme beauty of plumage, and both have been so ruthlessly persecuted by plume-hunters, seeking feathers of millinery purposes, that the scarlet ibises are nearly exterminated.

Wood-ibises and shell-ibises are names for birds of other groups, elsewhere described.

Ibn Sina, ĭb'n sē'nä. See AVICENNA.

Ibsen, Henrik, hĕn'rĭk ĭb'sĕn, Norwegian novelist and dramatist: b. Skien, Norway, 20 March 1828: d. Christiania, 22 May 1906. At 16 he became apprentice to an apothecary at Grimstad, a small village on the southeast coast of Norway, and here were composed his first works, 'Hösten,' a poem, and 'Catilina,' a play published in 1850 over the signature Brynjolf Bjanne. After a few months at the University of Christiania in 1850, where he wrote 'The Warrior's Mound,' played at the Christiania Theatre that year, he became manager of the new National Theatre at Bergen and turned his attention directly to dramatic composition. In 1856 his 'Banquet at Solhaug,' a Norwegian historical drama, was produced here, and from 1857 to 1862 he was manager of the Norwegian Theatre at Christiania. To this period belong his historical plays, 'Lady Inger of Östraat' (1857); and 'The Vikings at Helgeland' (1858); 'The Comedy of Love' (1862), and several poems. His greatest historical drama, 'The Pretenders,' appeared in 1864, and indignant at the political position of Norway at the time, Ibsen then left Norway to be absent (save for short visits) for, as it is proved, 27 years, living for a time in Germany and then in Trieste and Rome. His noble dramatic poem, 'Brand,' was first published in 1866, and the Storthing thereupon voted him the "poet's salary." In 1867 appeared the famous dramatic poem, 'Peer Gynt,' followed by a political comedy, 'The League of Youth' (1869); and the play, 'Emperor and Galilean,' his longest work (1873). In 1864 he returned to Norway for a short visit and was everywhere enthusiastically welcomed. His subsequent works include the social dramas which are the basis of his fame: 'The Pillars of Society' (1877); 'A Doll's House' (1879); 'Ghosts' (1881); 'An Enemy of the People' (1882); 'The Wild Duck' (1884); 'Rosmersholm' (1866); 'The Lady from the Sea' (1888); 'Hedda Gabler' (1890); 'Master Builder Solness' (1892); 'Little Eyolf' (1894); 'John Gabriel Borkman' (1896); 'When we Dead Awaken' (1900); 'Digte' (poems) appeared in 1871. By Ibsen's countrymen the poems 'Brand' and 'Peer Gynt' are considered his greatest works, both being intensely national, but nevertheless of universal application. Brand, the hero of the first, represents a protest against compromise, while 'Peer Gynt,' sometimes styled "the Scandinavian Faust," is an analysis of the human soul. The modern life dramas are the works by which Ibsen is best known to the world at large. The setting only is Norwegian, the lesson they convey is of world-wide extension. 'The Pillars of Society' is an attack upon hypocrisy as exemplified in the principal personages in a small town, while 'A Doll's House,' which has had a wide popularity in America, is concerned with the failure of marriage. 'Ghosts' is perhaps the most impressive and awesome of all of Ibsen's works, its theme being the consequences of hereditary vices. 'The Wild Duck' and 'Rosmersholm' are gloomy, despairing dramas; 'Hedda Gabler' presents in the character of Hedda a woman of the undomestic, selfish type, while the fearful price of success forms the motive of 'Master Builder Solness.' The theme of 'A Doll's House' is in effect that of 'Little Eyolf,' but in the latter Ibsen, who has hitherto seemed pessimistically to foretell the dissolution of modern society, now admits a hope of its regeneration. Over Ibsen's works a vast amount of controversy has arisen, and he has been fiercely assailed as cynical and even immoral, and as zealously defended. The truth of the matter appears to be that he was *par excellence* the poet of protest against social sophistry, and that he unerringly indicated the danger spots in modern life. There is nothing conventional in the construction or motive of his plays. More than once the climax of the play is represented as occurring prior to the opening of the drama which is concerned only with the consequences. Ibsen made a deep impression upon the literature of his century and his fame is not likely to decrease. Consult: Brandes, 'Henrik Ibsen,' in 'Eminent Authors of the 19th Century' (1886); Jaeger, 'Henrik Ibsen: a Critical Biography' (1890); Wicksteed, 'Four Lectures on Henrik Ibsen' (1892); Shaw, 'The Quintessence of Ibsenism' (1893); Boyesen, 'A Commentary on the Writings of Henrik Ibsen' (1894).

Ica, ē-sä', Peru. (1) A littoral department bounded north by the department of Huancavelica, east by Ayacucho, south by Arequipa, and west by the Pacific Ocean. Area, 8,718 square miles; pop. (1896) 90,962. (2) A town, capital of the above department on a river of the same name, 46 miles southeast of Pisco on Pisco Bay, with which it is connected by rail. It was founded in 1563. It is in a grapevine and sugar-cane producing region and has manufactures of wine and brandy. Pop. 9,000.

Ice, water in the solid state. When sufficiently cooled, water loses its fluidity, and becomes filled with multitudes of needle-like crystals belonging to the hexagonal system (see CRYSTAL), which increase and interlace until the whole mass becomes solidified. In nature, this change begins at the surface of the water and spreads gradually downward, so that the exact course of the freezing is not so easy to trace as it is in the laboratory, where the water can be uniformly cooled throughout its entire mass. When the freezing process is complete, the crystalline nature of the solid that results from it is not at all obvious. It is clearly visible, however, in snow-flakes, where the hexagonal form is also evident. In a solid block of ice the crystalline structure can also be demonstrated by a method that was used with much success by Tyndall, as a beautiful and instructive lecture experiment. The image of a slab of pure ice is thrown upon a screen by means of a projection lantern provided with a powerful electric light. At first nothing is seen, but very shortly the heat-rays passing through the ice cause it to melt internally, and the melting takes place according to the internal crystalline structure, which is gradually brought out upon the screen in great beauty. Six-sided stars, suggestive of the snow-crystals, appear, and these enlarge and become serrated at the edges as the electric beam gradually destroys the molecular architecture, the process continuing until the ice has been again reduced to the liquid form.

Pure water normally freezes at a temperature which is denoted by 32° on the Fahrenheit scale, and by 0° on the centigrade and Réaumur scales. It is possible, however, to cool pure water to a temperature considerably lower than this, if proper precautions are taken. As long ago as 1836, for example, Gay-Lussac observed that water, when placed in a vessel and covered with a layer of oil, may be cooled to 10° F. without freezing. If the vessel be slightly shaken or jarred, however, solidification ensues at once.

Pressure has a slight effect upon the temperature at which water freezes. This effect was predicted, from theoretical considerations, by James Thomson, in 1849. Dewar has since measured its amount with much care, finding that the freezing temperature is lowered by 0.014° F. for each atmosphere of pressure. Small as this quantity is, it is of importance in some branches of physics. In 1858 Mousson, by the application of an enormous pressure, succeeded in reducing the freezing point to 4° below zero, Fahrenheit. The presence of dissolved substances in the water also depresses the freezing point. Sea-water, for example, freezes at about 27° F. (the ice that is formed being nearly free from salt), and strong brine is used in the circulating pipes and cooling coils of refrigerating plants, since it can be cooled much below this temperature without freezing.

The effect of pressure in lowering the freezing point is illustrated in the familiar process of making a snow-ball from damp snow, — that is, from snow whose temperature is precisely 32° F. Under the pressure of the hand, the freezing point of the snow mass is lowered slightly, with the result that a partial melting of the crystals takes place. When the pressure is removed, the freezing point rises to its normal position, and the water that was formed by the pressure alone freezes again, and cements the mass together. (The superficial moisture, due to the warmth of the hand, is not here contemplated. The melting from this cause is a separate phenomenon.) The slight but real plasticity of large masses of ice, such as are met with in glaciers, is probably related to this phenomenon of the variation of the freezing point by pressure, but there is some difference of opinion among the authorities as to the precise way in which the slow downward flow of these ice masses is accomplished. The melting of ice by pressure, and its subsequent solidification upon the removal of the pressure, is known to physicists as «regelation».

Experiments that have been conducted in connection with precise thermometry, by Pernet and Marek, show that the temperature of melting ice is slightly different, according to the source of the ice, and the way in which it is treated; this variation being independent of the pressure, and existing even when the ice is sensibly pure. A variation in the melting point of as much as 0.164° F. has been observed; and in order to eliminate the effects of error from this cause, it is necessary, for the purposes of precise thermometry, to adopt a uniform mode of procedure in the treatment of the ice that is to be used for the establishment of the freezing point upon accurate thermometers. (Consult: Guillaume, 'Thermométrie de Précision,' ch.ii.).

When water that contains solid matter in solution or in suspension is frozen, the solid matter is mostly eliminated, so that the ice is much purer than the water from which it is produced. Some of the solids are almost invariably entangled among the interlacing crystals of the ice, however, so that numerous little particles of foreign matter often remain in the ice, imprisoned in tiny cavities. Bacteria and other germs that may have been present in the original water appear to be largely excluded from natural ice by the freezing process, though some of them are undoubtedly caught among the crystals and retained. In artificial ice, where a mass of water is frozen simultaneously on all sides, so that the solidification proceeds from the outside toward the centre of the cake in all directions, purification from this cause is hardly possible, and the middle part of the ice-cake is likely to be rich in whatever germs the original water may have contained. Fortunately the recent experiments of Sedgewick and others indicate that freezing and protracted storage of the ice is much more fatal to typhoid bacilli than was formerly supposed. Artificial ice, if prepared from distilled water, or from water that is certainly known to be free from disease germs, is undoubtedly safer than natural ice that is taken from streams or ponds of unknown purity; but in choosing between natural and artificial ice from the same identical water, the preference should be given to the natural product.

Water expands upon freezing, one volume of water at 32° F. becoming transformed, by freezing, into 1.0908 volumes of ice at the same temperature; which is equivalent to saying that water expands by one-eleventh of its own bulk upon freezing. The quantity of heat required to melt one pound of ice, from the state of ice at 32° F. to that of water at 32° F., is 142 times as great as the quantity of heat required to raise the temperature of a pound of water from 32° F. to 33° F. The specific heat of ice, near the temperature 32° F., is approximately 0.50.

Ice Age. See GLACIAL PERIOD.

Ice, Artificial. See ICE INDUSTRY.

Ice Boat. See ICE YACHTS and ICE YACHTING.

Ice-breaker, a vessel, especially a strong, heavy steamer, with powerful engines, for opening up navigable channels in frozen waters. On the Great Lakes of the United States, where such vessels are extensively used, they are generally fitted for carrrying cargoes or transporting railroad cars. Such vessels are usually so built as to run their bows up on the ice and break it by means of their great weight. An ice-breaker called the Yermak, built in England in 1899, for use in Russian waters, is 305 feet long, with 71 feet beam and draft of 25 feet. She did good harbor work in polar ice in 1900, but proved unequal to the heavy pack of the sea. Admiral Marakoff of the Russian navy, who superintended her trials, believes that the best way to reach the north pole is by means of a powerful ice-breaker, using liquid fuel instead of coal.

Ice Industry. Though the use of natural and artificial ice as an article of commercial value practically began only in the first part of the 19th century, yet the artificial production of cold began long before it was generally supposed to have been thought of.

In Greece and Rome during the early ages snow was more commonly used, being placed in cone-shaped pits 45 feet in diameter, 50 feet deep and lined with straw and prunings of trees. The snow was packed down and covered with more straw and prunings, over all of which a thatched roof was placed; after the ice was formed it was cut and carried out through a door left in the side of the pit for the purpose. During the 16th century snow and ice was stored in cellars for the purpose of cooling drinks. This custom spread from Greece and Italy to Western Europe and to France during the reign of Henry III. in the 16th century and by the end of the 17th century the sale of snow and ice had become a profitable trade. From that time until the beginning of the 19th century the ice trade was practically at a standstill, no material advance was made in the direction of improving the methods of harvesting the ice supplied by nature, nor was any attempt of any importance made to produce artificial ice. For purposes of description and comparison, ice may be divided into two classes, the natural and the artificial.

Natural Ice.— Probably the first ice cut and shipped as an article of commercial value was sent, in 1799, from New York to Charleston, S. C. This cargo was cut from a pond near Canal street. While this shipment was the first recorded it was of little importance; the real beginning of the industry came in the year 1805 when Frederic Tudor, of Boston, shipped a cargo of 130 tons to the West Indies. This resulted in a loss of $4,500, and Tudor's second shipment, two years later to Havana, likewise was made at a loss enormous for those days. He stuck to the business, however, and finally, in 1812, was granted by Great Britain a monopoly of the trade with her colonies in the West Indies, and later, in 1815–16, Spain granted him the same concession to export to Havana. In 1817–18 the trade was extended to Charleston and Savannah; to New Orleans in 1820; to Calcutta in 1833; and to Rio Janeiro in 1834. Thus a large and lucrative trade with southern countries and southern cities of the United States was built up; competitors began to come into the field, the first of these to enter the export field being the firm of Gage, Hittinger & Co. of Boston who introduced American ice to the people of London. They were in turn followed by a Salem merchant named Lander, and others. The Treasury Department gives the following figures for the export trade from 1850 to 1900:

Year.	Tons.	Value.
1850	....	$107,018
1855	41,117	190,793
1860	49,153	183,134
1865	59,927	225,825
1870	65,802	267,702
1875	53,724	208,249
1880	45,666	136,686
1885	38,901	89,420
1890	44,849	111,762
1895	17,295	41,915
1900	13,720	29,501

The harvest of natural ice is gathered on an enormous scale in the United States, the demand for the article being due in a large measure to the growth of other industries to which ice was a necessity. Before Croton water was introduced into New York and as far back as 1825, ice was cut on Sunfish pond, on the outskirts of the city, by some butchers who desired to preserve their stock of meat. In 1826 ice was cut on Rockland Lake, and at first all the ice cut was stored in the ground but later storehouses at Hubert street and Christopher street were built, and as the demand for ice gradually developed in all the larger eastern cities, large storehouses were erected nearby the places where the ice was cut. The capacity of these houses ranges from 10,000 to 90,000 tons and in size run from 100 to 150 feet in length by 30 to 50 feet in width. For gathering the ice there is an elaborate system of apparatus, but the usual methods employed are as follows: After the snow is cleared from the ice by means of scrapers or snow-plows, an ice-plow, either propelled by steam or drawn by horses — the latter means more commonly used — cuts deep grooves in the ice in one direction and then repeats the operation at right angles with the first, thus forming a perfect square, measuring a little more than 3 feet. As these grooves extend nearly through the ice it is a simple matter to saw through the remaining thickness, pry the cakes loose with crowbars, and float them to the icehouses through channels provided for the purpose. Upon reaching the icehouse the cakes are lifted on an elevator, run into the house, and packed in sawdust or other suitable material, to be held there in storage till needed.

The cost of harvesting a ton of natural ice varies greatly; it depending to a great extent upon the weather conditions, both during the process of the formation of the ice and during the process of cutting and housing. Under average conditions the cost of harvesting amounts to about 80 cents, though under very favorable conditions it has been known to have cost only from 25 to 30 cents per ton, but this has not been often. This, of course, does not include the cost of transportation, delivery, etc., and as the majority of the icehouses are a considerable distance from the centers of consumption, the cost of transportation is a large factor. The following figures, taken from 'The Ice Journal' give the quantities of ice harvested in Maine and on the Hudson River, the two most important fields of operation in the whole country:

Year.	Maine Tons.	Hudson River Tons.
1878	....	2,225,000
1879	....	2,371,000
1880	1,426,800	800,000
1881	904,800	2,558,000
1882	1,227,200	1,954,700
1883	1,364,500	3,017,600
1884	1,118,000	3,026,000
1885	1,490,400	3,010,500
1886	1,368,400	2,355,500
1887	1,311,100	3,266,000
1888	1,037,000	3,330,500
1889	1,529,600	2,742,000
1890	3,092,400	....
1891	1,285,000	2,624,000
1892	1,435,000	2,500,000
1893	1,444,000	3,407,839
1894	1,600,800	2,638,500
1895	1,413,500	3,409,000
1896	1,466,000	2,735,500
1897	1,526,500	2,675,033
1898	1,242,500	2,172,400
1899	1,326,430	4,300,293
1900	723,780	1,430,670

The moving of this enormous quantity of ice necessitates the maintainance of a large fleet of barges and other boats for the domestic trade, and of sailing vessels for the export trade, and to the cost of maintaining these vessels, when figuring the cost of harvesting, must be added the cost of towing, loading, discharging, dock and stable rent, repairs of boats, icehouses, and wagons, etc., all this before the ice is placed in the hands of the retailer.

The tools used in harvesting this crop are many and varied, and the manufacture of them has become a large and valuable source of income to several concerns in this country who have made this a specialty. Many of the ice tools now in use were invented by Nathaniel Wyeth and John Barker, of Boston. The ice plow was invented in 1830 and the patent clearing-tooth in 1872. Some of the most common tools now in use are: the snow-scraper or plane, the masher and the plow; augers and axes for tapping the ice in order to drain off surface waters; saws; forked bars for prying the cakes loose; trimming bars for squaring the cakes after loose; adzes, edging tongs, and chisels used in packing the ice when in the storehouse; saws and bars for prying loose previous to shipment; and tongs, scales, axes, etc., used on the retail delivery wagon.

Artificial Ice — The manufacture of ice as an industry was begun as early as 1866, but only reached a degree of commercial importance about 20 years ago. The beginning was naturally made in the Southern States, but as it became more generally used, factories sprang up over the entire country. The growth of the "infant industries" throughout the United States gave this industry an added stimulus, because the supply of natural ice was by far too small to meet the requirements of slaughtering and meat packing-houses, refrigerator cars, cold-storage warehouses, etc.

The growth of the industry from its inception may be seen in the following statistics:

	1900.	1870.
Number of establishments	787	4
Capital	$38,204,054	$434,000
Salaried clerks, officials, etc.	1,545	....
Salaries	$1,234,803	....
Wage-earners	6,933	97
Wages	$3,424,305	$40,600
Miscellaneous expenses	1,779,890	....
Cost of materials used	3,339,724	82,165
Value of product	13,874,513	258,250

The first experiments for making artificial ice for mercantile uses started with the Italians in the 16th century. The first machine used for the actual manufacture was invented by Dr. William Cullen, this being based on the vacuum principle, the atmospheric pressure being reduced by means of an air pump. Later, in 1795, several experiments were made by a Mr. Walker of Oxford, England, in the line of freezing mixtures. Prof. Leslie, of England, produced a considerable degree of refrigeration by including in the exhausted receiver of an air-pump, sulphuric acid, a substance rapidly absorbing vapor. In 1834 Jacob Perkins, an American engineer residing in London, obtained a patent for a machine generally credited with being the forerunner of the modern compressor machine. The refrigerant used in this machine was ether and brine was circulated at a temperature of 5° Fahrenheit through pipes which encircled the evaporator containing the ether. After running through the pipes the brine flowed into a receptacle containing boxes filled with water and thus the water was frozen. Later experiments were made by French and German inventors, boxes were supplanted by cans and this developed into the manufacture of can ice. Many of the improvements made in the ice-making apparatus are due to the efforts of Prof. A. C. Twining, of New Haven, Conn. He patented an ice machine in England in 1850 and in the United States in 1853; in 1855 he invented a machine, and put into active operation in Cleveland, Ohio, which produced 1,600 pounds of ice in 24 hours; and later discovered that ice would be transparent, with the exception of a small porous core, if frozen at a temperature slightly below the freezing point. In 1857 Dr. John Gorrie of Appalachicola, Fla., patented his ice-making machine; this was later followed by the compressed-air machine of Dr. Alexander Kirk; in 1858-60 the machine, upon which the modern ammonia absorption system was founded, was brought forth by Ferdinand P. E. Carre; and later the plate-ice system was introduced by Capt. David Smith, of Chatham, Mass., who erected the first machine of this character in the United States at Oakland, Cal. There have been nearly 4,500 patents taken out in the United States alone for refrigeration processes.

Two systems of making ice are now used, the compressor, and the absorption systems, the former the more generally used. The first step is the compression of the anhydrous ammonia (that is, ammonia which contains no water) into the gaseous form by means of a steam pump, a pressure of from 125 to 175 pounds per square inch being exerted. The next step is to reduce the gas to a liquid state by passing the ammonia through pipes which are in contact with the cold water or some other cold substance. The gas as the beginning contained a certain degree of heat, but by the condensation process this heat is eliminated, and, after being reduced to a liquid state, the ammonia reaches the third and last process, that of expansion. As the ammonia in the liquid state reaches the pipes which are in contact with the water to be frozen, it becomes gaseous because of the expansion, its temperature is thus reduced below the freezing point of water and so draws from the water the heat which was taken away by the condensation process. This results in the freezing of the water.

In the absorption process aqua ammonia is first converted into gas by the application of heat which raises the pressure to from 120 to 160 pounds per square inch. The ammonia is then reduced to liquid form by being passed through pipes in contact with cold water. The ammonia is then changed from a liquid to a gaseous form by the expansion process, the methods being the same as in the compressor system. The expansion draws out any heat in the gas, which, as it passes through the pipes in contact with the water to be frozen, absorbs the heat from them till they are of a like temperature.

A large portion of the ice manufactured in the United States is produced by the can system or the plate system. In making ice by the can system the water is first boiled and allowed to settle, in order to free the ice from any foreign substances and to reduce it to the greatest possible degree of purity. The water is then distilled, boiled again, and run through three kinds of filters. A series of tanks, containing a strong solution of brine, is placed under the freezing room, and through this brine run the pipes containing the liquefied ammonia gas. Into the tanks containing the brine are submerged the cans holding the water to be frozen. As in the compressor system, the ammonia in the pipes is expanded into gas as it passes into the brine, and absorbs enough heat from the brine and water to form the water in the can into ice. The whole process requires from 20 to 66 hours, according to the size and weight of the blocks of ice and to the temperature of the brine. The can is then raised from the tanks by means of a hoist and dipped into a well of warm water to loosen the contents.

The production of ice by the plate system is much slower and more cumbersome. In this process the tank contains the water to be frozen and into it is placed a hollow iron plate holding the coils of pipe filled with the freezing medium. Thus the ice is formed on the outside of the iron plate, is taken out and removed, and is then ready for use.

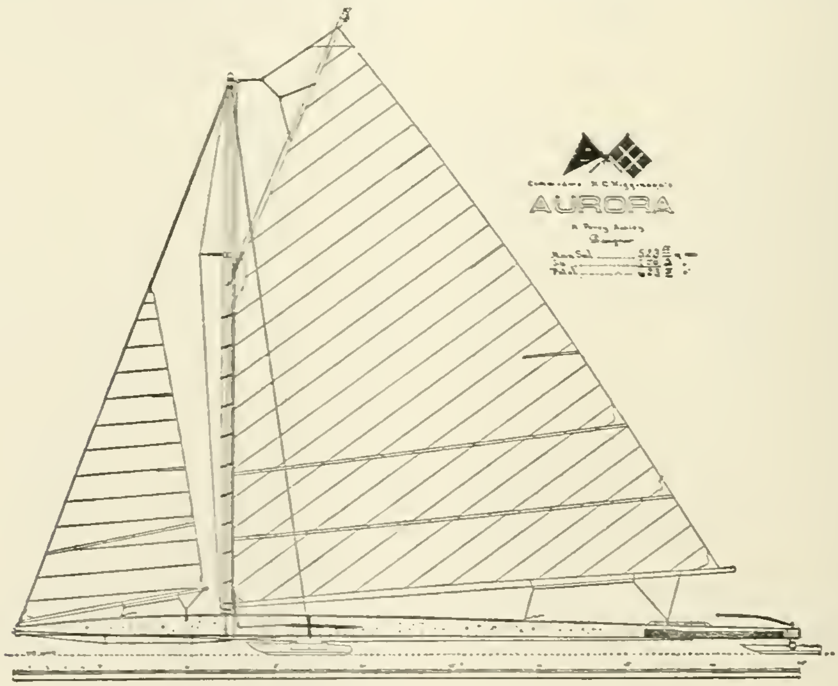
The cost of producing a ton of ice averages throughout the country for all seasons of the year, between $1.10 and $1.50: the average price to the wholesaler ranges from $2 to $2.25; and the retail prices range from 15 to 40 cents per hundred weight according to the season. The changes and improvements in the methods of producing artificial ice have so reduced the cost of manufacture that it can now compete with the natural product. See REFRIGERATION AND REFRIGERATING MACHINERY.

Ice Machines. See GAS, LIQUEFIED.

Ice in Medicine. See COLD.

Ice Yachts and Ice Yachting. The amusement or sport of sailing yachts over the ice has reached its highest development in the United States. The sport abroad is confined to Russia, Sweden and Norway. Boats of the Russian River Club are sailed over a portion of the Gulf of Finland. In 1901 the Stockholm Ice Yacht Club of Sweden built a fleet of fast-racing ice yachts from American designs by Ashley.

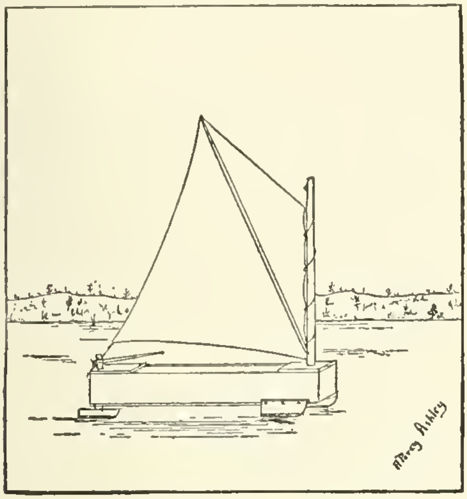
The first authentic ice boat in the United States was built by Oliver Booth, at Poughkeepsie, N. Y., in 1790. It was a square box mounted on three runners, shod with rough iron; with a rudder post and tiller of wood. In 1850 on the Shrewsbury River, in New Jersey, George D. Allaire, constructed an ice yacht of the box order, equipped with rough square iron bars for runners, sharpened with cutting edges. In 1855, on the same river, Nathan B Clark built a three-cornered platform boat, having sharpened runners, and added a jib to the sprit sails previously carried. The type of side-rail boat came into use about 1871 Jacob Buckhout of Poughkeepsie was the pioneer designer of this type, and at the Centennial Exhibition (1876) exhibited the side-rail yacht Whiff, built for Commodore Irving Grinnell of the New Hamburgh, N. Y., Ice Yacht club. She carried 347 square feet of canvas and measured 40 feet from the top of the bowsprit to the end of the main-boom. The sloop-rigged Icicle built on these lines carried 1,070 square feet of sail, but this excess of canvas was found impracticable and the building of large boats was abandoned. The revolution in ice yachting began in 1879, when H. Relyea of Poughbkeepsie built the Robert Scott, having a single backbone and an elliptical steering box. This boat carried 499 square feet of canvas and easily outsailed boats of twice her size. In 1883 the Jack Frost was built by Commodore Archibald Rogers of Hyde Park-on-the-Hudson and the famous racing yacht Haze was built the same year. The Jack Frost won the world's pennant in 1883 and the Haze in 1884. About this time the Shrewsbury Ice Yacht club of Red Bank, N. J., built a large lateen rigged boat, the Scud, carrying over 600 square feet of duck in a single sail. The Orange Lake, N. Y., club built at the same time the catboat Shadow, carrying 800 square feet of sail, and said to be the strongest ice yacht ever constructed. Both of these vessels proved unsuccessful as prize or pennant winners. In 1903 the "sloop" remained the fastest rig in the world, but in reality it is merely a catboat rig with a small jib. The 1903 model of the first class, carrying about 650 square feet of canvas, is capable of sailing a mile a minute, and costs to construct anywhere from $1,200 to $1,600.



The Most Modern and Expensive Ice Yacht (1902).

Racing Rules.— For class racing, ice yachts are divided into four classes: (1) Yachts carrying 600 square feet of sail area and over. (2)

Yachts carrying 450 square feet and under 600. (3) Yachts carrying 300 square feet and under 450. (4) Yachts carrying less than 300 square feet. Handicap or time allowance for mixed classes is made as follows: One second per square foot for every foot of canvas carried over the smaller boat, providing the race is sailed in one hour. If the race is sailed in 30 minutes ½ second per square foot is allowed, and proportionately in accordance with the time of the race.



Ice Boat of 1790.

The course is usually a triangle sailed over as required to make the number of stated miles; or a straight course to windward and return or to leeward and return. The standard distances for ice-yacht races are 20 miles, 15 miles or 5 miles. The larger the yacht the longer the course. Time limit: 20 miles, 1 hour 15 minutes; 15 miles, 35 minutes; 5 miles, 20 minutes.

In the United States and Canada there are 45 ice-yacht clubs. The challenge pennant of America is open to any American or foreign built yacht. It was held in 1903 by Jack Frost the Second, owned by Commodore Archibald Rogers of the Hudson River Ice Yacht club.

The record of leading American ice yachts are given in the following table.

It will be noted that the fastest time recorded in this table was made by the Jack Frost, 9 Feb. 1893, for 20 miles; time 49 minutes 30 seconds. In 1902 these records were excelled by the Joker, owned by Commodore D. C. Olin of the Kalamazoo, Mich., club, which sailed 20 miles on Gull Lake in 36 minutes 59 seconds. Ice yachts have actually sailed short distances at the rate of 85 miles an hour.

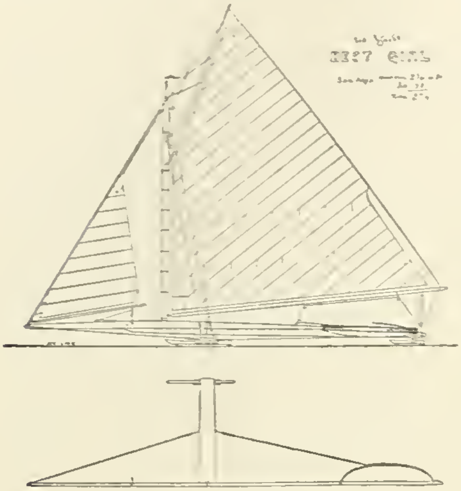
Ice Yacht Construction.—In the modern ice yacht the centre timber or backbone may be made of two pieces, one solid stick or a hollow truss

RACES FOR THE ICE-YACHT CHALLENGE PENNANT OF AMERICA.

NAME OF WINNING YACHT	Club	Date	Distance between buoys in miles	Number of times sailed over	Total Length of course in miles	Calc'lated distance sailed in miles	Time H. M. S.
Phantom	New Hamburg vs. Poughkeepsie	March 5, 1881	....	......	......	......	....
Aralam or Robert Scott	Poughkeepsie vs. New Hamburg	Feb. 6, 1883	10	Once	20	31.38	57
Jack Frost	Poughkeepsie vs. North Shrewsbury	Feb. 23, 1883	2½	Five	25	39.20	1 14 35
Haze	Poughkeepsie vs. North Shrewsbury	Feb. 9, 1884	6.66	Three	21	31.38	1 05 30
Haze	Poughkeepsie vs. New Hamburg	Feb. 14, 1885	2	Five	20	31.38	1 01 15
Northern Light	Poughkeepsie vs. North Shrewsbury	Feb. 18, 1885	2½	Four	18	31.38	1 08 42
Jack Frost	Hudson River vs. Poughkeepsie	Feb. 14, 1887	2	Four	16	25.10	0 43 40
Icicle	Hudson River vs. North Shrewsbury	March 8, 1888	2	Three	12	18.83	0 36 59
Icicle	Hudson River vs. North Shrewsbury	Feb. 25, 1889	2	Four	16	25.10	0 54 01
Icicle	Hudson River vs. North Shrewsbury	Feb. 5, 1892	1.46	Five	20	22.92	0 46 19
Jack Frost	Hudson River vs. Orange Lake	Feb. 9, 1893	2	Five	20	31.38	0 49 30
Icicle	New Hamburg vs. Hudson River	Jan. 21, 1899	2½	Four	20	38.	1 09 37
Jack Frost	*Hudson River vs. North Shrewsbury	Feb. 7, 1902 Feb. 13, 1902	2½ 2½	Four Four	20 20	36. 38.	1 02 21⅘ 53 24

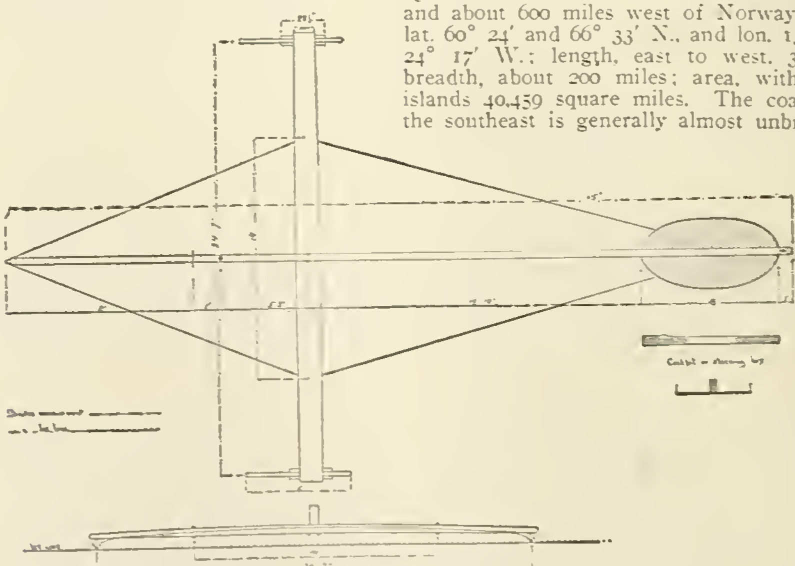
* Best two out of three races — all other races single races. All races sailed off Hyde Park, on the Hudson River, New York.

backbone. To this is joined at right angles the running plank, and a steering box or cockpit is attached at the aft extremity of the backbone. The best material is seasoned basswood, which



Side-guyed Ice Yacht, 1901.

is very light and stiff. The central objects in construction are lightness and strength and adaptability for perfect handling. The centre of sail balance should agree with the centre of balance of the hull.



Plan of The Aurora.

The fastest ice yachts are of the sloop pattern with about one-fifth of their sail area in the jib.

Commodore H. C. Higginson's ice yacht Aurora, of Orange Lake I. Y. C., carrying 623¾ square feet of sail, and equipped with hollow spars and backbone, weighs a total of 1,554 pounds, divided as follows:

	Lbs.
Hollow backbone (45 feet long)	489
Solid runner plank (26 feet long)	417
Hollow mast (32½ feet long)	118
Hollow boom	55
Hollow gaff	28
Runners and steel steering gear	225
Sails	71
Rigging	151
Total weight	1,554

The cost to build an ice yacht of the first class, carrying about 650 square feet, is $1,200, and of the fourth class, carrying 300 square feet, about $350.

Sailing.— Racing on a lake is preferred to river racing, as there are neither tides nor ice cracks to interfere. In sailing a yacht the sheets are trimmed flat. The closest a boat will go to the wind is 30° or 2⅔ points. The best course, or the one that will take the yacht farthest to windward, is 60° or 5⅓ points from the wind, when the advance to windward should be at the rate of half the velocity of the wind, while the actual velocity is equal to that of the wind. The yacht encounters the greatest velocity of the wind when her course is 90°, or 8 points from the wind, when the apparent wind is twice the actual velocity. The greatest speed of the boat is attained at 120°, or 10⅔ points from the wind, when her speed is twice that of the wind. The most rapid progress to leeward is made at 150°, or 13⅓ points from the wind, when the apparent velocity of the wind will equal its true velocity.

H. Percy Ashley,
Ice Yacht Architect.

Icebergs. See Ice.

Iceland, an island dependency of Denmark, 250 miles from the southeast coast of Greenland, and about 600 miles west of Norway; between lat. 60° 24′ and 66° 33′ N., and lon. 13° 31′ and 24° 17′ W.; length, east to west, 301 miles; breadth, about 200 miles; area, with adjacent islands 40,459 square miles. The coast-line on the southeast is generally almost unbroken, but on all other sides presents a succession of bays or fiords and promontories. The best harbors are those of Reykjavik and Eyrarbakki on the southwest, and of Akureyri on the north. The interior of the island has for the most part a desolate appearance. Lofty mountains of volcanic origin rise crowned with snow and ice, which stream into the intervening valleys and form immense glaciers. Glaciers cover a surface of upward of 4,000 square miles, and appear in all the mountains above 4,000 feet in elevation. These icy mountains, which take the common name of Jökul, have their culminating point near the southeast coast in Oræfa Jokul of 6,409 feet in height. Next to it in height are the Snæfell, near the east coast, 5,965 feet; and Eyjafjalls Jökul, in the south, 5,579 feet. The structure of these mountains is volcanic; in several of them the volcanic agency is still active, and eruptions have occurred within the last four centuries. Lava covers a large portion of the island. Of volcanic origin and agency are the numerous hot springs or geysers scattered throughout the island, but found more especially in the southwest, to the northeast of Reykjavik, where, from one of the principal geysers, jets of water are thrown to heights varying from 100 to 200 feet. (See GEYSERS.) The general effects of the volcanic agency and the geological formations exhibited on a magnificent scale in Mount Hecla, 5,095 feet high; lat. 63° 59′ N.; lon. 19° 44′ 15″ W. The hot springs are sometimes used for economical purposes; food is dressed over them, and in some places huts are built over small fountains, to form steam baths.

The immense reservoirs of snow and ice furnish supplies to numerous lakes and rivers. Of the former the most important are the Thingvalla Vatn, Hvitar Vatn, and Arnar Vatn in the southwest, and the My Vatn in the northeast.

The most valuable mineral product is sulphur, of which the supply appears to be inexhaustible, and surturbrand or lignite is also worked to some extent. The other minerals are chalcedonies, rock-crystals, and the double-refracting spar, for which the island is famous. On many parts of the coast, particularly the west, basaltic caves occur; that of Stappen is not unworthy to be compared with Fingal's Cave in Staffa.

The climate is mild for the latitude. At Reykjavik, on the southwest coast, the mean temperature of the year is 40°, that of summer 56°, and that of winter about 29° 30′. The air is damp and misty, the weather is extremely variable, and storms and hurricanes frequent. The prevailing winds are north and northeast. In the southern part of the island the longest day is 20 hours, and the shortest 4 hours, but in the northernmost extremity the sun at midsummer continues above the horizon a whole week, and of course during a corresponding period in winter never rises.

Vegetation is sparse and confined within narrow limits. Almost the only tree is the birch, which is stunted, hardly exceeding 10 feet in height. Heath and whortleberry cover the surface. Among flowering plants are saxifrages, sedums, etc. The want of fuel is sometimes supplied by sheep's dung or by drift-wood brought by the Gulf Stream and the polar currents; and the island furnishes a fine turf. Grain appears to have been at one time cultivated, but is not now grown; cole, potatoes, turnips, radishes thrive tolerably well. But the most valuable crop is grass, on which numbers of live-stock are fed. Flocks and herds have been estimated at 750,000 sheep, 20,000 cattle, and 40,000 horses. The last, though small, are strong and active and numbers of them are exported. Some of the sheep are four-horned. Reindeer were introduced about 1770, but all that now remain are a few living in a wild state. Wild fowl, including the eider-duck, are abundant; the streams teem with salmon, and on the coast fisheries of cod, haddock, herrings, etc., are carried on.

Manufactures are entirely domestic, almost every family possessing within itself the means of supplying its wants, and occasionally furnishing a surplus, of coarse woolens, mittens, stockings, etc., to be disposed of at the markets. The exports are wool, oil, fish, horses, feathers, worsted stockings and mittens, sulphur, and Iceland-moss. The inhabitants are Scandinavians, and speak a Scandinavian dialect, the original Norse. They are of a tall manly form, open countenance, florid complexion, and flaxen hair. They are simple in manners and customs, having no distinctions of rank, pure in morals, and hospitable. Their houses are chiefly composed of drift-wood and lava; fresh meat and bread seldom appear at their tables, but fish, butter, milk, and preparations of milk constitute their staple food. Their intellectual capacity is superior, education is diffused, and it is rare to meet with an Icelander who cannot read and write.

In religious profession they are Lutherans, the whole island forming a single bishopric. The civil division is into three bailiwicks — Süderamt, Westeramt, and Norderamt with Osteramt — subdivided into 20 smaller districts called Sysler. The governor takes the name of Stiftsamtmann, and presides over the althing or parliament (from "thing," a public assembly), which meets twice a year at Reykjavik, the capital and only town in the island, and consists of 36 members, of whom 30 are chosen by popular suffrage, and 6 (2 spiritual and 4 temporal) are nominated by the king. In response to petitions and complaints Iceland was granted home rule in 1874, and now has the entire management of all matters concerning the island particularly. A minister for Iceland, nominated by the king, is at the head of the administration, but the highest local authority is vested in the governor.

Christianity was introduced in 981, and legalized in 1000; when schools and two bishoprics, those of Holar and Skalholt, were established. The Latin language and the literature and learning of the West, introduced by Christianity, were warmly received in Iceland where poetry and history had been cultivated more than elsewhere in the north. Previously to this the Icelanders had discovered Greenland (983) and part of America (about 1000), and they were now led to make voyages and travels to Europe and the East. The most flourishing period of Icelandic history as regards church and state, — the period too when its intercourse with the outside world abroad was most active — was from the middle of the 12th to the beginning of the 13th century.

Early History.— In 1264 Magnus VI. of Norway united Iceland with his own kingdom, with which it passed to Denmark in 1380, remaining with the latter in 1814, when Norway was joined to Sweden. Toward the end of the 14th century science and art, which had begun to decay with the introduction of the Norwegian rule, sank to the lowest ebb, but they gradually recovered their position during the following century. In the 17th century the island was ravaged by Algerian pirates, who in 1627 murdered or carried off a large number of the inhabitants. In the 18th century the island suffered from 43 years' failure of crops and 18 famines. In 1707 about 18,000 persons died of smallpox. Between 1783 and 1785 volcanic eruptions, failure of crops, and famine reduced the population from 48,668 to 38,142. Famine raged again in 1824-5, principally through violent volcanic outbreaks; and a deadly epidemic scourged the country in 1827. In the beginning of the last century the althing, which had existed for about 900 years, was abolished, but it was reorganized in 1843. As already mentioned, a new constitution was granted in 1874, and in August of the same year the 1000th aniversary of the colonization of the island was celebrated, the king of Denmark being present.

Language and Literature.— The Icelandic language is the most northerly of all cultivated tongues. It is rich in roots and grammatical forms, soft and sonorous to the ear, being free from gutturals and excess of hissing sounds. There are 28 letters, namely, all the English except *w*; also *æ*, *ö* (the German *ä* and *ö*), and a character for English *th*. Icelandic literature may be divided into an ancient period, extending to the fall of the republic, and a modern, extending from that date to the present time. Poetry was early cultivated, and among the most important works in Icelandic literature is the collection of ancient heathen songs called the elder or poetic Edda, compiled soon after the introduction of Christianity. (See EDDA.) Many other poems, especially songs of victory, elegies, and epigrams, belong to the ancient period of the literature. Histories and romantic works, known by the name of Sagas, were also numerous. Among these we may mention the Volsunga Saga, the most important of all, the Vilkina Saga, the Saga of Hrolf Kraka and his companions, the Saga of King Ragnar Lodbrok, Frithiofs Saga, and the younger or prose Edda. Some of these are partly historical, but there is a larger and more valuable class that are altogether historical in their character, consisting of local and family histories and biographies. Among these we may mention the Islendingabók; the Landnamabók, an account of the settlement of the island; the Kristni Saga, an account of the introduction of Christianity; Njáls Saga (translated into English by G. W. Dasent); Viga Glums Saga; Egils Saga, the biography of a well-known poet and chief; Eyrbyggja Saga, an abstract of which was published by Sir Walter Scott; the Sturlunga Saga, a history of the important Icelandic race of the Sturlungar; the Orkneyinga Saga, a history of the jarls of Orkney (an English translation of which was published in 1873); the Færeyinga Saga, on the Faroe Islands; the Knytlinga Saga, a history of the Danish kings from Harold Blaatand to Canute VI.; and lastly, the famous Heimskringla or Chronicle of the Norwegian Kings, by Snorre Sturlason. Many of these works are materpieces of style, and are still read with delight by the people of Iceland. The early portion of the second period was barren of anything worth mention in the way of literature, nor can the modern period boast at all of works possessing the interest of those belonging to the ancient. In the 17th century there was a considerable revival of literary activity, the principal names being those of Arngrimur Jonsson (1568-1648), Gudmundur Andræ (died 1654), Runolfur Jonsson (died 1654), Arni Magnusson (died 1730), and Thormodur Torfason or Torfæus. The first complete edition of the Icelandic Bible was issued under the direction of Gudbrandur Thorlaksson (died 1627). The true revival of letters may be said to date from the middle of the 18th century, since which time there is scarcely a department of literature in which Icelandic writers have not done something, not to mention works on various branches of science. Many of the most valuable works of Europe have been translated into Icelandic even the poems of Milton. Pop. (1895), 73,449; (1903), 78,470.

Consult: Von Toil, 'Letters on Iceland' (1772); Poestion, 'Elsland, das Land und seine Bewohner' (1889); Burton, 'Ultima Thule, a Summer in Iceland'; Horn, 'History of the Literature of the Scandinavian North.'

Iceland Moss, a lichen (*Cetraria islandica*), found in all the northern parts of the world. It is valued for its nutritious and medicinal properties, and as an article of commerce is collected in Iceland and Norway. In the extreme north it grows even near the sea-level; farther south, only on the mountains. In Iceland it often thickly covers great tracts, and the gathering of it is a summer industry. It grows about 1½ to 4 inches high, consists of an almost erect thallus, and is of a substance leathery and rather cartilaginous. It has a bitter principle which is reduced by steeping in water, and the moss is prepared as food either by pounding and making it into bread or by boiling, with water or milk, till it makes a jelly, in which form it is an agreeable and beneficial diet in some forms of disease, especially in pulmonary disorders. It is also utilized in dressing the warp in weaving, and for sizing paper, being mixed in the vat with pulp.

Icelandic Language and Literature. See ICELAND.

Icer'ya, a genus of scale insects, containing the fluted scale. See SCALE INSECTS.

Ichneumon-fly, ĭk-nū'mŏn, the name of a large family (*Ichneumonidæ*) of insects of the order *Hymenoptera*. As the species of this family are very numerous (more than 1,100 genera had been described before 1903) so their manners are extremely diversified; but, in the general outlines of their character, they all agree, particularly in their depredations among the insect tribes. In some the female has the ovipositor in the form of a boring instrument, with which she is capable of perforating the hardest substances. Tht larvæ of wasps are the devoted prey of these insects, who no sooner discover one of their nests than they perforate the material of which it is constructed, and deposit their eggs within it. Others glue their ova to the skin of a caterpillar, while others again penetrate through it, and lay their eggs in its body. In all these cases the young, as soon as they are hatched, prey on the caterpillar or larva, without, however, destroying it at once, as upon the life of its victim that of the spoiler appears to depend. The caterpillar, in fact, seems healthy until the larvæ of the ichneumon have spun their cocoons, and entered the chrysalis state.

1. (1) Exenterus marginatorus attacking the larva of the pine-tree moth. (2) the cocoon of the latter as left by an ichneumon-fly; (3) as left by its rightful occupant: (4) Bassus albosignatus attacking the larva of the syrphus-fly; (5) male of the same. (6) Banchus falcator stealing upon a caterpillar; (7) larva of the ichneumon-fly.

2. Anomalon circumflexum attacking a caterpillar; and Ophion undulatus thrusting its ovipositor into

3. Spathius clavatus, in a window.

4. Pimpla instigator, preying upon a willow-moth.

5. Pupa-case of an Ophion.

6. Larva of Microgaster nemorum emerging from an infested caterpillar of the pine-tree moth.

7. Ichneumon pisorius the left-hand figure being that of a female depositing eggs in a boring in the trunk of an oak.

These carnivorous insects are of various sizes; some are so small that the aphis, or plant-louse, serves as a cradle for their young; others again, from their size and strength, are formidable even to spiders, destroying them with their stings. They are, as a whole, highly beneficial to humanity, as a large part of their prey consists of insects which are injurious to crops and valuable vegetation.

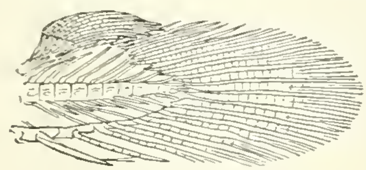
Ichneumons, small carnivorous animals of the civet family (*Viverridæ*) and sub-family *Herpestinæ*, which are distinguished from the true civets by the straight non-retractile claws, and various skeletal characters. While there are a number of genera the typical and most important is *Herpestes*, many species of which inhabit Africa, southern Asia, and the neighboring islands. The teeth are numerous, usually 40; the head is elongated, with short rounded ears; the limbs are short; and the body and stout tail are covered with long hairs. They vary in size from that of a squirrel to a cat. Their food consists of all kinds of small animals; rats and mice, birds and their eggs, snakes, lizards, etc., which they pursue chiefly on the ground but also in trees. The Egyptian ichneumon (*H. ichneumon*) or Pharoah's rat, is famous as one of the many animals venerated by the ancient people of that country, and because of its reputation as a destroyer of crocodile's eggs. While the eggs of this reptile may be occasionally devoured, the importance of the ichneumon in this respect is purely mythical. The Indian ichneumon or mungoose (*H. mungo*) is still better known. It lives in a semi-domesticated state, and performs an invaluable service as a destroyer of venomous serpents, whose fangs it generally manages to escape by its wonderful agility. This species has been introduced into Jamaica for the purpose of destroying rats, and has multiplied exceedingly and become a serious pest, though of late years it has been held in check by a great increase in the number of ticks.

Ichnology, ĭk-nol'ō-jĭ, that department of palæontology which treats of the foot-prints petrified in sedimentary rocks and made by extinct animals; the science of fossil foot-prints. Such foot-prints frequently occur in all formations, and have sometimes been the first and most instructive intimation of the existence of the animals that made them. This was particularly true of the foot-prints of dinosaurs (q.v.) so numerous and sharply marked in the brown sandstones of the Connecticut Valley; and they have greatly assisted in arriving at a true realization of those reptiles, which were at first regarded as birds. The tracks, trails, burrows, outlines of bodies, feathers and appendages of a vast variety of animals occur in the rocks and interest the ichnologist.

Ichthyol'ogy (Gr. ἰχθὺς, fish; λογὸς, a discourse), is the science of fishes. It is that branch of human knowledge which treats of the aquatic gill-bearing vertebrates, popularly known as fishes to English-speaking people.

Classification of Fishes.— In different treatises on fishes there appear very great differences in the classification proposed or adopted. Often in two works of parallel scope scarcely a group will appear in both with the same boundaries or under the same name. For this condition there are several causes. First, the tendency in some minds toward the extreme of subdivision, and in others toward the extreme of aggregation; second, the various values assigned by different authors to different sorts of characters, the actual value of each only to be determined by the final judgment of palæontology; third, the tendency of many writers to give new names to old groups. On this account a single class order may have half a dozen virtually synonymous names. Thus the terms *Chondropterygii, Elasmobranchii, Plagiostomi, Selachii, Placodii, Antacea*, and other less known names have been applied to the group of sharks and skates. Again various authors, recognizing the validity of a given group, may find it necesssary at times to change its boundaries. In such case a new name may be proposed, or a new definition be given to an old one. Either arrangement may lead to confusion. Thus with some writers, the groups of sharks, under various names, may include the order of *Chimæroids*, or, under the same names, the *Chimæroids* may be excluded from it.

The Chordata.— The great branch of chordate animals finds its origin probably in worm-like forms. It differs essentially from the invertebrate branches in the presence of a more



A Diphy-cercal Tail.

or less developed notochord (which in the higher forms gives place to a backbone), and in the presence of gill-slits, connected with respiration. These gill-slits and accompanying gill-structures are persistent in fishes, while in the higher vertebrates they are mostly relegated to the embryonic stages.

The *Chordata* include several classes of marine animals leading up to the true fishes, as follows:

Enteropneusta.— Balanoglossus (q.v.).
Tunicata.— Ascidians (q.v.).
Leptocardii.—Lancelots (q.v).
Cyclostomi.—Hag-fishes and Lampreys (qq. v.).
Cycliæ.— Extinct (palæozoic) fish-like forms.
Pisces.— Fishes, properly so called; the various primary divisions of which are usually called sub-classes.

But in view of the uncertainty attached to the mutual relations and origin of these groups, we may follow recent American custom in regarding the elasmobranchs, ostracophores, arthrodires, and teleostomes as distinct classes, the last named group containing the typical or true fishes. On anatomical grounds we must regard the *Elasmobranchii* (sharks) as the most primitive of these classes. As to this, palæontology gives no certain answer. There is no doubt that fishes existed and that some of the classes were well differentiated at a period long antecedent to the deposition of the oldest known remains. The earliest remains of fossil fishes now known occur in the Ordovician or Lower Silurian deposits at Cañon City, Colorado. Among the broken fragments are apparently parts of shields of ostracophores, scales of crossopterygians and vertebræ of a possible chimæroid. It is probable that primitive sharks existed still earlier than this, but no definable remains precede the Devonian.

The class or sub-class of *Elasmobranchii* (also called *Chondropterygii*, *Antacea*, etc.) agrees with the higher fishes in the presence of lower jaw, shoulder-girdle, pelvic girdle, paired fins, well developed skull, brain, and viscera. The gills are well developed, and the general structure and anatomy may be described as fish-like.

In distinction from the true fishes, the gills are differently formed, adnate by their outer margin, there are no membrane bones about the head, the ova are very large, the ventral fins are provided with claspers, there is no trace of air-bladder, the arterial bulb has three series of valves, there is a spiral valve in the rectum, the upper jaw is formed of palatal elements, the typical jawbones of the fish being undeveloped. The lower jaw is also different in structure from that of the true fishes.

The existing elasmobranchs are known as sharks, rays and chimæras. The vast majority of the known species are extinct. There are two strongly marked sub-classes among the elasmobranchs, the *Selachii* or sharks and rays, and the *Holocephali* or chimæras. In the *Selachii* there are five to seven gill-openings, the jaws are distinct from the skull, and the teeth are distinct. In the *Holocephali* there is but one external gill-opening, the jaws are coalescent with the skull, and the teeth are united to form bony plates or lamellæ. Both groups are very old in geologic times, having been separated at least since the Devonian. For this and other reasons some writers prefer to regard the sharks and chimæras as separate and coordinate groups.

We may without serious violence divide the sharks and rays into six orders; namely, *Pleuropterygii*, *Acanthodii*, *Ichthyotomi*, *Notidani*, *Asterospondyli*, and *Tectospondyli*, the first three of these being confined to Palæozoic time. We may regard the *Pleuropterygii* or the allies of *Cladoselache* as the most primitive, and therefore as standing first in an ascending series.

In this group the pectoral and ventral fins are broad and fold-like, the notochord is apparently not segmented, the tail is short and keeled, well specialized, its tip abruptly turned upward. There are no spines, the teeth are small, with many cusps. There is probably but one family, the *Cladoselachidæ* (extinct), *Cladoselache fyleri*, a large elongate shark from the Devonian of Ohio, is the best known species.

The *Acanthodii* are small sharks with a spine at the front of each fin except the caudal. The teeth are minute or wanting, and the skin is covered with small checker-like plates. There are three families, *Acanthœssidæ* (extinct), with one dorsal fin, *Diplacanthidæ* (extinct), with two, and the *Ischnacanthidæ* (extinct), small sharks found from the Devonian to the Permian.

The *Ichthyotomi* have the pectoral fin developed as an archipterygium or jointed limb with a fringe of rays on one or both sides. The dorsal fin extends along the back, and on the head is a first dorsal preceded by a long spine. There are two well-marked families, *Pleuracanthidii* and *Cladodontidæ*, abundant in the Carboniferous and Permian, but now extinct.

The *Notidani* or *Diplospondyli* have the notochord imperfectly segmented by vertical partitions, and the gill-clefts are six or seven in number instead of five, as in other sharks. Most of the species are extinct, the teeth being found in the rocks from the Jurassic to the present time. Two families are represented, the *Hexanchidæ* and the *Chlamydoselachidæ*, the latter eel-shaped sharks of the open sea, chiefly about Japan.

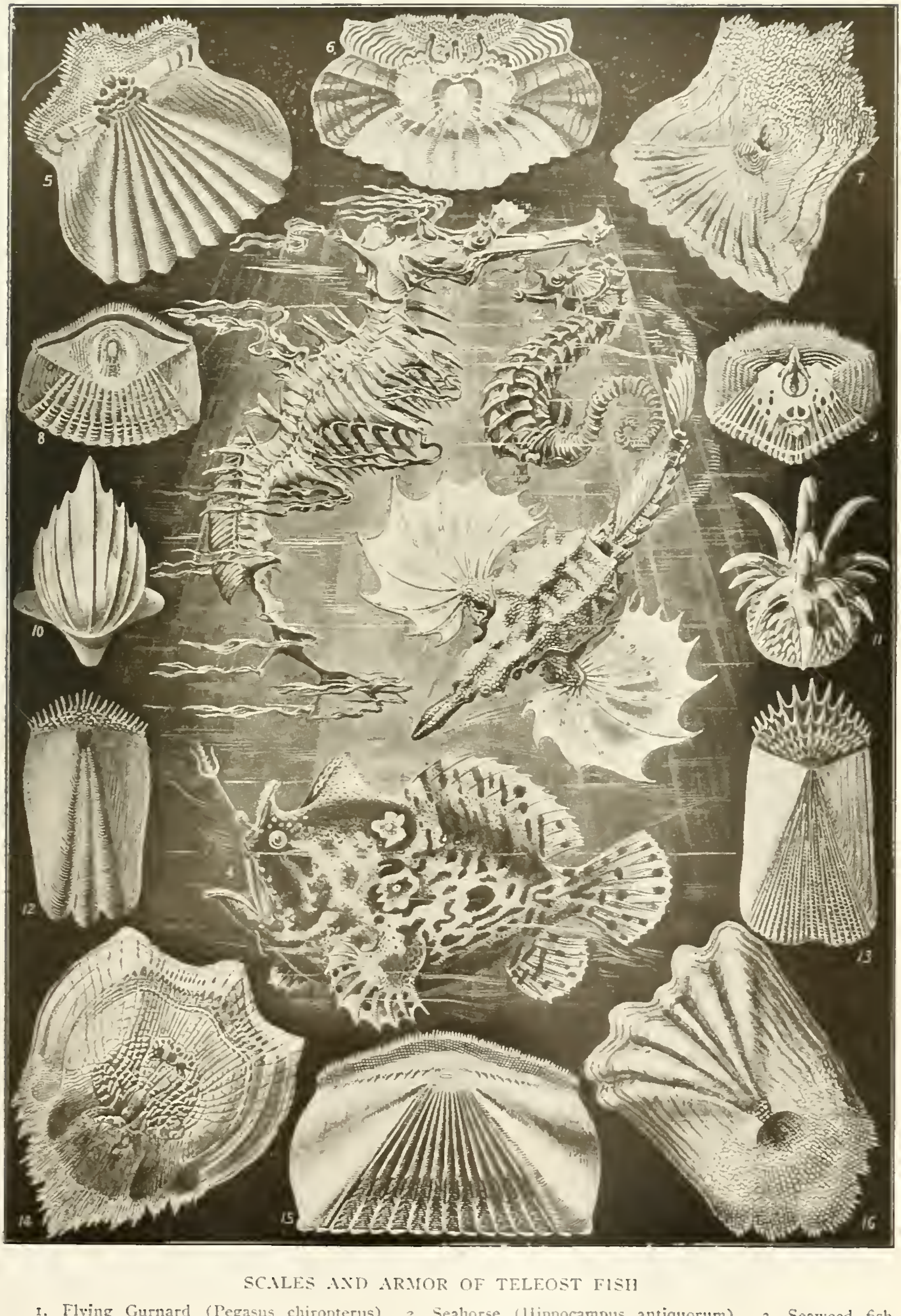
In the large order of *Asterospondyli* the vertebræ are strengthened by secondary plates of calcified tissue, which radiate outward from the small primitive cylinder. In these typical sharks there are five gill-slits, two dorsal fins, and one anal fin.

In the most primitive group, the sub-order *Cestraciontes*, the dorsal fins are each armed with a spine, the numerous teeth are small and mostly blunt, differing in form in different parts of the jaw, and the vertebræ are imperfectly formed. A curious fact in geological distribution is that a multitude of early types of shark disappear in the Permian or toward the end of Palæozoic time. Only cestraciont sharks are known to have any representatives in the Triassic, and this group may be ancestral to all modern sharks.

A Lancelet (*Amphioxus*).

Of the *Cestraciontes* the Palæozic families of *Cochliodontidæ* (extinct) and *Orodontidæ* (extinct), known mainly by the teeth, occur in the Lower Carboniferous. In some and probably all of these forms the dorsal fins were each armed with a spine. The *Edestidæ* (extinct), known only from coiled whorls of fused teeth, are doubtless closely related to these forms. These are found in the coal measures. The principal family of *Cestraciontes*, the *Heterodontidæ*, begins in the Permian, and is represented by five living species all in the Pacific Ocean, the longest known being the Port Jackson shark of Australia (*Heterodontus philippi*). We may here mention two families of sharks of uncertain relationship, the species confined to the Carboniferous Age. These are the *Petalodontidæ* (extinct), with blunt teeth, and some of them with broad fins like rays, and the *Psammodontidæ* (extinct), known from the blunt teeth only. Still more uncertain is the group of *Tamiobatidæ* (extinct) from the Devonian of Kentucky, resembling a ray, but probably a primitive offshoot from the sharks.

The remaining asterospondylous sharks from a sub-order, *Galei*, without dorsal spines, and with the vertebræ more perfectly calcified. The principal family is the *Carchariidæ*. Others are the *Sphyrnidæ* or hammer-heads, *Scyliorhinidæ* or cat-sharks, *Ginglymostomidæ*, *Hemiscylliidæ*, *Orectolobidæ*, *Lamnidæ* or man-eater sharks,



SCALES AND ARMOR OF TELEOST FISH

1. Flying Gurnard (Pegasus chiropterus). 2. Seahorse (Hippocampus antiquorum). 3. Seaweed fish (Phyllopteryx eques). 4. Tentacle fish (Antennarius tridens). 5—16. Characteristic forms of scales among teleost fishes: 5. 6. 7. Sparidæ (sea-breams); 8—9. Percidæ (perches); 10, Centriscidæ (snipefish); 11, Siluridæ (catfish); 12, Fistularidæ (flutemouths); 13, Pleuronectidæ (soles); 14, Labridæ (wrasses); 15. Pristipomidæ (fossil); 16, Sparidæ (Cantharus)

Odontaspididæ, or sand-sharks, *Alopiidæ,* or thresher-sharks, *Mitsukurinidæ* or spoon-bill sharks, *Cetorhinidæ* or basking-sharks, *Pseudotriakidæ* and *Rhincodontidæ.* Of the *Lamnidæ* and related families fossil teeth are very numerous from the Jurassic to modern times.

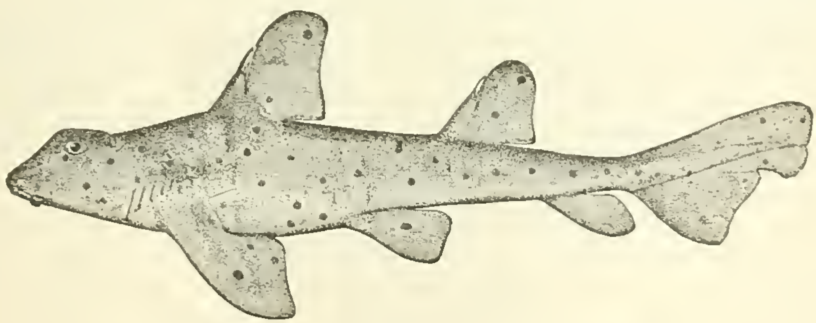
The *Tectospondyli* have the vertebræ each provided with secondary plates of calcified tissue concentrically arranged in one or more series. In these sharks there is no anal fin. To these belong the *Squalidæ* or dog-fishes, *Dalatiidæ, Oxynotidæ,* and *Echinorhinidæ* or bramble-sharks, these families forming together the sub-order *Cyclospondyli,* having the vertebral centrum a simple constricted cylinder pierced by the notochord. To the *Tectospondyli* proper we may refer a few families of sharks, the *Squatinidæ* or monk-fishes, and *Pristiophoridæ* or saw-sharks. A third sub-order, *Batoidei,* includes all the skates or rays. These agree with the true *Tectospondyli* in having a number of series of concentric plates within the vertebræ. The body is, however, more or less depressed, the broad pectoral fins outlining a body disk, and the gill-openings lie underneath instead of being lateral, as in all the sharks. The rays are first certainly known from the Jurassic, although several of the Carboniferous sharks have ray-like teeth, and have been referred to the group of rays.

The recognized families of rays are the *Pristididæ* or saw-fishes, the *Rhinobatidæ* or guitar-fishes, the *Narcobatidæ* or torpedos, the *Rajidæ* or skates, the *Dasyatidæ* or sting-rays, the *Myliobatidæ* or eagle-rays, the *Mobulidæ* or devil-fishes, and the *Ptychodontidæ* (extinct) of the Cretaceous. The earliest of these groups, the *Rhinobatidæ,* date from the Jurassic.

In the sub-class of *Holocephali* or *Chimæroids* the upper jaw or pterygoquadrate arcade is immovably joined to the skull. The teeth are coalesced into broad plates, and a fold of skin covers the gill-clefts so that there is but one external opening. The vertebral axis is imperfectly segmented, and the notochord is surrounded by partially calcified rings. In all recent genera, and in most others, there is a strong spine in the first dorsal, and in the male the forehead has a singular cartilaginous hook with a brush of spines at the end.

There are fragments referred to the skeleton of a chimæroid found in the Lower Silurian at Cañon City, Col. Numerous forms appear in the Devonian. Four genera, representing three families, are now extant, the *Rhinochimæridæ* (*Rhinochimæra* and *Harriotta*) in the deep seas, *Chimæridæ* or elephant-fishes (*Chimæra*) in the north and south temperate seas, and *Callorhynchidæ* (*Callorhynchus*) in the seas of the southern hemisphere only. Extinct families are the *Ptychodontidæ* (extinct), the *Squaloriidæ* (extinct), and the *Myriacanthidæ* (extinct). Numerous extinct genera are referred to the *Chimæridæ.* Fossil fin-spines of many species of sharks and chimæroids, fishes otherwise unknown, occur in the rocks. These are called ichthyodorulites, and their proper classification is often a matter of much uncertainty. The earliest of these are known as *Onchus,* occurring in the Upper Silurian.

Class Ostracophori.— The earliest vertebrates actually recognized as fossils are known as ostracophores (ὄστρακον, a box; φορέω, to bear). These are most extraordinary creatures, which may be described as jawless, limbless, enveloped in a coat of mail. While they have been called mailed lampreys, the likeness to lampreys is almost wholly negative, resting in the total absence of jaws, limbs, and limb-girdles. What the mouth was like can only be guessed, but no trace of jaws has yet been found in connection with it. The most remarkable distinctive character is found in the presence of a hard shell, made of bony plates covering the anterior part of the body, while the backbone is developed as a persistent notochord, imperfectly segmented. The entire absence of jaw structures, as well as the character of the armature, at once separates them widely from the mailed arthrodires of a later period.



Bullhead Shark of California (*Gyropleurodus francisci*).

This group was originally called *Ostracodermi,* a name preoccupied for the group of bony trunk-fishes (*Ostraciidæ*). The names *Protocephali* and *Aspidoganoidei* have also been used for them. The still earlier name *Placodermi* included the *Arthrodires* as well.

The ostracophores are found in the Ordovician, Silurian, and Devonian rocks, after which they disappear. The species are very numerous and varied. Their real affinities have been much disputed. Traquair regards them as much modified allies of ancient sharks, which view of the case is supported by features in the structure of the most shark-like of the orders, *Anaspida.* The absence of jaws and limbs separates them widely from true fishes, and there is no clear evidence in the structure of the fins and fin-supports that these structures are homologous with the fins and fin-supports of true fishes, or even of sharks. In this group are four well-marked orders, *Heterostraci, Anaspida, Aspidocephali,* and *Antiarcha.*

The *Heterostraci* (ἕτερος, different; ὄστρακον, box) have no bone-corpuscles in the coat of mail. This order includes the *Pteraspidæ* (extinct), *Thelodontidæ* (extinct), *Drepanaspidæ* (extinct), and *Psammosteidæ* (extinct).

The *Anaspida* are more fish-like in appearance, having the armature of the head not plate-like, but formed of tubercles. There are two families, all of recent discovery, *Birkeniidæ* (extinct) and *Euphaneropidæ* (extinct).

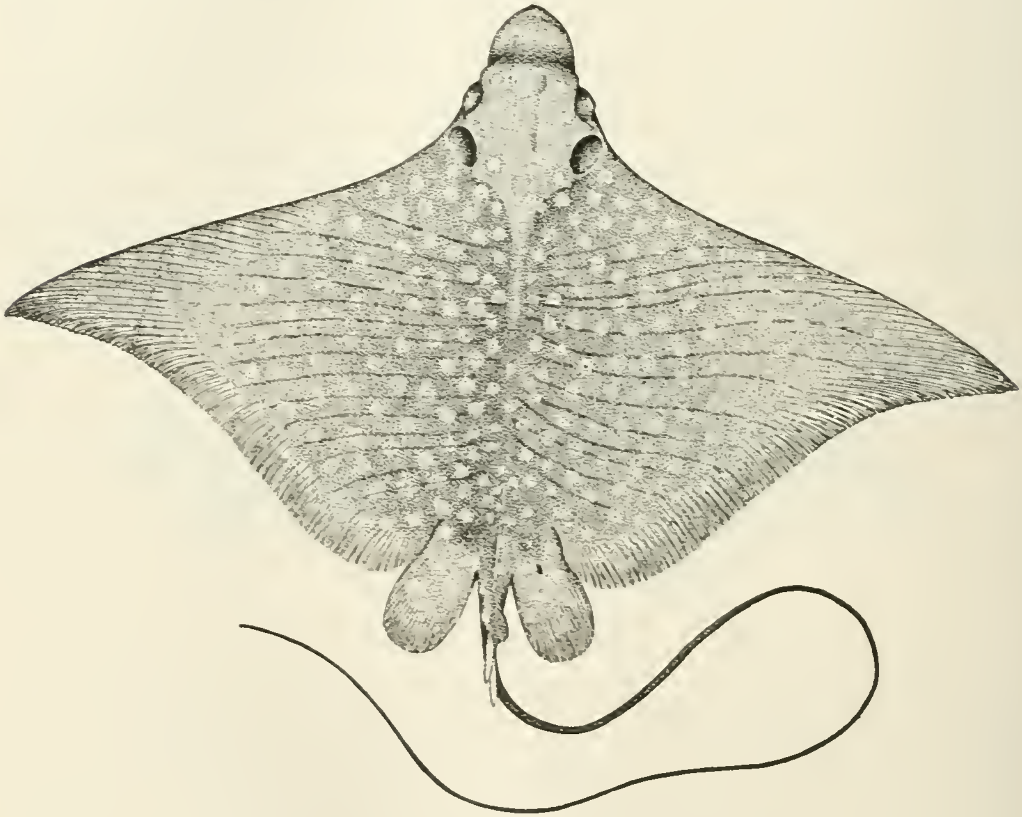
The *Aspidocephali* (also called Osteostraci) have bone-corpuscles in the shields, and the shield of the back is of one piece, without lateral line-channels or sense-organs. The order includes four families, *Ateleaspidæ* (extinct), *Cephalaspidæ* (extinct), *Thyestidæ* (extinct), and *Odontodontidæ (Tremataspidæ)* (extinct), with many genera and species.

The *Antiarcha* have also bone-corpuscles in the plates, which are also enameled. The sense-organs occupy open grooves, and the dorsal and ventral shields are of many pieces. The head is jointed on the trunk, and jointed to the head are paddle-like appendages covered with bony plates and resembling limbs. There is no evidence that these erectile plates are real limbs. They seem to be rather jointed appendages of the head-plate, erectile on a hinge like a pectoral spine.

There is but one family, *Asterolepidæ* (extinct). *Pterichthyodes milleri*, named by Agassiz for Hugh Miller, from the Lower Devonian, is the best-known species.

Class Arthrodires.— Another group of extinct mailed fishes is known as *Arthrodira* (ἄρθρον, joint; δειρή, neck). In this group jaws are developed, but of peculiar character, the mandibles being regarded as mere dermal elements, not forming part of the skeleton. The head in all the species is covered with a great bony helmet. Behind this on the nape is another large shield, and between the two is typically a hinge-joint, which has been compared to the hinge of a spring-beetle (elater). Some of these plates are traversed by sensory grooves. Nothing whatever is known of the internal structure, and as the skeleton is soft, the backbone notochordal, there is no trace of shoulder-girdle, nor any certain evidence of limbs, although peculiar structures have been interpreted as such. The presence of a peculiar type of jaws separates the group from the mailed ostracophores, from which the arthrodires differ also widely in the character of the armature.

Dr. Woodward and several other recent writers have regarded the arthrodires as armored, widely modified offshoots of the primitive *Dipneusta*. But the evidence does not seem to justify the union of the arthrodires with the latter group, and it would seem as reasonable to regard them as derived directly from the sharks or the ostracophores. The arthrodiran fishes occur in abundance from the Silurian times to the Mesozoic. In the Devonian their gigantic size and thick armor gave them the leading position among the hosts of the sea, ranging in



Spotted Sting-ray (*Aetobatus narinari*).

size "from that of the perch to that of the basking-shark."

The class, called by Dr. Dean *Arthrognathi*, is divided by him into two sub-classes, *Arthrodiro*, with a hinge at the neck, and *Anarthrodira*, without hinge. In the first of typical sub-class are two orders, *Temnothoracici*, with the single family *Chelonichthyidæ* (extinct), *Arthrothoraci*, with the families *Coccosteidæ*, *Dinichthyidæ* (extinct), *Titanechthyidæ* (extinct), *Mylostomidæ*, and *Selenosteidæ* (extinct). To the *Chelonichthyidæ* belongs the noted species *Homosteus milleri*, celebrated by Hugh Miller under the name of "the Asterolepis of Stromness," in his 'Footprints of the Creator.'

The arthrodires without joint at the neck constitute the order *Stegotholami*, with the families of *Macropetolichthydiæ* (extinct), and *Asterosteidæ* (extinct).

The best known of the many genera of arthrodires is *Coccosteus*, found in the Scottish Devonian.

Class Teleostomi.— We may unite the remaining groups of fishes under a single class for which the name *Teleostomi* (τέλεος, true; στόμα, mouth), proposed by Bonaparte in 1838, may be retained. The fishes of this class are characterized by the presence of a suspensorium to the mandible, by the existence of membrane-bones (opercles, suborbital, etc.) on the head, by a single gill-opening, leading to gill-arches bearing bilamellate gills, and by the absence of claspers on the ventral fins. The skeleton is more or less ossified in all the *Teleostomi*. More important as a primary character distinguishing these fishes from the sharks is the presence typically and primitively of the air-bladder. This arises at first as a diverticulum from the ventral side of the œsophagus, and develops as a lung, but in later forms it becomes degraded to a swim-bladder, springing from the dorsal side of the alimentary canal, and in very many forms it is altogether lost with age. The group comprises the vast majority of recent fishes, as well as a large percentage of those known only as fossils. In these, the condition of the lung can be only guessed.

The *Teleostomi* are doubtless derived from sharks, their relationship being perhaps nearest to the *Ichthyotomi* or to the primitive chimæras. The lowest *Teleostomi* retain the shark-like condition of the upper jaw, made of palatal elements which, as in the *Chimæro*, may be fused with the cranium. In the lower forms also the primitive diphycercal or protocercal form of tail is retained, as also the archipterygium or jointed axis of the paired fins, fringed with rays on one or both sides.

We may divide the teleostomes or true fishes into three sub-classes, the *Crossopterygii* or fringe-fins, the *Dipneusti* or lung-fishes, and the *Actinopterygii* or ray-fins. Of these, recent writers are disposed to consider the *Crossopterygii* as most primitive, and to derive from this, by separate lines, each of the remaining sub-classes, as well as the higher vertebrates.

Sub-class Crossopterygii.—The earliest teleostomes constitute the class called after Huxley, *Crossopterygii* (κροσσός, fringe; πτερόν, fin). Its essential character is the retention of the jointed pectoral fin or archipterygium, its axis fringed by series of soft rays. This character it shares with the *Ichthyotomi* among sharks, and with the *Dipneusti*. From the latter it differs in the hyostylic cranium, the lower jaw being suspended from the hyomandibular — and by the presence of distinct premaxillary and maxillary elements in the upper jaw. In these characters it agrees with the ordinary fishes. The skeleton is more or less perfectly ossified. Outside the cartilaginous skull is a bony coat of mail. The skin is covered with firm scales or bony plates. The tail is diphycercal, straight, and ending in a point. The shoulder-girdle, attached to the cranium, is cartilaginous, but overlaid with long, bony plates, and the branchiostegals are represented by a pair of gular plates.

In the single family represented among living fishes the heart has a muscular arterial bulb with many series of valves on its inner edge, and the large air-bladder is divided into two lobes, having the functions of a lung, though not cellular as in the lung-fishes.

The fossil types are very closely allied to the lung-fishes, and the two groups have no doubt a common origin in Silurian times. It is now usually considered that the crossopterygian is more primitive than the lung-fish, though at the same time more nearly related to the ganoids, and through them to the ordinary fishes.

From the primitive *Crossopterygii* the step to the ancestral amphibia, which are likewise mailed and semi-aquatic, seems a very short one. It is true that most writers until recently have regarded such dipneustans as the *Ceratodontidæ*, as representing the parents of the amphibians. But the weight of recent authority, Gill, Boulenger, Dollo, and others, seems to place the point of separation of the higher vertebrates with the crossopterygians.

Cope and Woodward divide the *Crossopterygii* into four orders or sub-orders, *Haplistia*, *Rhipidistia*, *Actinistia*, and *Cladistia*. To the last belong the existing species (*Polypteridæ*) alone. In all these the pectorals are narrow with a single basal bone, and the nostrils, as in the dipneustans, are below the snout.

In the *Haplistia* the notochord is persistent, and the basal bones of dorsal and anal fins are in regular series, much fewer in number than the fin-rays. The single family *Tarrossiidæ*, regarded as lowest of the crossopterygians, are small fishes of Carboniferous Age.

In the *Rhipidistia* the basal bones of the median fins are found in a single piece, not separate as in the *Haplistia*. Four families are recognized, *Holoptychiidæ* (extinct), *Rhizodontidæ* (extinct), *Osteolepidæ* (extinct), *Onychodontidæ* (extinct), the first of these being considered as the nearest approach of the crossopterygians to the dipnoans.

In the *Actinistia* there is a single fin-ray to each basal bone, the axonosts of each ray fused in a single piece. The notochord is persistent, causing the backbone in fossils to appear hollow, the cartilaginous material leaving no trace in the rocks. The genera and species are numerous, ranging from the Subcarboniferous to the Upper Cretaceous, and belonging to the single family *Cœlacanthidæ* (extinct).

In the *Cladistia* the axis of the pectoral limb is fan-shaped, made of two diversified bones joined by cartilage. The notochord is restricted and replaced by ossified vertebræ. The axonosts of the dorsal and anal are in regular series, each bearing a fin-ray. The order contains the single family *Polypteridæ*, represented by numerous species in the Nile, Senegal, and Kongo rivers. In this group the pectoral fin is formed differently from that of the other crossopterygians, being broad, its base of two diverging bones with cartilage between. This structure, more specialized than in any other of the crossopterygians or dipneustans, has been regarded by Gill and others, as above stated, as the origin of the fingered hand (chiropterygium) of the frogs and higher vertebrates. The base of the diverging bones has been identified as the antecedent of the humerus, the bones themselves as radius and ulna, while the intervening, non-ossified cartilage breaks up into carpal bones, from which metacarpals and digits ultimately diverge. This hypothesis is at least a reasonable one. The nostrils, as in true fishes, are superior. The body in these fishes is covered with rhombic enameled scales, as in the garpike, the head is similarly mailed, but in distinction from the garpike, the anterior rays of the dorsal are developed as isolated spines.

The young have a bushy external gill, with a broad scaly base. The air-bladder is double, not cellular, with a large air-duct joining the ventral surface of the œsophagus. The intestine has a spiral valve.

The cranium is remarkable for its generalized form, this forming a trait of union between the ganoids and the primitive *Amphibia* or *Stegocephali*. Without considering *Polypterus*, it is not possible to interpret the homologies of the cranium of the amphibians and the sharks.

Sub-class Dipneusti or Lung-Fishes.— The *Dipneusti* (δίς, twice; πνέω, to breathe) are a group characterized by the presence of paired fins consisting of a jointed axis with or without rays. The skull is autostylic, the upper jaw being made, as in the *Chimæra*, of palatal elements fused with the cranium and without premaxillary or maxillary. Dentary bones little developed. Air-bladder cellular, used as a lung, in all living species. Heart with many valves in the muscular arterial bulb. Intestine with a spiral valve. Teeth usually of large plates of dentine covered with enamel on the pterygopalatine and splenial bones. Nostrils concealed, when the mouth is closed, under a fold of the upper lip. Scales cycloid, mostly not enameled.

This group has been usually known as *Dipnoi*. But this term was first taken by Leuckart, in 1821, as a name for amphibians, before any of the living *Dipneusti* were known

The *Dipneusti* agree with the crossopterygians by the presence of lungs, a character which separates them from all the earlier orders of fishes. In its origin the lung or air-bladder arises as a diverticulum from the alimentary canal used by the earliest fishes as a breathing-sac, the respiratory functions lost in the progress of further divergence. Nothing of the nature of lung or air-bladder is found in lancelet, lamprey, or shark. In none of the remaining groups of fishes is it wholly wanting at all stages of development.

In the Dipneusti or dipnoans, as in the crossopterygians and higher vertabrates, the trachea or air-duct arises from the ventral side of the œsophagus. In the more specialized fishes, yet to be considered, it is transferred to the dorsal side, thus avoiding a turn in passing around the œsophagus itself. From the sharks these forms are further distinguished by the presence of membrane-bones about the head. From the *Actinopteri* (ganoids and teleosts) dipneustans and crossopterygians are again distinguished by the retention of the fringe-fin or archipterygium as the form of the paired limbs. From the crossopterygians the dipnoans are most readily distinguished by the absence of maxillary and premaxillary, the characteristic structures of the jaw of the true fish. The upper jaw in the dipnoan is formed of palatal elements attached directly to the skull, and the lower jaw contains no true dentary bones. The skull in the dipnoans is in the *Chimæra* is autostylic, the mandible articulating directly with the palatal apparatus, the front of which forms the upper jaw, and of which the pterygoid hyomandibular and quadrate elements form an immovable part. The shoulder-girdle, as in the shark, is a single cartilage, but it supports a pair of superficial membrane-bones.

In all the dipnoans the trunk is covered with imbricated cycloid scales and no bony plates, although sometimes the scales are firm and enameled. The head has a roof of well-developed bony plates made of ossified skin and not corresponding with the membrane-bones of higher fishes. The fish-like membrane-bones, opercles, branchiostegals, etc., are not yet differentiated. The teeth have the form of grinding-plates on the pterygoid areas of the palate, distinctly shark-like in structure. The paired fins are developed as archipterygia, often without rays, and the pelvic arch consists of a single cartilage, the two sides symmetrical and connected in front. There is but one external gill-opening, leading to the gill-arches, which, as in ordinary fishes, are fringe-like, attached at one end. In the young, as with the embryo shark, there is a bushy external gill, which looks not unlike the archipterygium pectoral fin itself, although its rays are of different texture. In early forms, as in the ganoids, these scales were long and enameled, but in some recent forms, deep sunken in the skin. The claspers have disappeared, the nostrils, as in the frog, open into the pharynx, the heart is three-chambered, the arterial bulb with many valves, and the cellular structure of the skin and of other tissues is essentially as in the *Amphibia*.

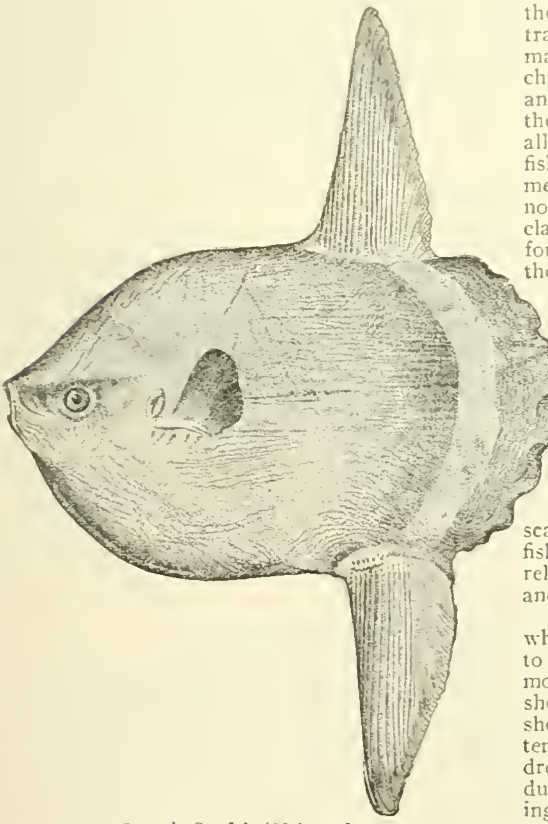
The developed lung, fitted for breathing air, which seems the most important of all these characters, can, of course, be traced only in the recent forms, although its existence in all others can be safely predicated. Besides the development of the lung we may notice the gradual forward movement of the shoulder-girdle, which, in the dipneustans, as in the crossopterygians, is attached to the head. In the fishes generally there is no distinct neck, as the post-temporal, the highest bone of the shoulder-girdle, is articulated directly with the skull.

We may divide the dipnoans into two orders, *Ctenodipterini*, with the families *Uronemidæ* (extinct), *Dipteridæ* (extinct), and *Ctenodontidæ* (extinct). These families occur from the Devonian to the Mesozoic. The more specialized order of *Sirenoidei* includes the families of *Ceratodontidæ* and *Lepidosirenidæ*, each of these represented by living forms. Most of the *Ceratodontidæ* are extinct, occurring in the Mesozoic; but two species, *Neoceratodus forsteri* and *N. miolepis*, live in rivers of Australia. No fossil *Lepidosirenidæ* are known. *Lepidosiren paradoxus* lives in the swamps of southern Brazil and *Protopterus annectens, P.*

dolloi, and *P. æthopicus*, in those of the Nile region.

Sub-class Actinopteri.—After setting off from the great group of fishes primitive or archaic types, one after another, we are left at last with only those having fish-jaws, fish-fins, and in general the structure of the typical fish. For all these in all their variety, as a class or subclass, we adopt the name of *Actinopteri*, suggested by Prof. Cope. The name (ἀκτίς, ray; πτερόν, fin) refers to the structure of the paired fins. In all these, the bones supporting the fin-rays are highly specialized, and at the same time concealed by the general integument of the body.

In general, two bones connect the pectoral fin with the shoulder-girdle. The hyperacoracoid is a flat square bone, usually perforated by a foramen lying above, and parallel with it the irregularly formed hypocoracoid. Attached to these is a row of bones, the actinosts or pterygials, short, often hourglass-shaped, which actually support the fin-rays. In the higher forms the actinosts are few (four to six) in number, but in the lower types they may remain numerous, a reminiscence of the condition seen in the crossopterygians and especially in *Polypterus*. Other variations may occur; the two coracoids are sometimes imperfect or specially modified, and the actinosts may be distorted in form or position. Among the lower *Actinopteri* many archaic traits still persist, and by its earlier representatives the group is joined very closely to the *Crossopterygii*. The great class may be divided into two series or sub-classes, the *Ganoidei*, which retain the ancient traits, and the *Teleostei* or bony fishes, in which most of these have disappeared.



Oceanic Sunfish (*Mola mola*).

Even among the *Ganoidei*, as the term is here restricted, there remains a great variety of form and structure. The group constitutes several distinct orders, and as a whole does not admit of perfect definition. All of the species known have the tail strongly heterocercal. Most of them have the skeleton still cartilaginous, and in some it remains in a very primitive condition. Most of them have an armature of bony plates, diamond-shaped with an enamel like the surface of teeth. All of them have the air-bladder highly developed, usually cellular and functional as a lung, but connecting with the dorsal side of the gullet, not with the ventral side, as in the dipnoans. In all these remain more or less perfectly developed the optic chiasma, the many valves of the arterial bulb, and the spiral valve of the intestines found in the more archaic types. But traces of some or all of these structures are found in some bony fishes, and their presence in the ganoids by no means justifies their separation with sharks, dipnoans, and crossopterygians as a great primary class, *Palæichthyes*. All forms of body may be found among the ganoids. In the earlier seas they were scarcely less varied and perhaps scarcely less abundant that the teleosts in the seas of to-day. So far as fossils show, the characteristic actinopterous fin, with its reduced and altered basal bones, appeared at once without intervening gradations.

The name *Ganoidei* (γάνος, brightness; εἶδος, resemblance), alluding to the enameled plates, was first given by Agassiz to those forms, mostly extinct, allied to the garpike, and covered with bony scales or hard plates. As originally defined, catfishes, sea-horses, *Agonidæ*, and other wholly unrelated types were included with the garpikes and sturgeons as ganoids.

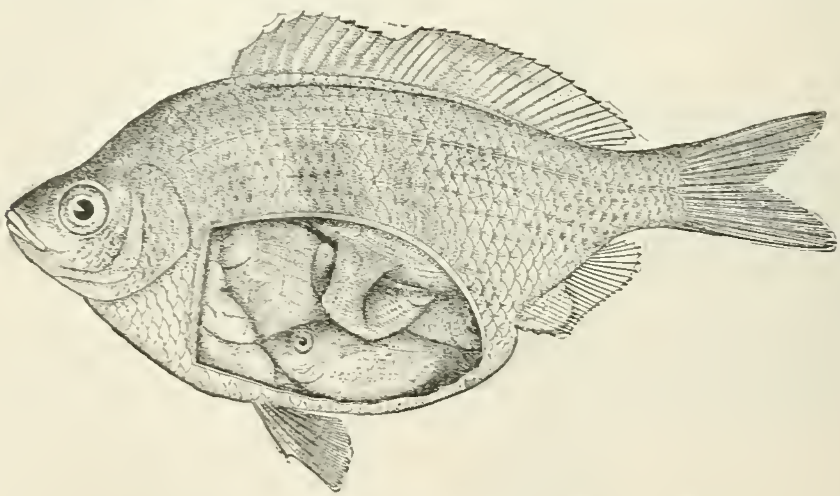
These were eliminated by Johannes Müller, who recognized the archaic characters common to the existing forms. Still later Huxley removed the crossopterygians, and others have shown that the *Ostracophori* and *Arthrodira* should be placed far from the garpike in systematic classification. Cope and Woodward have dropped the name ganoid altogether as productive of confusion through the many meanings attached to it. Others have retained it as a convenient group name for the orders of archaic *Actinopteri*. For these varied and more or less divergent groups it seems convenient to retain it.

The order *Lysopteri* (λύσις, a loosing; πτερόν, fin) comprises the earliest ganoids, beginning in the Devonian, covered with enameled scales. The families are *Palæoniscidæ*, *Platysomidæ*, *Dictyopygidæ*, and *Dorypteridæ*. The order *Chondrostei* (χόνδρος, cartilage; ὀστέον, bone) includes a great variety of forms, characterized by the less cartilaginous skeleton, the distinctly heterocercal tail, and the presence of bony plates, rather than scales, on most parts of the body. These represent a degenerate offshoot from the *Lysopteri*, the form being less like that of the typical fishes. The earliest members of this group appear in the Tertiary, the most primitive family being the *Chondrosteidæ* (extinct). Another family is that of *Belonorhynchidæ* (extinct). The *Acipenseridæ* (sturgeons) are well represented among living fishes. The order *Sclachostomi* (σέλαχος, shark; στόμα, mouth) includes the paddle-fishes (*Polyodontidæ*). two living species. and one extinct, in the Eocene. The order *Pycnodonti* including the family of *Pycnodontidæ* (extinct), consists of a deep-bodied, compressed fishes with small mouths and a peculiar physiognomy. The order *Lepidostei* (λεπίς, scale; ὀστέον, bone) includes numerous families with rhombic enameled scales. The families are *Semionotidæ*, *Lepidotidæ*, *Isopholidæ*, *Macrosemiidæ*, *Pholidophoridæ*, *Aspidorhynchidæ*, and *Lepisosteidæ*, all extinct save the *Lepisosteidæ*, represented by four species known as garpike in the rivers of North America. The earliest fossil garpikes occur in the Eocene. The *Halecomorphi* (*halec*, herring; μορφή, form) comprise the *Pachycormidæ*, *Protosphyrænidæ*, *Liodesmidæ*, *Oligopleuridæ*, and *Amiidæ*. All these have perished, except the *Amiidæ*, which group is represented by a single species, the Bowfin, *Amia calva*, in the waters of the eastern United States. In these forms there is a gradual transition from diamond-shaped scales. covered with enamel, to the cycloid scales of the ordinary soft-rayed fishes. The line separating the *Lepidostei* and *Halecomorphi* from each other and from the *Isospondyli* is a very narrow one.

Sub-class Teleostei or Bony Fishes. — The fishes which still remain for discussion constitute the great sub-class or series of *Teleostei* or bony fishes. They lack wholly or partly the ganoid traits, or show them only in the embryo. The tail is slightly if at all heterocercal. the fulcra disappear. the actinosts of the pectoral fins are few and large. rarely if ever over five in number. the air-bladder is no longer cellular in most species, nor does it assist in respiration. The optic nerves are separate, one running to each eye without chiasma. The skeleton is almost entirely bony, the notochord usually disappearing entirely with age. The valves in the arterial bulb are reduced in number, and the spiral valve of the intestines disappears. Traces of each of the ganoid traits may persist somewhere in some group. but as a whole we see a distinct specialization and a distinct movement toward the fish type with the loss of characters distinctive of sharks. dipnoi, and ganoids. In a general way the skeleton of all teleosts corresponds with that of the striped bass. and the visceral anatomy is in all cases sufficiently like that of the sunfish.

The mesocoracoid or præcoracoid arch, found in all ganoids. persists in the less specialized types of bony fishes. although no trace of it is found in the perch-like forms. With all this, there is found among the bony fishes, an infinite variety in details of structure. For this reason the *Teleostei* must be broken into many orders, and these orders are very different in value and in degrees of distinctness. the various groups being joined by numerous and puzzling intergradations.

Order Isospondyli.— Of the various subordinate groups of bony fishes there can be no question as to which is most primitive in structure or as to which stands nearest the orders of ganoids. Earliest of the bony fishes in geological time is the order of *Isospondyli* (ἴσος, equal; σπόνδυλος. vertebra), containing the allies recent and fossil of the herring and the trout. This order contains those soft-rayed fishes which have the ventral fins abdominal, the mesocoracoid or præcoracoid arch developed (sometimes lost in degeneration), and the anterior vertebræ unmodified, essentially similar to the others.

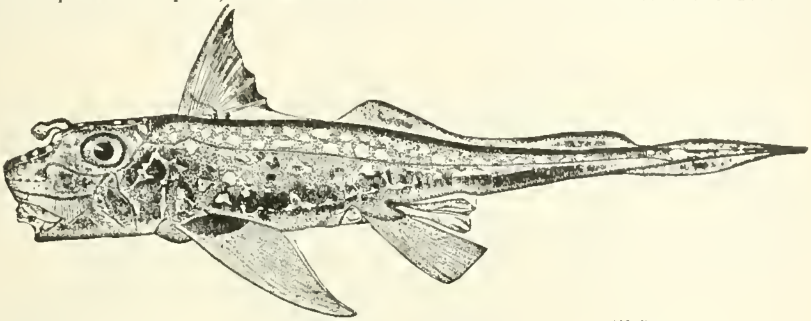


Sparada, or Viviparous Perch of California (*Cymatogaster aggregatus*).

The ganoids pass by degrees into the *Isospondyli*, and the soft-rayed fishes pass again by imperceptible gradations into those more specialized forms having spines in the fins, structures which are again lost in the most modified members of the same group.

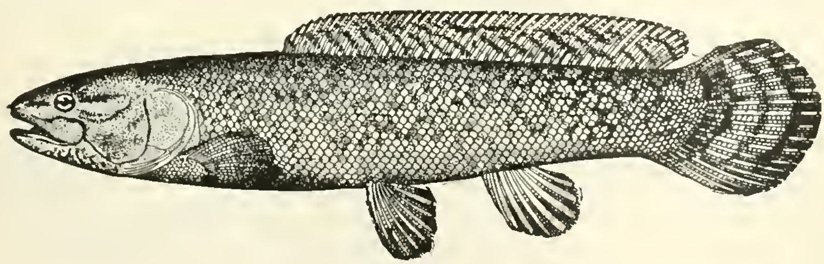
Ganoid traits are present in certain families of *Isospondyli*. Among these are the gular plate (found in *Amia* and the *Elopidæ*), presumably derived from the similar plate in the earliest ganoids, additional valves in the arterial bulb in *Albulidæ*, the cellular air-bladder of *Notopterus* and *Osteoglossum*, the spiral intestinal valve in *Chirocentridæ*, and the ganoid scales of the extinct *Leptolepidæ*. From these characters it is inferred that the soft-rayed fishes are descended from the *Lepidostei* or *Halecomorphi*. The more primitive *Isospondyli* approach more nearly to these ganoid forms than to their later descendants, the catfishes, the eels, or the pikes.

Most ancient of the *Isospondyli* is the extinct family of *Leptolepidæ* of the Triassic. Families mostly still extant, but nearly all of them more or less represented in fossils from the Jurassic on, are the *Elopidæ* or tarpons, the *Albulidæ* or



Rat-fish or Elephant-fish of California (*Hydrolagus colliei*).

lady-fishes, the *Chanidæ* or milk-fishes, the *Hiodontidæ* or moon-eyes, the *Spaniodontidæ* (extinct), the *Pachyrhizodontidæ* (extinct), the *Thryptodontidæ* (extinct), the *Pterothrissidæ*, the *Chirocentridæ*, the *Notopteridæ*, the *Enchodontidæ* (extinct), the *Ichthyodectidæ* (extinct), the *Osteoglossidæ*, the *Pharcodontidæ* (extinct), the *Clupeidæ* or herrings, the *Dussumieriidæ* or round herrings, the *Dorosomidæ* or gizzard-shad, the *Engraulididæ* or anchovies, the *Alepocephalidæ*, the *Pantodontidæ*, the *Salmonidæ* or salmon and trout, the *Thymallidæ* or graylings, the *Argentinidæ* or smelt, the *Microstomidæ*, the *Salangidæ* or ice-fish, the *Galaxiidæ* or New Zealand trout,



The Bowfin (*Amia calva*).

the *Haplochitonidæ*, *the Gonorhynchidæ*, the *Notopteridæ*, and a host of other forms, mostly from the deep seas, constituting (sub-order *Inomiæ*) the families of *Aulopidæ*, *Ctenohirissidæ* (extinct), *Synodontidæ* or lizard-fishes, *Benthosauridæ*, *Bathypteroidæ*, *Ipnopidæ*, *Rondeletiidæ*, *Cetomimidæ*, *Myctophidæ* or lantern-fishes, *Rhinellidæ* (extinct), *Dercetidæ* (extinct), *Chirothicidæ* (extinct), *Exocoetoididæ* (extinct), *Maurolicidæ*, *Chauliodontidæ* or viper fishes, *Gonostamidæ*, *Astronesthidæ*, *Stomiatidæ*, *Malacosteidæ*, *Plagyodontidæ* or lancet-fishes, *Evermannellidæ*, *Paralepididæ*, *Sternoptychidæ*, and *Idacanthidæ*.

The order of *Lyopomi* (λύω, loose, πόμα, opercle), contains a few deep-sea fishes, without mesocoracoid and with the opercular bones distorted. One family, the *Halosauridæ*, with fossil allies.

A series of soft-rayed fishes descended from the *Isospondyli* are grouped together to form the super-order or series called *Ostariophysæ*. These differ from the *Isospondyli* in having the four anterior vertebræ much modified, the air-bladder being connected, by a series of ossicles called the Weberian apparatus, with the auditory organ.

This series includes the orders of *Eventognathi*, *Heterognathi*, *Nematognathi*, and *Gymnonoti*, immense groups comprising the vast majority of the fresh-water fishes of the world.

The *Eventognathi* and *Heterognathi* have the mouth-parts normal, the maxillary not rudimentary, and the body usually covered with ordinary scales. In the order *Heterognathi* (ἕτερος, differing; γνάθος, jaw) the lower pharyngeals are not especially modified, and the jaws usually with teeth. This group comprises most of the river-fishes of South America and Africa. It includes the families of *Characidæ* and *Erythrinidæ*, the former with and the latter without the adipose fin characteristic of catfishes and salmon.

The order *Eventognathi* εὖ, well; ἐν, within; γνάθος, jaw) is characterized by the absence of teeth in the jaws, and by the high degree of specialization of the lower pharyngeals, which are scythe-shaped, and in typical forms are armed with a relatively small number of highly specialized teeth of peculiar forms and arranged in one, two, or three rows. In all the species the gill-openings are restricted to the sides, there is no adipose fin, and the broad flat branchiostegals are but three in number. In all the species the scales, if present, are cycloid, and the ventral fins, of course, abdominal. The modification of the four anterior vertebræ and their connection with the air-bladder are essentially as seen in the catfishes. The families of *Eventognathi* are the *Kneriidæ*, *Homalopteridæ*, *Cobitidæ* or loaches, *Catostomidæ* or suckers, and *Cyprinidæ* or carp, dace and minnows. The last is the largest family recognized in ichthyology, comprising over 2,000 species, almost all confined to the north temperate zone.

The order of *Nematognathi* or catfishes is characterized among the *Ostariophysæ* by the fact that the maxillary bone is rudimental, forming the base of a long barbel. There are no true scales, the body being naked or mailed, and about the mouth are always fleshy feelers. The multitude of species inhabit chiefly the rivers of the tropics, only the typical catfishes of the principal family of *Siluridæ* occurring in waters of the United States and Europe. The families are *Diplomystidæ*, *Siluridæ*, *Bunocephalidæ*, *Plotosidæ*, *Chacidæ*, *Chlariidæ*, *Hypophthalmidæ*, *Argidæ*, *Sisoridæ*, *Pygidiidæ*, *Loricariidæ*, and *Calliththyidæ*, the members of the last three groups armed with a bony coat of mail.

The order *Gymnonoti* contains elongate eel-like fishes without dorsal fin and with the tail excessively long. The vertebræ are modified, as in the preceding orders, but there is no mesocoracoid arch. The families are *Electrophoridæ* and *Gymnotidæ*, all river-fish of South America.

The order *Scyphophori* contains river-fishes of Africa in which the small mouth is at the end of a long snout. There are no pharyngeal teeth, and the opercular bones are considerably modified. In all there is a deep cavity on each side of the cranium, covered by a thin bony plate, the supertemporal bone. The families are *Mormyridæ* and *Gymnarchidæ*.

Next we may place a long series of more or less related families, known collectively as eels. In all these the upper jaw is more or less degenerate, the ventral fins are wanting, and the shoulder-girdle has typically lost its connection with the skull. The earliest fossil eels have traces of scales, the caudal fin separate, and, according to Dr. O. P. Hay, abdominal ventral fins. These characters are lost in all or most of the living forms.

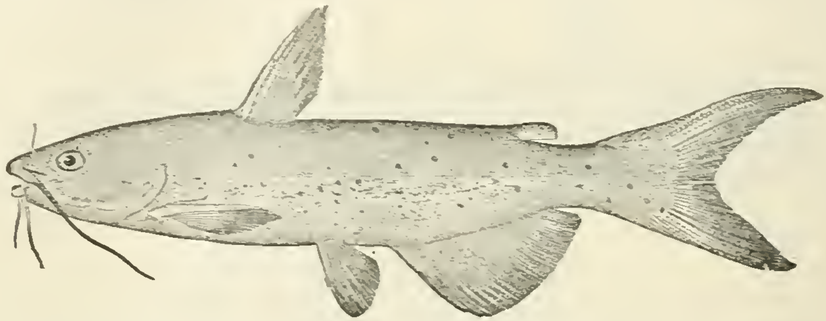
The eels may be distributed among different orders. The *Symbranchia* (σύν, together; βράγχος, gill) — *Ichthyocephali*, and *Holostomi* — have normal fish-like jaws, and the shoulder-girdle is sometimes joined to the skull. The families are *Monopteridæ* or rice-field eels, *Symbranchidæ*, *Amphibnoidæ*, and *Chilobranchidæ*.

The true eels or apodes have the shoulder-girdle free from the skull, the premaxillaries more or less coalesced with the vomer, and the body elongate and of many vertebræ. The families are *Anguillavidæ* (extinct), with distinct caudal and sometimes with ventral fins, *Anguillidæ*, or true eels, *Leptocephalidæ* or conger-eels, *Simenchelidæ*, *Murænesocidæ*, *Nettastomidæ*, *Nemichthyidæ*, *Ophichthyidæ*, *Ilyophidæ*, *Heterocongridæ*, *Dysommidæ*, *Euchelidæ* (extinct), *Murænidæ* or morays, *Myrocongridæ*, and *Moringuidæ*.

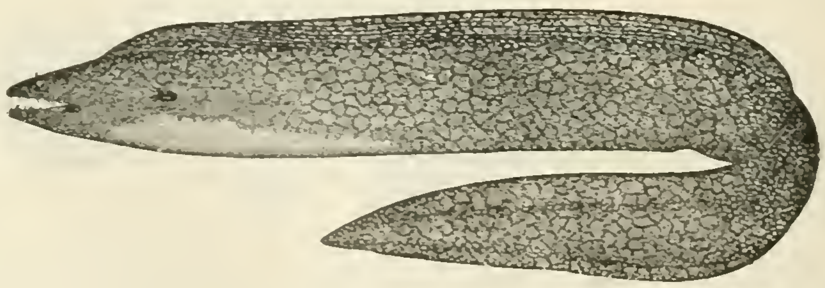
The small order of *Carencheli* contains one family, *Derichthyidæ*, characterized by the snake-like neck and the structure of the jaws.

The order *Lyomeri* includes deep-sea eels of enormous gape, with the parts of the head very loosely joined, and with the fifth gill-arch not modified to form a pharyngeal. There are two families, *Saccopharyngidæ* and *Eurypharyngidæ*.

Still more aberrant is the small order of *Heteromi* (ἕτερος, differing; ὦμος, shoulder), the spiny eels, elongate fishes, having the shoulder-girdle detached from the head and the coracoids united in an imperforate plate. This group includes eel-like fishes of the deep



Channel Cat-fish (*Ictalurus punctatus*).



Muræna.

sea, with spines in the dorsal fin — the families, *Protonotocanthidæ* (extinct), *Notacanthidæ*, and *Lipogenyidæ*.

Another order of uncertain relationship is that of *Opisthomi*, with normal coracoids, spines in the dorsal fin, and the shoulder-girdle remote from the skull. It contains one family, the *Mastacembelidæ*, small fishes from the streams of tropical Asia and Africa.

Another small order, the *Xenomi* (ξένος, strange; ὦμος, shoulder), has the coracoids rudimentary and cartilaginous, with no basal bones or actinosts to the pectoral fin. One family, *Dalliidæ*, characterized by the black-fish of the marshes of Alaska and Siberia.

In the order *Haplomi*, the mesocoracoid arch is wholly undeveloped, as is the case in all of the other groups remaining to be enumerated.

In common with the soft-rayed fishes in general, the air-bladder has a persistent air-duct, the fins are without spines, the ventral fins are abdominal, and the scales are cycloid.

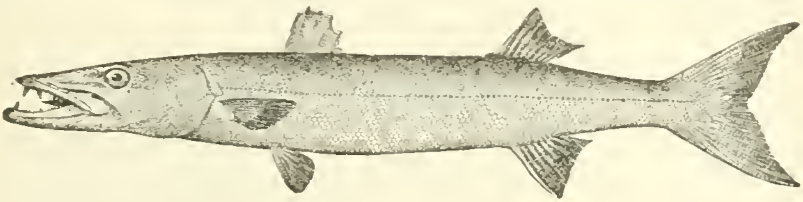
There is no adipose dorsal in the *Haplomi*, the dorsal is inserted far back, and the head is generally scaly. Most, but not all, of the species are of small size, living in fresh or brackish waters, and they are found in almost all warm regions, though scantily represented in California, Japan, and Polynesia. The families are *Esocidæ* or pikes, *Umbridæ* or mud-minnows, *Poeciliidæ* or killifishes, and *Amblyopsidæ* or blind-fishes of the caves. The *Gonorhynchidæ* and the extinct families of *Crossognathidæ* and *Cobitopsidæ* may be doubtfully added to this group.

Order Acanthopterygii.— The most of the remaining bony fishes constitute a natural group for which the name *Acanthopterygii* (ἄκανθα, spine; πτερόν, fin or wing), may be used. This name is often written *Acanthopteri*, a form equally correct and more euphonious and convenient. These are characterized, with numerous exceptions, by the presence of spines in the fins, by the connection of the ventral fins to the shoulder-girdle, by the presence, in general, of more than one spine in the anterior part of dorsal and anal fins, and as a rule of one spine and five rays in the ventral fins, and by the absence in the adult of a duct to the air-bladder. Minor characters are these: The pectoral fins are inserted high on the shoulder-girdle, the scales are often ctenoid, and the edge of the upper jaw is formed by the premaxillary alone, the maxillary being always toothless.

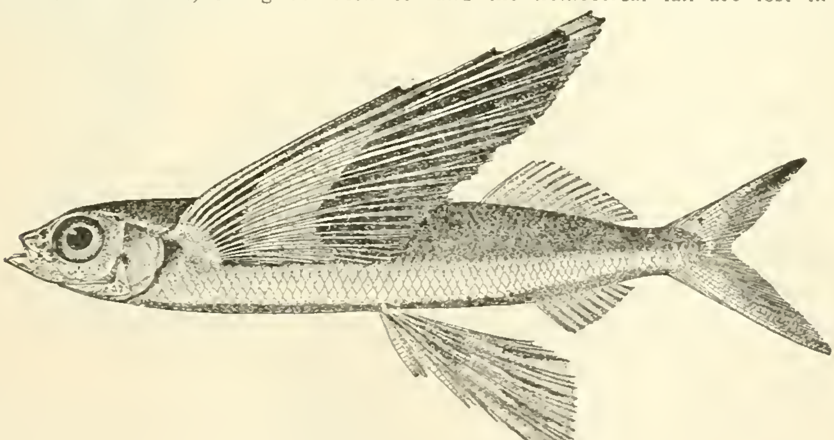
But it is impossible to define or limit the group by any single character or group of characters. It is connected with the *Isospondyli* through the *Haplomi*, on the one hand, by transitional groups of genera which may lack any one of their characters. On the other hand, in the extreme forms, each of these distinctive characters may be lost through degeneration. Thus fin-spines, ctenoid scales, and the homocercal tail are lost in the codfishes, the connection of ventrals with shoulder-girdle fails in certain peculiar forms, and the development of the air-duct is subject to all sorts of variations. In one family even the adipose fin reappears.

The *Acanthopterygii* or preferably *Acanthopteri*, the *Physoclysti* of Müller, the *Thoracices* of older authors, and the *Ctenoidei* of Agassiz, include substantially the same series of forms.

Among the many subordinate groups, suborders or super-families, a few stand out as susceptible of definition. Among these is the



Barracuda (*Sphyræna barracuda*).



A Flying-fish (*Exocœtus volitans*).

group of *Salmopercæ*, composed of perch-like fishes, with spines in the fins and with ctenoid scales, yet retaining at the same time the abdominal ventrals and the adipose fin of the salmon. This constitutes the family of *Percopsidæ*, trout-perches or sand-rollers. The extinct *Erismatopteridæ* and *Asineopidæ* probably belong here.

The sub-order *Symentognathi* agree externally with the *Haplomi*, but have the lower pharyngeals solidly united, and the air-duct lost in the course of development. The families are *Belonidæ*, the gars, *Scombresocidæ*, the sauries, *Hemiramphidæ* or half-beaks, and *Exocœtidæ* or flying-fishes. This order and the *Haplomi* are joined by Hay under the name of *Mesichthyes*, the groups forming a perfect transition from soft-rayed to spiny-rayed fishes.

The group of *Percesoces* has the general traits of the spiny-rayed fish, with the ventral fins abdominal. Here belong the *Sphyrænidæ* or barracudas, the *Atherinidæ* or silversides, and the *Mugilidæ* or mullets. Another sub-order, *Rhegnopteri*, includes the *Polynemidæ* or thread-fins. Other transitional forms, with the ventrals abdominal, and spines usually present in the fins, constitute the sub-orders of *Hemibranchii*, *Lophobranchii* and *Hypostomides*. In all of these the bones of the gill-arches are reduced in number, and the gill-structures are distinctly degenerate. For this reason Dr. Hay has proposed to unite them as a distinct order, *Phthinobranchii* (φθίνων, waning). The *Hemibranchii* include the families *Gasterosteidæ* (sticklebacks), *Protosyngnathidæ* (extinct), *Aulorhynchidæ*, *Fistulariidæ* (cornet-fishes), *Aulostomidæ* (trumpet-fishes), *Urosphenidæ* (extinct), *Rhamphosidæ* (extinct), *Marcorhamphosidæ* (snipe-fishes), and *Centriscidæ* (shrimp-fishes). The more degenerate sub-order of *Lophorbranchii* includes the *Solenostomidæ*, the *Syngnathidæ* (pipe-fishes), and the *Hippocampidæ* or sea-horses. The singular order of *Hypostomides* includes the *Pegasidæ* (sea-moths or sea-dragons).

In another sub-order we may place the *Berycoidei*, fishes perch-like in general structure and usually well armed, with the ventral fins thoracic, but their number of rays never I, 5, the typical number in all perch-like forms. The berycoids are especially characterized by the presence of the orbitosphenoid bone, a structure wanting in all perch-like families; are the earliest in time of the fishes of this pattern, appearing in the Cretaceous or earlier. The families are *Berycidæ*, *Trachichthyidæ*, *Holocentridæ* or soldier-fishes, *Polymixiidæ*, and *Monocentridæ* or pine-cone fish.

Another group or sub-order *Zeoidei*, agrees well with the beryces in the presence of more than five soft rays in the ventral fins and in the armature of the fins. It differs, however, in the character of the skeleton, the post-temporal, especially being adnate to the skull, as in the butterfly-fishes or *Chætodontidæ*.

One family, *Zeidæ*, the John-dories, belongs here. In the same group we may place provisionally an extinct family, *Amphistiidæ*. Dr. Boulenger has suggested that to fishes allied to the *Amphistiidæ* we may trace the origin of the John-dories, and of the great group of flounders as well. This is an interesting suggestion, but the actual line of descent is as yet not proved.

The sub-order *Selenichtyes* includes the family of *Lampridida* or opahs. In this group is a single species, a huge fish almost as deep as long, with the hypercoracoids greatly developed and the ventral fin with many soft rays, an archaic character unknown in other spiny-rayed fishes.

In this neighborhood belongs the sub-order of *Heterosomata*, or flounders, characterized by the twisting of the cranium, an arrangement which permits the fish to lie flat on one side on the sand, while both eyes are turned to the upper or colored side. In this group there are no fin-spines. The young flounder when first

A Sea-horse (*Hippocampus*).

hatched has the skull and eyes symmetrical, and the modification of the head proceeds by degrees.

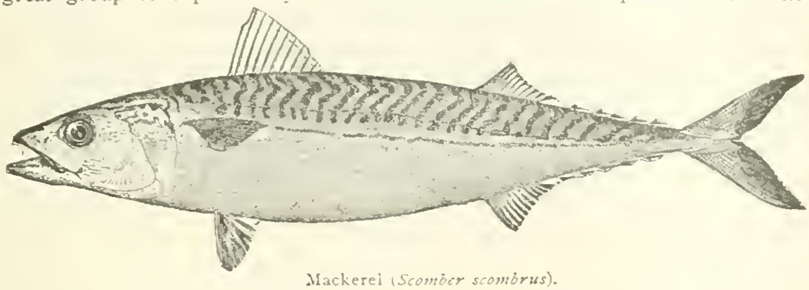
There are two families, *Pleuronectidæ* or flounders, and *Soleidæ* or soles.

To the group or super-family *Scombroidea* belong a great variety of fishes, usually swift in motion and with thin soft scales, the ventral fins, if present, having a spine and five soft rays.

The families are *Rachicentridæ*, the sergeant-fishes, *Pomatomidæ* or bluefishes, *Carangidæ* or Cavallas, *Nematistiidæ* or papagallos, *Scombridæ* or mackerels, *Palæorhynchidæ* (extinct), *Lepidopidæ* or scabbard-fishes, *Trichiuridæ* or cutlass-fishes, *Istiophoridæ* or sail-fishes, *Xiphiidæ* or sword-fishes, *Coryphænidæ* or dolphins, *Bramidæ* or pomfrets, *Pteraclididæ*, *Stromateidæ* or harvest-fishes, *Icosteidæ* or rag-fishes, *Acrotidæ*, *Zaproridæ*, *Luvaridæ* or Lowars, *Menidæ*, *Leiognathidæ*, *Steinegeriidæ*, and *Tetragonuridæ* or square-tails. The *Grammicolepidæ* perhaps belong in this neighborhood.

The imperfectly known families, *Bathyclupeidæ*, *Stephonoberycidæ*, and *Pempheridæ* have some resemblance to berycoids, but the ventral rays are I, 5.

The great group or super-family *Pericoidea* agrees with the mackerel-like fishes in general structure, but the scales are usually coarser and rougher, and the structure less adapted to swift movement. Many members of this group are confined to the fresh waters. The families are *Centrarchidæ*, the sunfishes, *Kuhliidæ*, the silver-bass, *Elassomidæ*, the pigmy-perch, *Aphredoderidæ*, the pirate-perch, *Percidæ*, the river-perch and darters, *Apogonidæ*, the beardless mullets, *Scombropidæ*, *Acropomidæ*, *Serranidæ*, the bass, *Lobotidæ*, the flashers, *Rypticidæ*, the soap-fishes, *Kyphosidæ*, the chopas, *Scorpididæ*, *Theroponidæ*, the slave-fishes, *Hæmulidæ*, the grunts, *Lutianidæ*, the snappers, *Sparidæ*, the porgies, *Cæsionidæ*, *Gerridæ*, the majorras, *Mænidæ*, the picarels, *Sciænidæ*, the drums, *Centropomidæ* (or *Oxylabracidæ*), the robalos, *Polycentridæ*, *Nandidæ*, *Oplegnathidæ* or stone-wall perch, *Sillaginidæ*, *Pentacerotidæ*, *Priacanthidæ*, the catalufas, *Mullidæ*, the surmullets. Remotely allied to the percoid fishes are the *Pseudochromididæ*, the *Opisthognathidæ* or jaw-fishes, the *Malacanthidæ*, the *Latilidæ* or tile-fishes, and possibly the *Cepolidæ* or band-fishes.



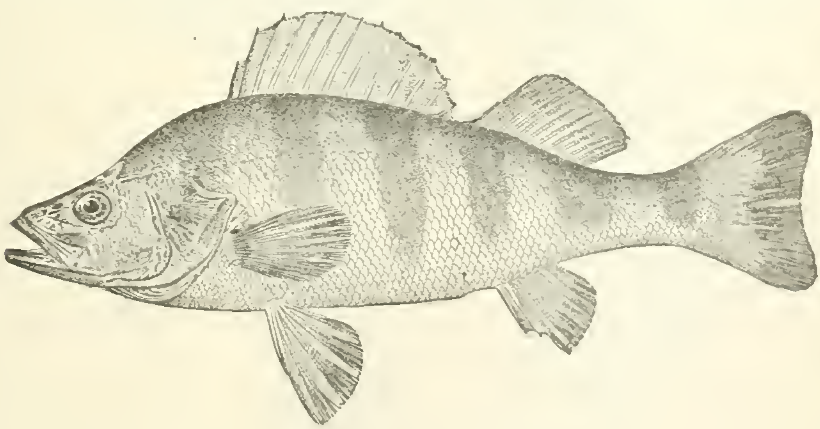
Mackerel (*Scomber scombrus*).

The group or sub-order of *Labyrinthici* comprises fresh-water fishes of the Indian region, with a peculiar apparatus for storing water connected with the gills. The families are *Osphromenidæ* or gouramies, *Anabantidæ* or climbing perch, *Helostomidæ*, *Luciophalidæ*, and *Ophiocephalidæ* or snakehead fishes.

Another group, called *Pharyngognathi* by Müller, is characterized by the complete union of the lower pharyngeals, a character developed independently in the *Synentognathi* and in some *Sciænidæ*. It contains three sub-orders or super-families. The *Chromides* have a single nasal opening on either side. Of these there are two families, the *Pomacentridæ* or damsel-fishes, chiefly beautiful inhabitants of the coral reefs, and the *Cichlidæ*, river-fishes of the tropics of both continents.

The *Holconoti* comprise the viviparous perch or surf-fishes of California and Japan; one family, *Embiotocidæ*.

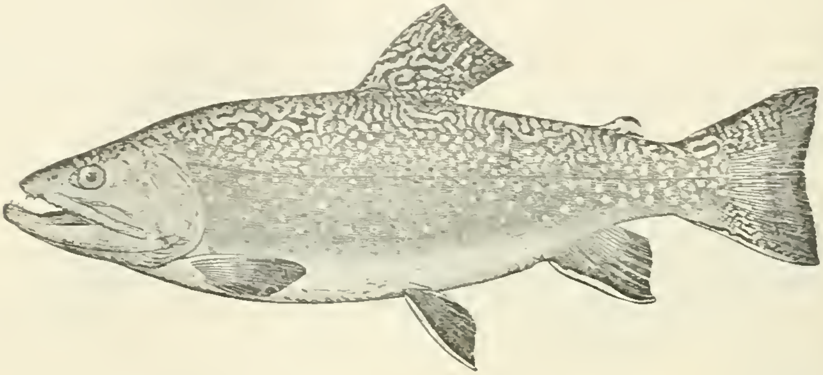
The *Pharyngognathi* proper, having two nostrils on either side, smooth scales and the gills three and one half, constitute four families, *Labridæ*, wrasse-fishes or doncellas, *Odacidæ* *Siphonognathidæ*, and *Scaridæ* or parrot-fishes, in which the teeth are united to form a bird-like beak.



Yellow Perch (*Perca flavercens*).

A large group of more or less related forms, perhaps derived from ancestors of the *Zeoidea* is known as *Squamipinnes* or *Chætodontoidea*. These are characterized in general by the union of the post-temporal or uppermost bone of the shoulder-girdle with the skull. The ventral fins in these fishes have one spine and five (rarely fewer) rays. The scales are small and often rough. The presence in the more primitive forms of 24 vertebræ and five soft rays in the ventrals indicates the common origin of these fishes with the members of the scombroid, percoid, and labroid groups. While the more primitive of the chætodontoid series much resemble primitive members of the other series, the extremes of the former represent a wide divergence, specialization, and degeneration.

known collectively as *Plectognathi*, the bones of the jaws being more or less consolidated. Three sub-orders exist among these forms, *Sclerodermi*, with separate rough scales and separate teeth, the *Ostracodermi*, with the body enclosed in a bony box, and the *Gymnodontes*, with the teeth coalescent into one or two plates in each jaw.

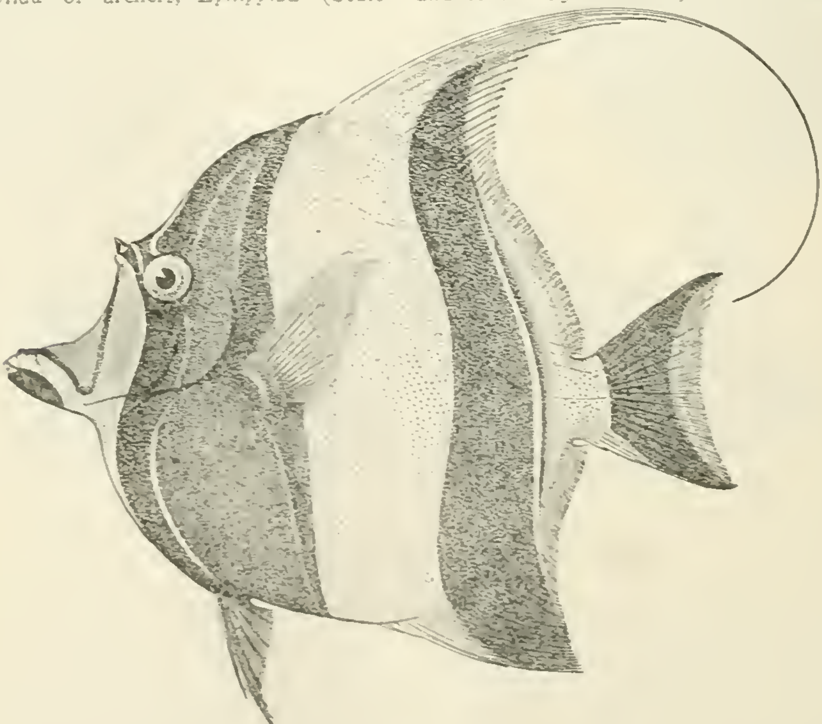


Brook or Speckled Trout (*Salvelinus fontinalis*).

The typical families are the *Ilarchidæ* or spade-fishes, the *Chætodontidæ* or butterfly fishes, characteristic of coral reefs and the *Zanclidæ* or Moorish idols. Aberrant types are the *Toxotidæ* or archers, *Ephippidæ* (*Scatophagidæ*), *Antigoniidæ* or boar-fishes, and *Drepanidæ*. Still more aberrant are the *Acanthuridæ*, tangs or surgeon-fishes, the *Siganidæ*, with the last ventral ray spinous like the first. From the tangs are descended the degenerate types

To the *Sclerodermi* belong the three families, *Triacanthidæ*, *Balistidæ* or trigger-fishes, and *Monacanthidæ* or file-fishes. To the *Ostracodermi* belong the *Ostraciidæ* or trunk-fishes, and to the *Gymnodontes*, the *Triodontidæ*, the *Tetraodontidæ* or globefishes, the *Tropidichthyidæ*, the *Chonerhinidæ*, the *Diodontidæ* or porcupine fishes, the *Heptadiodontidæ* (extinct), and the *Molidæ* or head-fishes.

A small group known as the super-family



Moorish Id[illegible] *cornutus*).

Cirrhitoidea is characterized by the thickened and unbranched character of the lower pectoral rays, the third suborbital being at the same time not enlarged. Here belong the *Cirrhitidæ*, the *Aplodactylidæ*, the *Latrididæ*, and possibly the *Trichodontidæ*. This group seems to mark a direct transition from the perch-like fishes to those with mailed cheeks.

The sub-order of mailed-cheek fishes, *Pareioplitæ*, is characterized by the presence of the suborbital stay, a process extending backward from the third suborbital to or toward the upward limb of the preopercle. This stay is subject to great exaggeration in some forms, while in others it is much reduced. It is, however, always present in these fishes and in no others. In the more primitive types, the ventrals have one spine and five rays. There are 24 vertebræ, and the scales are normally developed. In the extremes there are remarkable cases of specialization on the one hand and of degeneration on the other.

The families of mailed-cheek fishes are the *Caracanthidæ*, the *Hexagrammidæ*, or greenfishes, the *Anoplopomidæ*, or skil-fishes, the *Scorpænidæ* or rose-fishes and sea-scorpions, the *Platycephalidæ*, the *Bembridæ*, the *Hoplichthyidæ*, the *Cottidæ* or sculpins, the *Cyclopteridæ* or lump-fishes, the *Liparididæ* or sea-snails, the *Rhamphocottidæ*, the *Agonidæ*, sea-poachers or alligator-fishes, the *Triglidæ* or sea-robins, the *Peristediidæ*, and the *Cephalacanthidæ* or flying gurnards. The last three families differ considerably in osteology, and are segregated by Dr. Gill as the sub-order *Craniomi*.

In the sub-order *Discocephali* the spinous dorsal fin is modified to form a sucking disk. This is placed on the head, and is made of two series of flat plates. There is one family, the *Echineididæ* or remoras.

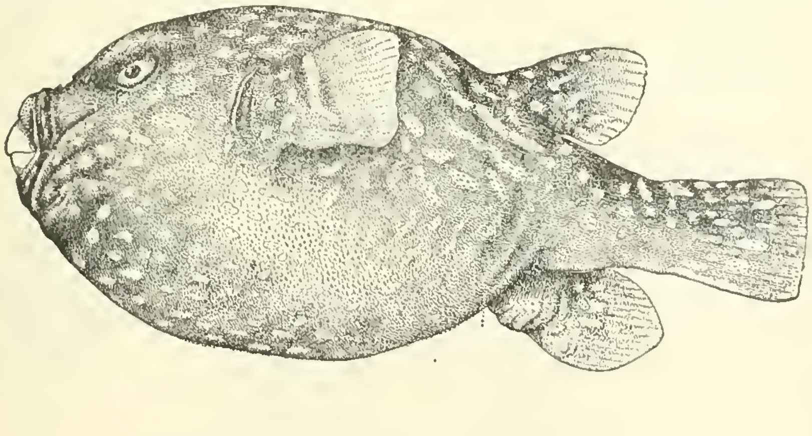
The large family of *Gobiidæ* forms a super-family called *Gobioidea*. The gobies are distinguished by numerous minor traits, the restricted gill-openings, the short spinous dorsal and usual connection of the ventral fins among others. With the gobies may be associated the small family of *Oxudercidæ*.

To the sub-order *Jugulares* we may refer many families which agree in having the ventral fins inserted before the pectorals. The superfamily *Trachinoidea* for the most part retain the normal number of ventral rays, the spine, and five soft rays. To this group belong the *Trachinidæ* or weavers, the *Uranoscopidæ* or stargazers, the *Percophidæ*, *Nototheniidæ*, *Pteropsaridæ*, *Harpagiferidæ*, *Chænichthyidæ*, *Champsodontidæ*, *Bovichthyidæ*, the *Draconettidæ*, *Callionymidæ* or dragonets, the *Platypteridæ*, and perhaps the *Chiasmodontidæ* and *Hemerocœtidæ*.

Other divergent or aberrant families in this neighborhood are the *Comephoridæ*, or Baikal-fishes, the *Bathymasteridæ* or ronquils, and the *Gadopsidæ*. The *Batrachoididæ* or toad-fishes represent the group *Haplodoci*.

The group *Xenopterygii*, without spinous dorsal and with a large sucking disk between the ventral fins, contains the *Gobiesocidæ* or cling-fishes.

The super-family *Blennioidea* contains the blennies and their relatives, with the ventrals jugular and always few-rayed. Here belong the *Blenniidæ*, *Pholididæ*, *Stichæidæ*, *Xiphasiidæ*, *Cryptacanthodidæ* or wry-mouths, *Anarrhichadidæ* or wolf-fishes, *Ptilichthyidæ*, *Cerdalidæ*, *Patæcidæ*, *Gnathanacanthidæ*, and the extinct family of *Blochiidæ*.



A Californian Globefish (*Ovoides setosus*).

Very closely allied to the blennoid series, and also belonging to the *Jugulares*, is the super-family *Ophidioidea*, differing in the absence of fin-spines. Here belong the *Zoarcidæ* or eel-pouts, the *Ammodytidæ* or sand-launces, the *Bleekeriidæ*, the *Brotulidæ*, the *Brotulophidæ*, the *Ophidiidæ* or cusks, the *Fierasferidæ* or pearl-fishes, the *Xenocephalidæ*, *Scytalinidæ*, *Congrogadidæ*, and *Bregmacerotidæ*.

A sub-order of uncertain relations, characterized by the absence of foramen in the hypercoracoid, by the peculiar form of the tail, by the jugular insertion of the ventrals and the absence of spines, is the *Anacanthini*. Here belong the *Gadidæ* or codfishes, the *Merlucciidæ* or hakes, the *Macruridæ* or grenadiers, the *Ateleopodidæ* and *Bathyonidæ*.

Still more uncertain are the relationships of the sub-order *Tæniosomi*, ribbon-shaped fishes of the deep sea, soft in body and often reaching an immense size. The families are *Trachypteridæ* or deal-fishes, *Regalecidæ* or oar-fishes. The *Lophotidæ* or crest-fishes show some resemblance to these.

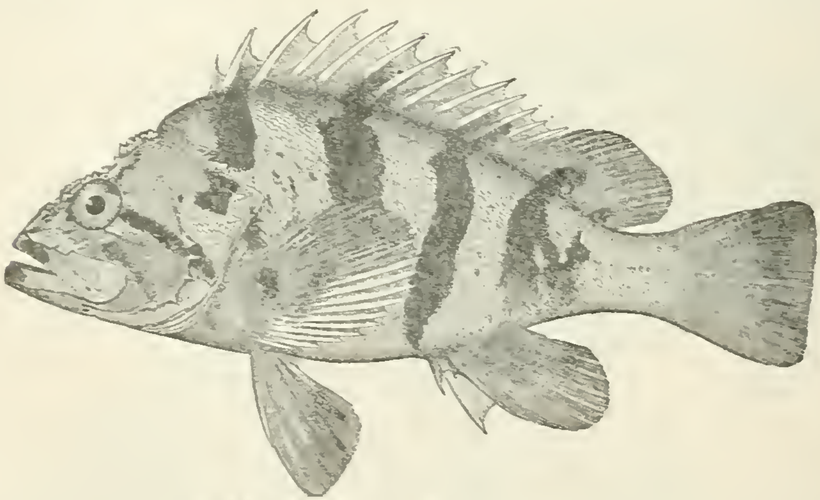
Finally we may close the long series with the order of *Pediculati*. These are jugular fishes, degenerate in structure, the small gill-opening *behind* the pectoral fins. The families are *Lophiidæ*, the anglers, *Antennariidæ* or walking-fishes, *Ceratiidæ* or sea-devils, and *Ogcocephalidæ* or sea-bats.

History of Systematic Ichthyology.— The title of "Father of Ichthyology" is justly given to Petrus Artedi, a Swede, associate and intimate friend of Linnæus. Artedi was the first to recognize the meaning of genus and species in ichthyology, and to supply the outlines of a classification. After Artedi's untimely death (by drowning in a canal in Holland), Linnæus edited his manuscripts, publishing them in 1738, in five parts, as follows: (1) Ichthyological biography; (2) Ichthyological philosophy; (3) Genera of fishes, involving a complete classification of the forms he knew, his genera corresponding to the groups now called families; (4) Synonymy of all species recorded by authors, and (5) Description of all the species actually examined by Artedi. Of true fishes (exclusive of whales) 228 species are recorded by Artedi — a small portion of the 12,000 species now actually known (1903).

But the work of Artedi is masterly in its method and shows a stronger touch than that of any of his successors in ichthyology until the time of Cuvier. In the 'Systema Naturæ' Linnæus did little more for fishes than to substitute binomial names for the descriptive phrases of Artedi.

With the 'Règne Animal' (1817–28) of Cuvier, a new era in zoology began. In this epoch-making work the "Animal kingdom," as the title indicates, was "arranged according to its organization." Comparative structure finds its reflection in the schemes of classification. The application of the principles of morphology was carried out in detail with the fishes in the great 'Histoire Naturelle des Poissons' (1828–49) of Georges Dagobert Cuvier and Achille Valenciennes, long the most valuable general work on fishes. The only general work on fishes since Cuvier and Valenciennes is the monumental 'Catalogue of the Fishes of the British Museum' (1859–70) by Dr. Albert C. L. G. Günther. In this work 6,843 species are described and 1,682 doubtful species are mentioned in foot-notes, the number of species known in 1870 being estimated at 9,000. Since that date about 3,000 have been described, the number of living species at present, according to an enumeration made by Dr. Boulenger, being about 12,000. The number of fossil species known may be estimated at 3,000 to 4,000.

The systematic arrangement of Cuvier was extended and modified by Louis Agassiz to include the multitude of fossil forms made known in his 'Poissons Fossiles.' Still more important corrections and changes in the general scheme of classification were suggested by Johannes Müller, the greatest comparative anatomist of the 19th century. Other valuable contributions to taxonomy have been made by Dr. Günther, Dr. Edward Drinker Cope, and especially by Dr. Theodore Gill, a critical writer who ranks with the first of taxonomists of the age, and whose views have been accepted in substance if not in name as representing our best present knowledge of the origin and relationship of forms among the vertebrate animals.



Black-banded Rock-fish (*Sebastodes nigricinctus*).

The contributions of Geoffroy Saint-Hilaire, Pieter van Bleeker, Carl Gegenbaur, Ramsay H. Traquair, George Albert Boulenger, Louis Dollo, Bashford Dean, Karl Zittel, Arthur Smith Woodward to the systematic arrangement of the higher groups of fishes have also been of great value.

In modern times the students of systematic ichthyology have been very numerous. The local faunal work in various nations has been very extensive. In Great Britain we may note Parnell's 'Natural History of the Fishes of the Firth of Forth' (1838); William Yarrell's 'History of British Fishes' (1859); the earlier histories of British Fishes by Edward Donovan and by William Turton, and the works of Jonathan Couch (1862), and Dr. Francis Day (1888), possessing similar titles. H. G. Seelye has also a useful 'Synopsis of the Fresh-water Fishes of Europe.' William Swainson studied the fishes of Sicily, W. Thompson those of Ireland, and Rev. Richard T. Lowe and J. Y. Johnson have done excellent work on the fishes of Madeira.

In Germany and Austria the chief local works have been those of Heckel and Kner on the fresh-water fishes of Austria (1858), and C. Th. von Siebold on the fresh-water fishes of Central Europe (1863). The two memoirs of Eduard Ruppell on the fishes of the Red Sea and neighboring parts of Africa, 'Atlas zu der Reise im nördlichen Afrika' (1828), and 'Neue Wirbelthiere' (1837), rank with the very best of descriptive work.

In Italy, Charles Lucien Bonaparte, Prince of Canino, has published an elaborate 'Fauna Italica' (1838), and numerous minor papers. O. G. Costa published (about 1850) a Fauna of Naples.

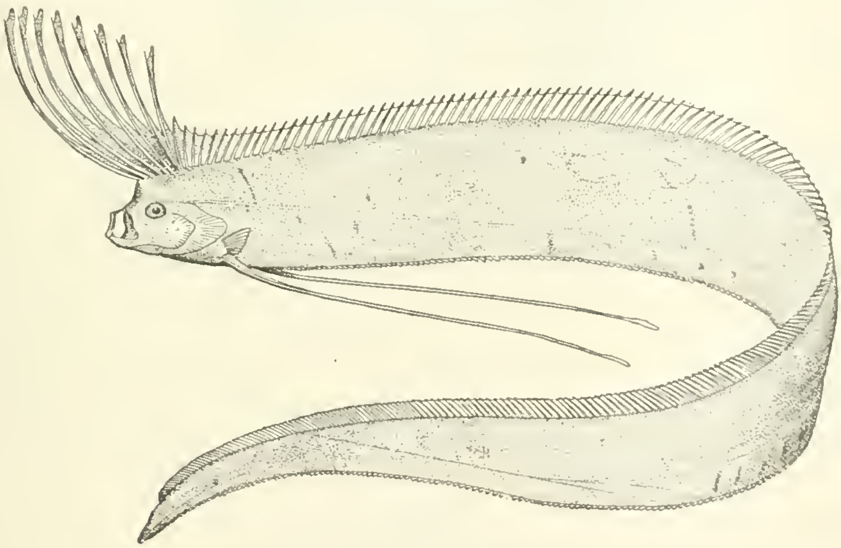
In France, the fresh-water fishes are the subject of works by Emile Blanchard (1866), and Emile Moreau. Léon Vaillant has written on various groups of fishes. The 'Mission Scientifique au Mexique,' by Vaillant and F. Bocourt, is a most valuable contribution to our knowledge of the fishes of Mexico.

In Holland the chief great works have been those of Schlegel and Pieter van Bleeker. Professor Schlegel, of the University of Leyden, described in 'The Fauna of Japonica' the fishes collected about Nagasaki in Japan by Ph. Fr. de Siebold and Bürger.

Pieter van Bleeker (1819–78), a surgeon in the Dutch East Indies, is the most voluminous writer in ichthyology. His chief work is the 'Atlas Ichthyologique des Indes Orientales Néerlandaises,' illustrated by colored plates. The writings of Dr. Bleeker constitute the chief source of our knowledge of the fauna of the East Indies. Dr. Van Lidth de Jeude, of the University of Leyden, is the author of a few descriptive papers on fishes.

The fish fauna of Cuba has been the lifelong study of Dr. Felipe Poey y Aloy (1799-1891), a pupil of Cuvier, for a half century or more the honored professor of zoology in the University of Havana. Of his many useful papers, the most extensive are his 'Memorias sobre la Historia Natural de la Isla de Cuba,' followed by a 'Repertorio' and an 'Enumeratio' on the same subject. Before Poey, Guichenot of Paris had written on the fishes collected in Cuba by Ramon de la Sagra. Philip H. Gosse (1810–88) wrote on the fishes of Jamaica. Much earlier, Robert Herrmann Schomburgk (1804–65) wrote on the fishes of British Guiana. Other papers on the Caribbean fishes were contributed by Johannes Muller and F. H. Troschel, and by Richard Hill and J. Hancock.

Besides the work in South America of Marcgrave, Agassiz, Reinhardt, Lütken, Steindachner, Jenyns, Boulenger, and others already named, we may note the local studies of Dr. Carlos Berg in Argentina, Dr. R. A. Philippi in Chile, and special records of Humboldt, Garman, J. F. Abbott, and others in recent times. Carl H. Eigenmann and also Jordan and Eigenmann have studied the great collections made in Brazil by Agassiz. Steindachner has described the collection of Johann Natterer and Gilbert those made by Dr. John C. Branner. The most recent extensive studies of the myriads of Brazilian river-fishes are those of Dr. Eigenmann.



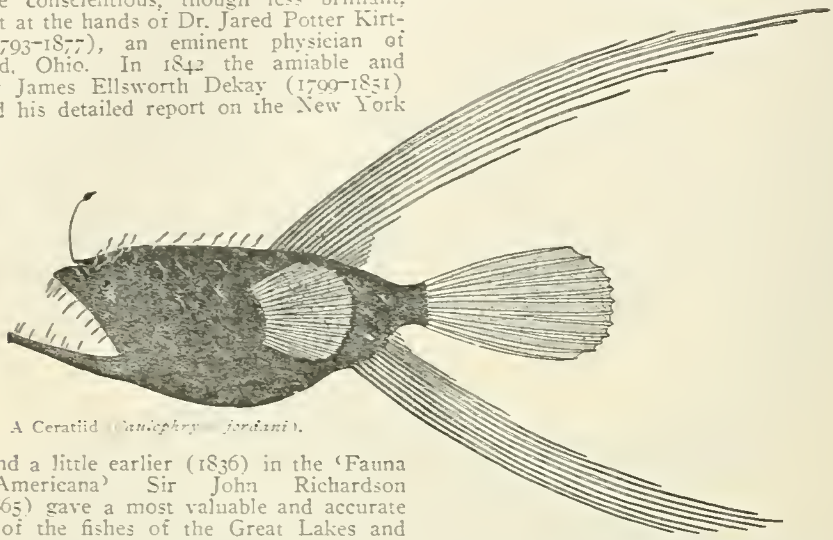
A Ribbon-fish or Oarfish (*Regalecus*).

In New Zealand, F. W. Hutton and J. Hector have published a valuable work on the fishes of New Zealand. Later writers have given us a good knowledge of the fishes of Australia. Notable among them are W. Macleay, James Douglas Ogilby, and Edgar R. Waite. Clarke has also written on 'Fishes of New Zealand.'

The most valuable work on the fishes of Hindustan is the elaborate treatise on the 'Fishes of India,' by Francis Day.

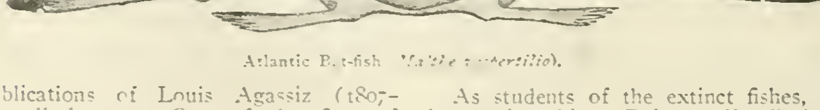
The most recent as well as the most extensive studies of the fishes of Japan were made in 1900 by the present writer and his associate, John Otterbein Snyder.

The scanty pre-Cuvieran work on the fishes of North America has already been noticed. Contemporary with the early work of Cuvier is the worthy attempt of Professor Samuel Latham Mitchell (1764–1831) to record in systematic fashion the fishes of New York. Soon after followed the admirable work of Charles Alexandre Le Sueur (1780–1840), artist and naturalist, who was the first to study the fishes of the Great Lakes and the basin of Ohio. Constantine Samuel Rafinesque (1784–1842), the third of this remarkable but very dissimilar trio, published numerous papers descriptive of the species he had seen or heard of in his various botanical rambles. This culminated in his elaborate but untrustworthy 'Ichthyologia Ohiensis.' The fishes of Ohio received later a far more conscientious, though less brilliant, treatment at the hands of Dr. Jared Potter Kirtland (1793–1877), an eminent physician of Cleveland, Ohio. In 1842 the amiable and scholarly James Ellsworth Dekay (1799–1851) published his detailed report on the New York



A Ceratiid (*Caulophryne jordani*).

fauna, and a little earlier (1836) in the 'Fauna Boreali-Americana' Sir John Richardson (1787–1865) gave a most valuable and accurate account of the fishes of the Great Lakes and Canada. Almost simultaneously, Rev. Zadock Thompson (1796–1856) gave a catalogue of the fishes of Vermont, and David Humphreys Storer (1804–91) began his work on the fishes of Massachusetts, finally expanded into a 'Synopsis of the Fishes of North America' (1846) and a 'History of the Fishes of Massachusetts' (1867). Dr. John Edwards Holbrook (1794–1871), of Charleston, published (1860) his invaluable record of the fishes of South Carolina. The monograph on Lake Superior (1850), and



Atlantic Bat-fish (*Malthe vespertilio*).

other publications of Louis Agassiz (1807–73) are well known. One of the first of Agassiz's students was Charles Girard (1822–95), who came with him from Switzerland, and in association with Spencer Fullerton Baird (1823–87) described the fishes from the United States Pacific Railway Surveys (1858) and the United States and Mexican Boundary Surveys (1859).

Most eminent among the students and assistants of Professor Baird was his successor, George Brown Goode (1851–99), whose greatest work, 'Oceanic Ichthyology,' published in collaboration with Dr. Tarleton Hoffman Bean, was barely finished at the time of his death. The work of Theodore Nicholas Gill and Edward Drinker Cope has been already noticed.

The present writer began a systematic 'Catalogue of the Fishes of North America' in 1875, in association with his gifted friend, Herbert Edson Copeland (1849–76), whose sudden death, after a few excellent pieces of work, cut short the undertaking. Later, Charles Henry Gilbert (1860—), a student of Professor Copeland, took up the work, and in 1883 a 'Synopsis of the Fishes of North America' was completed by Jordan and Gilbert. Dr. Gilbert has since been engaged in studies of the fishes of Panama, Alaska, and other regions, and the second and enlarged edition of the 'Synopsis' was completed in 1898, as the 'Fishes of North and Middle America,' in collaboration with another of the writer's students, Dr. Barton Warren Evermann.

As students of the extinct fishes, following the epoch-making 'Poissons Fossiles' of Louis Agassiz, some of the notable names are those of Pander, Asmuss, Heckel, Hugh Miller, and Ramsay H. Traquair. An indispensable 'Handbuch der Palæontologie' is that of Karl A. Zittel, translated by Charles R. Eastman. The most valuable general work is the 'Catalogue of the Fossil Fishes in the British Museum' in four volumes, by Dr. Arthur Smith Woodward, a worthy companion of Günther's Catalogue of the living fishes.

In America Dr. John Strong Newberry, and Professor Edward W. Claypole have studied the fossil fishes of Ohio. Edward Drinker Cope and Dr. Joseph Leidy have written on the Eocene and Cretaceous fishes of the Rocky Mountains. Numerous recent papers of importance have been published by Dr. Bashford Dean, of Columbia University, Dr. Charles R. Eastman, of Harvard, and Dr. Oliver Perry Hay of New York. Other important records are due to Orestes St. John, A. H. Worthen, Charles D. Walcott, J. F. Whiteaves, S. W. Williston, and the Redfields, father and son.

Besides all this there has risen, especially in the United States, Great Britain, Norway, Canada, and Australia, a vast literature of commercial fisheries, fish culture, and angling, the chief workers in which fields we may not here enumerate even by name.

See FISHES, GEOGRAPHICAL DISTRIBUTION OF.

DAVID STARR JORDAN,
President Leland Stanford Jr. University.

Ichthyopsida, ik-thī-ŏp'sĭ-da. See HERPETOLOGY.

Ichthyopterygia. See ICHTHYOSAURIA.

Ichthyornis, ik-thĭ-ôr'nĭs, a genus of fossil carinate birds constituting an order *Ichthyornithes* and family *Ichthyornithidæ*. They were about the size of, and presumably had much the habits and appearance of, rather large gulls, but they had extremely large heads, and both mandibles of the long pointed beak were studded with sharp, backward pointing, snake-like teeth, each set in a distinct socket. These sea-birds fished in the great inland sea which during the Cretaceous Age covered so much of the present western half of the United States, and the remains of two species and of some allied forms, as *Aptornis*, are found in western Kansas, but they became extinct at the end of the period.

Ichthyosauria, Ichthyopterygia, or **Fish-lizards**, an order of reptiles, embracing primitive marine forms with a fish-like body, long head and tail, and no distinct neck, whose remains are found exclusively in the Mesozoic, and most plentifully in the Lias. They varied in length from 3 to about 30 feet, and, as shown by their numerous coprolites (q.v.), fed upon fishes and cephalopods (squids). "The members of this order," remarks Zittel, "differ conspicuously from all living reptiles and are distinguished chiefly by their fish-like form of body, paddle-shaped limbs with numerous oval or polygonal phalanges, large head with elongated rostrum, short amphicœlous vertebræ, and naked integument." They had no dermal armament like crocodiles, but the snout was prolonged, narrow like that of a gavial or a dolphin, the teeth were acutely conical, crocodile-like, and thickly set in a groove without separate sockets; as many as 400 have been counted in a single mouth. The eyes were surrounded by a circle of wedge-shaped sclerotic plates. That they breathed air is plain from the absence of branchial arches, the shape of the hyoid bones, and other evidences of pulmonary respiration; and their viviparous habit is demonstrated by several well-preserved skeletons embracing embryonic remains in the abdominal cavity,— as many as seven young in one case. As regards external form and adaptation to a marine existence, the ichthyosaurus "depart as widely from other reptiles as whales do from land mammals, and occupy as isolated a position." Their composite character is most puzzling to the phylogenist, and nothing is certainly known as to their origin or descent, except that they certainly were modified from terrestrial ancestors. The only family is *Ichthyosauridæ*, which existed from the Lias to the Cretaceous periods, and contains the small-sized and primitive genus *Mixosaurus*, the typical and exclusively Old World genus *Ichthyosaurus*, *Baptanodon* (q.v.), and *Shastasaurus*, the last two being American in their distribution. Consult: Zittel-Eastmann, 'Text-book of Palæontology,' Vol. II. (New York 1902); Gadow, 'Amphibia and Reptiles' (London 1901).

Ichthyosis, ĭk-thĭ-ō'sĭs, a congenital, chronic disease of the skin characterized by dryness, harshness, and a scaly appearance suggestive of the skin of fish. Nothing is known of its causation; it is not dangerous to life; its cure is impossible.

Iconoclasts, ī-kŏn'ō-klăsts (image-breakers), that Christian party in the Church of the 8th and 9th centuries who would not tolerate images in the churches or places of worship. The Byzantine emperor, Leo the Isaurian, issued an edict in 726 ordering the people to abstain entirely from paying religious reverence to sacred images and a second edict soon after ordered the destruction of the images. This order occasioned commotions, first in the islands of the Archipelago; and as the Popes Gregory II. and III., as well as Germanus, the patriarch of Constantinople, declared the veneration of sacred images to be in consonance with the Church's doctrine and constant practice, and the Emperor Leo refused to recall his edict on their command, they excommunicated him, and his subjects in Italy threw off their allegiance. Thence arose two parties, the Iconolatræ (image worshippers) and the Iconoclasts. Leo's son and successor, Constantine Copronymus, held the same views as his father. He convened a council at Constantinople (754), in which the use as well as the worship of images was condemned. Constantine's son, Leo IV., who ascended the throne 775, followed the same course, but proceeded with more clemency and moderation. On the death of Leo IV., in 780, he was succeeded by his son Constantine, under the guardianship of Irene, mother of the latter, and widow of Leo. Irene favored the orthodox party, and on attaining this position of authority openly avowed her sentiments, and summoned a council to be held in 787, under her protection at Nicæa (Nice) in Bithynia, to pass upon the question at issue. This council condemned the Iconoclasts. Among the Greeks the controversy concerning images broke out anew after the banishment of Irene (802), and lasted about half a century. Her successor, Nicephorus, did not, indeed, remove the images from the churches, but he forbade the adherents of the images from persecuting their adversaries. Finally the Empress Theodora, by a council held at Constantinople (842), restored the worship of images among the Greeks, which was confirmed by a second council, held 869–70, in the same place.

Icteridæ, ĭk-tĕr'ĭ-dē, a family of birds, the American orioles, or hangnests, and blackbirds (qq.v.).

Icy Cape, Alaska, a promontory so named on account of the immense masses of ice by which it is usually surrounded on the north coast, and projecting into the Arctic Ocean west of the Otukah River, about midway between Capes Lisburne and Barrow. It was discovered by Cook in 1778, and was the farthest point that he reached north of Bering Strait.

Ida, (1) the classical name of Kaz-Dagh, a mountain range of Asia Minor, 30 miles southeast of the plain of Troy, with its highest peak, Gargaron (4,650 feet), near the head of the Gulf of Adramyti. In mythology it is famous as the range where Ganymede was stolen; where Paris pronounced judgment on the beauty of the rival goddesses and where the celestials stationed themselves to witness the battles for Troy on the nether plain. (2) The classical name also of a mountain (now Psilotri) in Crete (q.v.), the loftiest (7,500 feet) of the range which traverses the island. The most celebrated legends connected with it are those relating to the infancy of Zeus.

Ida Grove, Iowa, a town, the capital of Ida County, 28 miles north of Denison, on the Maple River, and on the Chicago & N. W. railroad. Farming and stock-raising are carried on largely in the vicinity, and the town has flour mills, grain elevators, and manufactures of machinery, harness, brooms and bricks. Among the municipalized installations is a heating-plant. Pop. (1900) 1,967.

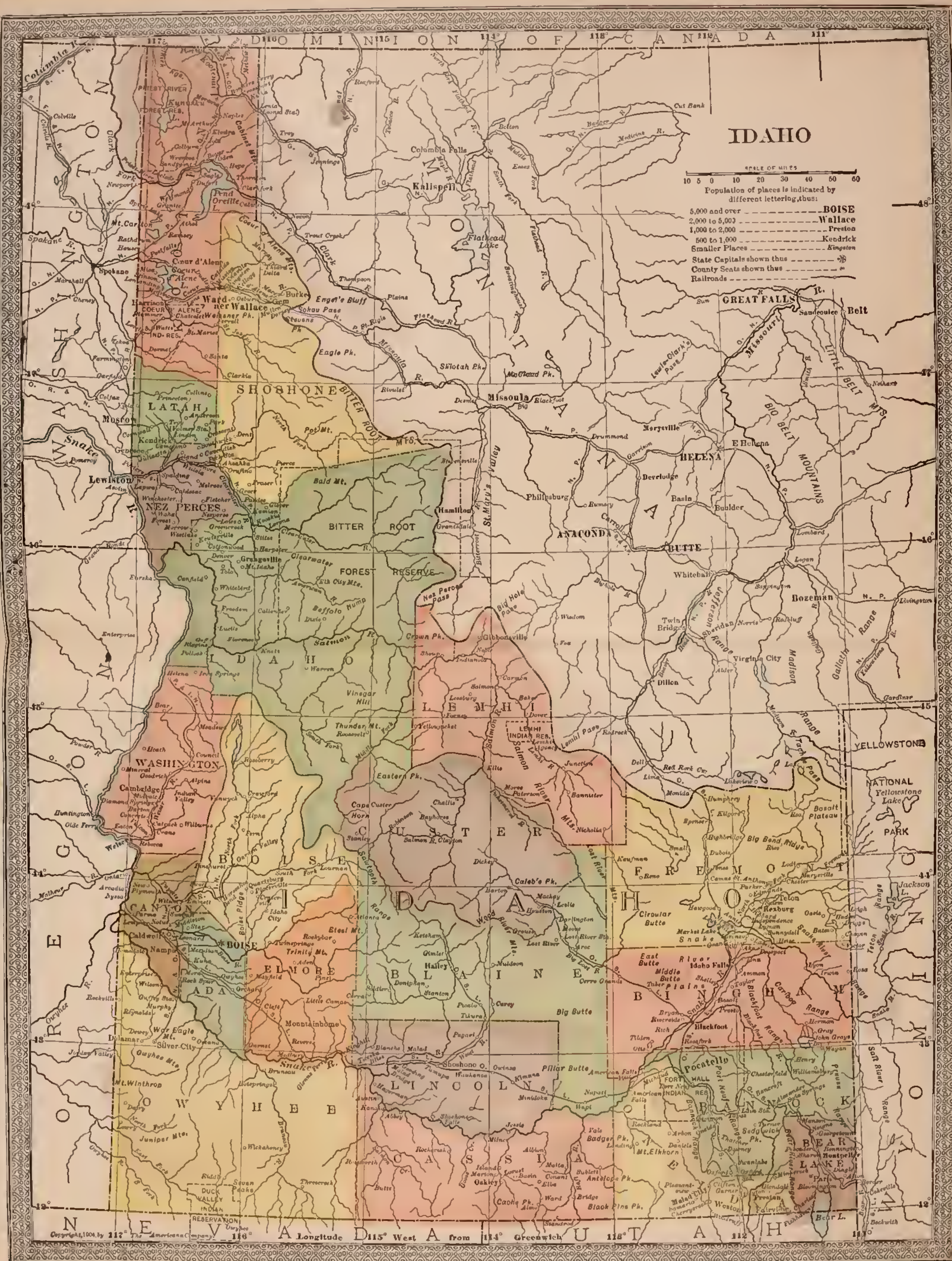
Idaho (Indian, «mountain gem»), a Rocky Mountain State of the United States, next east of Oregon and Washington: its slender northern prong abutting on British Columbia; Montana and Wyoming lie on the east, Nevada and Utah on the south. Capital, Boisé. Length, 485 miles; breadth, 50 to 300; area, 84,800 square miles, 510 water. Pop. (1903) est. 177,000.

Topography.— Idaho is part of the high plateau known as the Great Basin, the main Rockies bounding it on the east and the Cascade Range on the west: it has a mean elevation of some 4,700 feet, but the Bitter Root range in the northeast, extended north by the Cœur d'Alène and Cabinet, and the Salmon range in the centre, have snow-capped peaks rising in the latter to 12,000 feet, of rugged grandeur. These send out spurs extending west entirely across the State. The Saw Tooth range in the west centre, and the Goose Creek and Bear River ranges in the south, are the other chief ranges, the last two stretching across the State. The river system belongs almost entirely to Columbia, with a basin of some 60,000 square miles within the State: the Snake or Lewis Fork winding across its whole southern breadth and up much of the west boundary for some 850 miles, navigable from Salmon Falls, in the centre, to the entrance of the Powder River from Oregon. The chief Idaho affluents are the Salmon and Clearwater; others are the Boisé and Payette. In the north are the Spokane, Pend d'Oreille, Kootenai, and others, all flowing into the Columbia. A large area in the southern part is drained by streams which sink into the earth not far from the mountains (the «lost river» drainage system), and some reach the Snake River by subterranean channels. A small part of the south drains into Salt Lake by the Bear River. The chief lakes are Cœur d'Alène, Pend d'Oreille, and Kaniksu, all in the extreme north, and Bear Lake, in the extreme south, half in Utah. The State has many beautiful waterfalls; four of them are on the Snake,— the 210-foot Shoshone Falls, the Twin, Salmon, and American.

Geology.— The most conspicuous physical and geological feature is the vast barren lava plain, some 400 miles by 40 to 60, and about 20,000 square miles in extent, stretching along the Snake River. This is a relatively recent (Tertiary) overflow, which in enormous volume flooded the Pacific Slope to the ocean. The but recent quiescence of the volcanic activity is shown by the geysers, steam and soda springs, and hot pools, still plentiful in this region. It is rich in fossils, including those of the elephant and mastodon, tapir, simiads, and saurians.

Forests.— The timber region occupies about 11,000 square miles, mostly in the northern part, but somewhat in the upper Boisé, Payette, and Weiser valleys; a dense growth mostly of conifers,— white and yellow pine, red cedar, spruce, hemlock, etc. Of the Bitter Root Timber Reservation, 5,400 square miles are in Idaho; the loftier regions, the Alpine Fir district, produce a poor quality. The forest products were over $1,000,000 in 1892.

Climate, Soil, and Agriculture.— The upper levels have the severe winters of the northern latitudes, and heavy snowfalls from the abundant moisture; the lower ones and the sheltered valleys have a very agreeable and equable climate. The rainfall is light and the soil consequently arid in the southern parts, as in the Great Basin generally, the mountains cutting off the vapors from either side; but in the mountainous districts rain is abundant, and agriculture can be carried on without irrigation. Here, however, the sandy and clayey soil makes it less profitable than ranching. In the mountain valleys and along the rivers, where irrigation can be brought into play, and the soil from lava decomposition is exceedingly rich, production is abundant. The chief districts irrigated are those near swift streams with shallow channels, as the headwaters of the Snake in the east and the district around the Boisé and Payette in the west. Over 600,000 acres were irrigated in 1900. In 1902 a great effort was made to increase this by nearly one half, irrigating 276,000 acres in the Snake Valley by two great canals, with power developed at Shoshone Falls. The chief crop is hay, which in 1902 amounted to 955,676 tons, valued at $5,256,218. Next to this was wheat, 6,021,946 bushels, valued at $4,215,362; other cereals, as oats and barley, produced several million bushels, but wheat made about three fourths of the total. The State raised some $4,000 worth of flaxseed. The raising of vegetables to supply the mining towns is assuming importance, and the fruits for which the Pacific Slope is becoming noted are shared by Idaho, chiefly apples and prunes, grown mainly in the Boisé basin,—



IDAHO
SCALE OF MILES
10 5 0 10 20 30 40 50 60
Population of places is indicated by different lettering, thus:
5,000 and over BOISE
2,000 to 5,000 Wallace
1,000 to 2,000 Preston
500 to 1,000 Kendrick
Smaller Places Kingston
State Capitals shown thus
County Seats shown thus
Railroads
DOMINION OF CANADA
MONTANA
WASHINGTON
OREGON
NEVADA
UTAH
WYOMING
YELLOWSTONE NATIONAL PARK
Longitude West from Greenwich
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the fruit product being about $400,000 a year. The stock-raising interest is very important, nearly half the surface of the State being pasture; but the long severe winters and deep snows make it precarious and costly in precisely the sections best adapted to it, and the northern packers and cattlemen generally winter their stock and draft animals in the Snake and adjoining valleys, where they can live and forage in the winter. The most important item is sheep, which are increasing with great rapidity; from 1,956,467 in 1899–1900, they numbered 4,541,815 in 1902, fourth in the United States. Idaho ranks third in the wool clip, which was 21,639,387 pounds in 1902. The sales of wool and mutton together in 1902 were $4,775,000. There are some 60,000 dairy cows in the State, and nearly half a million meat cattle.

Mining.— Idaho ranks high as a mining State, having rich deposits not only of gold, silver, copper, and lead, but of iron, coal (several new mines opened in 1903), salt of excellent quality, and other minerals. Its lead is the purest in the country, the Cœur d'Alêne district producing about one third of all in the United States. The gold is distributed all through the State; not only in the quartz, but in the gravels of the rivers, especially the Boisé (the most noted), the Salmon, and the Snake. Dredging from the Snake River bed is carried on; but the great event of the last year (1902) was the discovery of immense new quartz ledges in the Thunder Mountain district, which are expected to raise production to the old level of the days before the partial exhaustion of the placers. The yield of metals in 1902 was 92,750 ounces of fine gold, valued at $1,917,150; 5,591,734 ounces of silver, valued at $2,577,789, and 68,953 long tons of lead, besides about 300,000 pounds of copper. The production is restricted by the American Smelting and Refining Company, in order not to glut the market.

Manufactures.— The production of lumber is the chief industry, and flour milling next. Railroad cars, harness and saddlery (always needful in a ranching country), foundry and machine-shop products, furniture, and cigars are also of some importance. There are about 1,600 persons employed in the various manufactures, earning about $1,000,000 yearly in wages; the annual output is about $4,800,000 in value.

Railroads.— The mountainous character of the State, and its slight development, have retarded the construction of means of transportation; the Oregon Short Line through the Snake Valley in the south, and the Great Northern and Northern Pacific through its extreme northern tip, furnish what it has, except a Northern Pacific branch along the Clearwater and a short distance north. There are about 1,400 miles of main track in the State.

Banks.— In 1901 there were 13 national banks in Idaho, with $650,000 of capital stock, $223,354 in outstanding circulation, and $231,650 in United States bonds. There were also ten State banks, three private banks, and a loan and trust company.

Education, Charities, Religion, etc.— The State has over 750 school buildings, and 1,100 teachers, and spends over half-million dollars annually on the schools. Besides ten public high schools, and as many private academies, there are two State normal schools, at Albion and Lewiston, the University of Idaho at Moscow, State Academy at Pocatello, and an agricultural and technological school at Idaho Falls; with two industrial schools at De Smet for the Cœur d'Alêne Indians, academies at Lewiston, Boisé, Genesee, and Pocatello. The State has an insane asylum at Blackfoot, and a State prison at Boisé. In religion, it is predominantly Mormon, with the Catholics next; Methodists, Baptists, and Presbyterians follow in that order.

Indians.— There were 4,226 Indians in the State in 1900, at four reservations, Cœur d'Alêne, Fort Hall, Lemhi, and Nez Percé. But in 1902 the Fort Hall reservation was thrown open to settlement, and about 3,000 settlers took up claims. The Indians at Cœur d'Alêne and Nez Percé are self-supporting.

Government and Finances.— The governor and legislature are elected biennially; sessions are limited to 60 days, except at the members' expense. There are 21 members in the Senate and 46 in the House. The State has one Representative in Congress. After admission as a State a Republican governor was elected until 1897, when the Democrats and Populists united. Until 1902 the Fusion candidates for governor were elected, but in 1902 a Republican governor was elected, and the State is now Republican. The assessed valuation of property (1902) is about $52,000,000, and the bonded debt $443,-500.

Population.— 1870, 13,999; 1880, 32,610; 1890, 84,385; 1900, 161,772. There were about 25,000 more males than females, as natural in a mining and ranching State. Only 24,604 were foreign born. The chief place was Boisé, with 5,957 inhabitants; next Pocatello, 4,046. The only others over 2,000 were Moscow, 2,484, and Lewiston, 2,425. There were 21 counties, as follows, with their capitals: Ada, Boisé; Bannock, Pocatello; Bear Lake, Paris; Bingham, Blackfoot; Blaine, Hailey; Boisé, Idaho City; Canyon, Caldwell; Cassia, Albion; Custer, Challis; Elmore, Mountainhome; Fremont, St. Anthony; Idaho, Mt. Idaho; Kootenai, Rathdrum; Latah, Moscow; Lemhi, Salmon; Lincoln, Shoshone; Nez Percé, Lewiston; Oneida, Malad City; Owyhee, Silver City; Shoshone, Wallace; Washington, Weiser.

History.— Idaho was first explored by Lewis and Clark in 1805 (See LEWIS AND CLARK'S EXPEDITION), and was part first of Oregon Territory, then of Utah, Washington, and Nebraska successively. The Jesuit, Father De Smet established a mission at Cœur d'Alêne in 1842, but till the discovery of gold in 1882 it was visited only by hunters and trappers. On 3 March 1883 it was organized as a Territory, but included the present Montana and most of Wyoming. In 1864 Montana was set off, and in 1868 Wyoming with other territory. When gold was discovered at Cœur d'Alêne, in 1882, a great migration set in, and in 1889 a convention framed a constitution and petitioned for admission to the Union. In 1883 all Mormons were disfranchised, a law held constitutional by the United States Supreme Court; but in 1893, on the Mormon Church disclaiming polygamy, the law was repealed. Miners' strikes in 1892 and 1899 caused great disturances: in the latter year the United States soldiery were compelled to intervene and imprison a great body of miners.

Consult: Bancroft, 'Washington, Idaho, and Montana'; Ouderdonk, 'Idaho, Facts and Statistics Concerning Its Mining, Farming, and Industries.' LAWRENCE H. GIPSON,
University of Idaho.

Idaho Springs, Colo., town in Clear Creek County; on the Colorado & S. railroad; about 30 miles west of Denver. It is situated in the plateau region of the Rocky Mountains at an elevation of about 7,600 feet. The hot and cold soda springs tend to make it a famous resort for health seekers. In 1859 gold was discovered at Jackson's Bar, now a part of the town of Idaho Springs. This district has been most productive in its yield of gold. The chief industrial establishments are concentrating mills, lumber-yards, and machine-shops. Pop. (1900) 2,502.

Idaho, University of, the State university situated at Moscow. Work was begun in 1892; it is open to both men and women, and there is no tuition for residents of the State; a small fee is charged to non-residents. The government is by a board of regents; the courses offered include the classical course, general science, civil and mining engineering, and agriculture. The university is also active in organizing farmers' institutes. The annual income, derived mostly from State appropriations is about $71,000; in 1905 the number of students was 376; the number of professors and instructors 28.

Iddesleigh, ĭdz'lĭ, EARL OF. See NORTHCOTE, STAFFORD HENRY.

Ide, Fannie Ogden, "RUTH OGDEN," American author: b. Long Island 1853. She has written various juvenile stories, among them 'A Loyal Little Red-Coat' (1889); 'A Little Queen of Hearts' (1892); 'Little Homespun' (1896); 'His Little Royal Highness' (1897); 'Tattine' (1900); 'Loyal Hearts and True' (1900); Friendship (1904); 'The Good and Perfect Gift' (1904).

Ide, Henry Clay, American jurist: b. Barnet, Vt., 18 Sept. 1844. He was graduated at Dartmouth in 1866. He was a member of the Vermont State Senate in 1882–5, and a delegate to the National Republican Convention of 1888. In 1891 he was appointed United Commissioner in Samoa, and later (1893–7) was chief justice of Samoa under the joint appointment of the United States, Germany, and England. He became in 1900 a member of the Taft commission; secretary of finance and justice of the Philippines, Sept 1901; vice-governor 1 Feb. 1904; and in 1906 governor-general.

Idealism. This word is not easy to define briefly, as it is used in many connections where the common element in the various significations it takes on are not at first sight apparent. We may say at once, however, that idealism is a fundamental attitude or point of view from which men interpret the world, or some special phase of human experience. Its essential characteristic is found in the fact that it interprets the reality with which it deals as having a meaning, an idea, apart from its sensible appearance, and assumes that in this inner significance its truth and ultimate essence consists. Not the outward show of things, not the fact of coexistence and sequence among sensible phenomena, but the meaning or "idea" is for idealism the point of primary importance in understanding either the world as a whole, or any of its various parts. Now, as Plato perceived, this inner idea of anything is ultimately identical with its "good," *i. e.* what it is good for, its purpose or function in a rational system of things. Accordingly, the essence of idealism is found in its teleological mode of explanation. This point of view, when logically carried out, implies further that what is real is rational or intelligible, since its idea can be grasped. That means, in other words, that mind or intelligence is the ultimate principle in which things find their explanation. Moreover, it of course follows that the material world with its mechanical laws is in some sense secondary and derivative. Idealism is thus directly opposed to materialism and mechanism (q.v.), which take matter or energy or some unintelligent form of existence as the *prius* from which everything else is derived. Realism, as a philosophical theory, affirming the existence of a reality apart from subjective experience, is not properly contrasted with idealism; though, as we shall see later, these terms are used to denote opposing tendencies in literature and art. It is, however, a mistake to suppose that idealism denies objective reality and reduces the world to sensations and ideas in the mind of the individual. On the contrary, the more adequately the principle of idealism is grasped, the more completely is justice done to the objective side of experience.

Science, including philosophy, religion, art, and literature, are all different ways of interpreting life and existence, involving, indeed, varying attitudes of the self toward reality, and varying degrees of explicitness. Religion, art, and literature differ from science and philosophy in not being reasoned interpretations of reality, but primarily expressions of the emotional or feeling aspects of experience. Yet the various sides of experience are not independent and isolated, but act and react on one another as parts of a functional unity. Consequently, the interpretations of religion, art, and literature presuppose more or less explicit theories about the nature of things. These, however, exist in the form of unexamined assumptions and uncritical standards of value. With regard to these interpretations, we can at once say that all forms of religion which rise above mere fetichism necessary presuppose an idealistic view of the world. This is obviously true of a religion like Christianity. But even if a religion denies individual immortality and the doctrine of a personal God, it cannot exist without assuming that the universe is to some extent governed by the ideas and purposes of a superhuman power (or plurality of powers), and that it is not therefore a mere play of mechanical phenomena. Art and literature, too, are naturally — at least in their highest forms — affiliated with idealism. For the emotional and æsthetic satisfaction at which they aim can be fully attained only on the assumption that the ultimate nature of things is in harmony with the demands of the human spirit, and that therefore these ideals are not vain illusions. There are, however, two causes which at certain periods bring about a reaction against idealism in these fields, and give rise to what is known as realistic art and realistic literature. In the first place, the conceptions of science and philosophy are at certain periods so prevailingly mechanical and naturalistic as to fetter the wings of imagination and render impossible any idealistic interpretation on the part of art and literature. If the world is demonstrably unmeaning and mechanical, there is no permanent artistic satisfaction in a false idealism. The imagination cannot be divorced from reason, but must find its satisfaction in representing things in harmony with their true nature and known laws of action. But, again, realism in art and literature may be the result of a onesided idealism, which, by ignoring the aspect of things that science emphasizes, gives rise to the same divorce between the truth of fact and the truth of art. It is clear that if idealism is to prevail in these fields it must not ignore the facts and laws of the natural world, or run counter to them, but must do justice to these facts while it transcends, through its interpretations, the scientific standpoint. Mere idealism, then, is an unsatisfactory standpoint in art and literature, and the reaction toward realism to which it gives rise is justifiable and necessary. In a somewhat similar sense, "idealist" is used popularly as a term of reproach to denote a person who ignores the facts and practical conditions of any situation, construing it in a onesided way in terms of his own ideas of what ought to be. But idealism, to be adequate, must go beyond the uncritical ideas of the individual. The true idealist is the man whose ideas are adequate to the situation in all its complexity and concreteness, whose interpretation of what is and ought to be is derived from a penetrating analysis of all the objective conditions.

What of the relation of natural science and philosophy to idealism? It is obvious that the very task of the natural sciences necessitates the adoption of conceptions which are fundamentally different in character from those employed by idealism; for science is primarily concerned with the relations of particular phenomena. It is always concerned with the mechanism of the parts, and knows nothing of the ideal purpose or significance of wholes. As Kant said, "where mechanism ceases there ceases also the possibility of scientific explanation." This is the ground of the long-standing quarrel between natural science on the one side, and idealistic philosophy and religion on the other; the former can interpret the world only in mechanical terms, while the latter must read it in terms of teleology.

The history of thought shows that both these methods of explanation have steadily confronted each other in philosophy. Idealism and materialism were developed almost simultaneously in Greece — the former by Plato, and the latter by Democritus — and the division between these opposing principles under one form or another persists until the present day. Although philosophical systems necessarily vary with the changing intellectual and social conditions of different periods, yet it remains true, as Fichte said, that in principle "there are and can be only two systems of philosophy, idealism, and materialism, and that neither one can directly refute the other, since they are constructed upon totally different planes." Materialism, as philosophy, adopts the conceptions and methods of the natural sciences, and differs from the latter only in the greater scope and generality of its problems. It aims to be (in Spencer phrase) "completely unified science." Idealism, as we have already seen, has a different problem from that set by science, and states its conclusions in terms that are quite foreign to the latter.

It is usual to distinguish between subjective and objective idealism. The former is an incomplete and undeveloped form, and finds its best representative in Berkeley (q.v.). It resolves material existence into a series of ideas in the mind of the individual, holding, in Schopenhauer's phrase, that "the world is my idea." The proof that it offers for this position is based mainly on the epistemological thesis that we know and can know nothing but our own ideas. The difficulties and inconsistencies of this view are now generally recognized, and the idealism of the present day is known as objective idealism. This does not deny the existence of external reality, but finds implicit in it the same principles of reason and purpose that are present in the individual mind. Indeed, this is true of the great idealistic thinkers of all times — of Plato and Aristotle, no less than of Schelling and Hegel. As a philosophical system, idealism has, of course, to formulate its conclusions in a series of logical propositions, and to furnish proofs of their validity. In doing this it does not depend upon the Berkeleian argument mentioned above, but rather proceeds by way of a criticism of the standpoint and categories of natural science. That is, idealistic philosophy attempts to show that the scientific standpoint, when taken as philosophy, *i. e.* as an ultimate account of the nature of things, is in itself incomplete and inconsistent, and that when the necessary supplementations and corrections are made it points the way to a view of the world as a rational and purposive system. To make our view of the world completely consistent, many idealists maintain, we are obliged to hold that all its parts are included in an all-embracing system of experience, which finds its unity and its utimate reality in the ideas and purposes of an Absolute Mind.

Bibliography.—Compare Plato, especially the 'Phædrus,' and 'Republic,' Books VI., VII.; Berkeley, 'Principles of Human Knowledge,' 'Dialogues,' etc.; T. E. Webb, 'The Veil of Isis' (Dublin 1885); W. Knight, 'Idealism and Experience in Literature, Art and Life' (in 'Essays in Philosophy' 1890); J. Watson, 'Christianity and Idealism' (1897); W. D. Hyde, 'Practical Idealism' (1897); L. Brunschwicg, 'L'idéalisme contemporain' (1905); Willmann, 'Geschichte des Idealismus.'

James E. Creighton,
Professor of Philosophy, Cornell University.

Ides, one of the threefold divisions of the Roman month. See Calendar.

Idiocy, that state of permanent mental deficiency which arises from an affection of the brain either before or at the time of birth or at an early period of life. It is thus distinguished from insanity, which is a condition of mental derangement occurring in the developed brain. Idiocy is a term of very wide applicability owing to the fact that very many grades of arrested development occur. In a general sense it is applied chiefly to the worst of these forms, while the term Imbecility is used to denote the milder forms. The distinction between idiocy and imbecility is thus a somewhat arbitrary one, for the two conditions shade into each other by almost imperceptible degrees.

Causes.— The causes of idiocy and imbecility are often very obscure. A large proportion of cases are congenital; that is, they arise from causes acting *in utero.* The child is born with a brain already hopelessly impaired. Heredity is thus a very evident cause; defects in the ancestral stock and vices in the parents and near progenitors are doubtless very active. Alcoholism, syphilis, and other toxæmias are certainly among these causes; as well as consanguinity and various diseases in the parents. Injuries to the mother while pregnant may be responsible. The subject of ante-natal disease is still a very obscure one, but evidence is not lacking to show that the fœtus may suffer from disease; and in the critical stage of development of the brain before birth this organ may suffer irreparable damage. The same may be said of the infant and very young child. Injury and disease may act most disastrously upon the undeveloped brain. Thus blows upon and injuries to the head may cause idiocy; also injuries at the time of birth, due to difficulties in the labor, may act. The various infectious diseases of childhood are responsible for some cases; thus scarlet fever, measles, whooping cough, and cerebro-spinal fever have been noted as causes of permanent arrest of development. No doubt in many cases it is difficult or even impossible to detect the active cause.

The following are the most universally recognized varieties of idiocy:

Microcephalus.— In this form the brain and its enveloping skull-case remain abnormally small. In extreme grades the deformity is very striking. These are among the lowest and worst forms of idiocy, and in some cases there is scarcely a spark of intelligence. The patient cannot be said to do more than vegetate. The original cause probably acts in these cases at a very early period in the ante-natal life, and determines an almost complete arrest of brain development.

Hydrocephalus.— In this form the natural cavities or ventricles of the brain become enormously distended and the skull is correspondingly enlarged. The mental impairment varies within wide limits. In some cases the idiocy is almost if not quite as great as in microcephalus, but in other cases a fair degree of intelligence is preserved. There may be also various forms of paralysis, speech defect, epileptoid seizures, and impairment of the special senses. Hydrocephalus probably depends upon closure of one or other of the outlets for the cerebro-spinal fluid between the ventricles of the brain.

Porencephalus — Occlusion or stoppage of one of the main arteries of the brain at an early period of development, not necessarily antenatal, may cause such an arrest of development of a portion of the brain-mass that a cavity results, and this is called porencephalus. Such a stoppage of an artery may be caused presumably by injury or by one of the infectious diseases. The symptoms are usually arrest of development of the mental faculties in various degrees, speech defects, paralysis, such as hemiplegia, athetoid movements, and epilepsy.

Mongolian Idiocy.— In some cases the patient bears a real or fancied resemblance to certain racial types, as the Negroid, Mongolian, etc. The latter of these is the best marked, and is now included (after Langdon Down) in most descriptions. The patient's head is deficient in the posterior region; he is of short stature, has oblique and widely separated eyes, and a flattened nose. The attempt is made by some writers to construct special mental features for the Mongolian idiot, but with not very great success. He is simply an idiot, with varying degrees of mental power, and his resemblance to a Calmuck is only accidental.

Paralytic Idiocy.— In the fœtus and in the infant and very young child certain accidents or diseases may cause cerebral hemorrhages, which, just as in the adult, cause in turn various kinds of paralysis. The most common are hemiplegia or paralysis of the arm and leg on one side; diplegia, or paralysis of both arms and legs; and monoplegia, or paralysis of one limb. Such an accident in early life is apt to cause more or less idiocy or imbecility in addition to the paralysis. Some of these patients are also epileptic.

Epileptic Idiocy.— A rather large proportion of feeble-minded children are epileptic. This symptom may be associated with paralysis of various kinds, as already said, or it may not be complicated in any way with marked physical defects. It is only too likely, however, to induce a progressive mental deterioration; or, to speak more accurately for some cases, to prevent a normal brain development. The epileptic child is usually feeble-minded — some more, some less.

Sensorial Idiocy.— In some cases the organs of sight or hearing, or both, may be defective, or undeveloped, and the child's brain does not develop normally merely because it is deprived of these important avenues of sensation. Such children may have more brain capacity than at first appears, and they can be educated. In some cases, however, as in some deaf-mutes, the mental faculties remain more or less undeveloped.

Genetous Idiocy.— Ireland, a well known authority, proposes this term for a certain class of congenital idiots, but it is not very distinctive. It includes feeble-minded children, usually of a rather low grade, who are born with undeveloping brains. The term really applies to many members of the other groups already referred to.

High and Low Grade Idiots. — These terms and intermediate ones are often applied merely to designate feeble-minded children according to the approximate degree of their lack of development. While lacking in scientific precision, such terms denote conveniently various grades of idiocy. There are many idiots who are not microcephalic, nor hydrocephalic, nor Mongolian, nor paralytic, nor epileptic, nor in fact to be included in any usually accepted class, and yet they are unmistakably idiots, and often of low grade. The truth is, that all classifications must remain unsatisfactory until we know more about the causation and pathology of the various forms.

Cretinism.— A highly specialized form of idiocy is cretinism. This is always associated with defect in the thyroid gland; sometimes this gland is entirely absent, at others it is immensely hypertrophied, and thus practically destroyed. Cretinism is endemic in some countries, as in and about the Alps and Pyrenees. The cretin is both physically and mentally stunted. He is of low stature, of peculiar and characteristic physiognomy, of pale and unhealthy skin, usually beardless, sometimes sexually undeveloped, and with many defects in the skeleton and muscular system. Mentally he is usually an imbecile at least, and in some cases even quite idiotic. Cases vary widely, however, in the degree of feeble-mindedness. In the United States cretinism is only sporadic.

Pathology.— As already indicated, idiocy is due to a wide variety of causes, and therefore its pathology also varies extensively. Among the processes found in the brains of idiots are sclerosis, atrophy, porencephalic defects, old inflammations, occluded and destroyed blood vessels, distended ventricles, and thickened membranes.

Treatment.— In recent years the effort has been made to train and educate the feeble-minded child, and to develop in it as far as possible the defective mental faculties. Training schools for these patients now exist in this country and in Europe, and the most humane and enlightened efforts are being put forth to ameliorate the condititon of these unfortunates, and to render the more hopeful of them useful members of society. It is needless to say, however, that not much can be accomplished with feeble-minded children of low grade, and with the very lowest nothing whatever can be done. With the imbecile and demi-imbecile, however, the results obtained sometimes justify the pains and expense. For the vast majority of feeble-minded children asylum treatment is desirable, even indispensable. These unfortunate patients cannot associate with healthy children, and they require a special environment. The prospect for cure in most cases is quite hopeless. See also INSANITY.

Bibliography.— Brush, 'Idiocy and Imbecility' in Keating's 'Cyclopedia of the Diseases of Children,' Vol. IV. (1890); Ireland, 'Idiocy and Imbecility' (1887); Seguin, 'Idiocy, and its Treatment by the Physiological Method' (1866); Tuke, 'A Dictionary of Psychological Medicine' (1892).

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Idol, in a sense now obsolete, or nearly so, an image (Greek εἴδωλον) or likeness of anything; in later and chiefly present signification, any image or likeness of a deity used or designed as an object of worship. By extension the term has also come to be applied to anything which is an object of adoration or of supreme affection or regard. (See next article.)

Idol'atry, the worship of idols in any sense; in the restricted usage ordinarily observed, it is the worship of the Deity or of a deity under a visible form; and from the point of view of the Christian, or any other religion which rejects the worship of images, consists in worshipping as God what is not god. With regard to the origin and character of idolatry, there is a wide divergence of opinion. The Christian religion conceives idolatry as a declension from the one true God, sees in the various forms of heathen worship only more or less complete degradations of an original revelation, and ascribes to it the same origin as to sin. Some philosophical and historical writers, on the other hand, see in idolatry an innate searching after God, and accordingly the first stage of human development, the necessary beginning of a knowledge of God. Idolatry may assume various forms. One nation seeks its god in the powers of nature, worships the heavenly bodies and the elements, and creates for itself a nature-worship; another develops a hero-worship, and a third has merely an animal and image worship, the lowest form of which is fetishism (q.v.). To this last and rudest form of idolatry, that consisting in animal and image worship, the name of idolatry is sometimes confined. See IMAGE WORSHIP.

Idrisi, ĭd'rē-sē, or **Edrisi, Abu-Abdallah Mohammed,** Arabian geographer: b. about 1100; d. about 1180. He studied at the Moorish University of Cordova, traveled through various countries bordering on the Mediterranean, visited France and England, and was then invited to the court of Roger II. of Sicily, where he resided under the patronage of Roger and his successors till his death. He constructed at the request of Roger a terrestrial globe of silver, on which the figure of the earth was shown with as much accuracy as the state of geographical knowledge then permitted. He accompanied this with a descriptive treatise bearing the title 'Nuzhat Almushtâk,' completed about 1150. An old manuscript of this work was discovered at Paris in 1829, and published in a French translation by Jaubert.

I'dyl, or Idyll (from a Greek diminutive meaning a "little form or image"), the name originally and still most usually applied to a short and highly finished descriptive poem, especially if it treats of pastoral subjects. This last circumstance is not, however, an essential character of the idyl. All that is necessary to constitute a poem of this class is that it presents to view a complete picture in small compass, and accordingly the idyl may refer to a great variety of subjects, and the fact that the subjects of idyls are usually pastoral is due to this, that pastoral life, at once simple and picturesque, affords the best material for such short descriptive poems. The term idyl is sometimes used even more extensively but in a manner so capricious as to be incapable of definition.

Iglesias, José Maria, hō-sā' mä-rē'ä ē-glā'-sē-äs, Mexican historian and publicist: b. City of Mexico, 5 Jan. 1823. He studied law in the University of Mexico, was appointed professor of jurisprudence there, became secretary of justice in 1857, and, after service as head of the treasury department, again held the post in 1853–67. In 1868 he was elected to Congress, in the same year was appointed secretary of the interior, in 1873 chosen president of the supreme court. After the fall of Lerdo de Tejada, he established a government which soon yielded to the superior power of Diaz. His publications include: 'Apuntes para la Historia de la guerra entre Méjico y los Estados Unidos' (1852); and 'Revistas históricas sobre la Intervención Francesca' (1870).

Igloo'lik, Canada, a small island in the Arctic Ocean, near the east end of Fury and

Hecla Strait in lat. 69° 21' N. and lon. 81° 55' W. It is noted as the place where Parry wintered in 1822–3.

Ignacio (ēg-nä'sē-oo) **Islands**, Mexico, a chain of islands in the Gulf of California, off the Bay of Topolobampo, in the State of Sinaloa. The chief are Macapule and Altamura.

Ignatius, ĭg-nā'shĭ-ŭs, **Father.** See Lyne, Joseph Leycester.

Ignatius, Saint, bishop of Antioch, said to have been a disciple of the Apostle John, and on that account reckoned among the number of the apostolic fathers. According to the most trustworthy tradition he was appointed bishop of Antioch 69 A.D., and thrown to wild beasts in the circus of Antioch by the command of Trajan, about the time of that emperor's expedition against the Armenians and Parthians. Another account places his execution at Rome. The year of his death is variously stated: by some 107 A.D. is given as the date, by others placed so late as 116 A.D. By the Greek Church his festival is celebrated on 20 December, by the Latin on 1 February. In the literature of the early Christian church Ignatius holds an important place as the reputed author of a number of epistles. These have come down to us in three forms. In the longest text they are 13 in number, but since the discovery of a shorter text containing only seven (addressed respectively to the Ephesians, Magnesians, Philadelphians, Trallians, Smyrniots, Romans, and to Polycarp), the first has been universally recognized as in great part spurious, some of the letters entirely so, and others containing interpolations. But even in this shorter form the genuineness of the Ignatian epistles has been disputed by numerous scholars. Both of these texts are in Greek, but a still shorter text in the Syriac language, containing only three letters (to the Romans and the Ephesians, and to Polycarp), and even these in a shorter form, was published in 1845 by Cureton. There has been much discussion as to the genuineness of these shorter collections. At present the prevalent belief is that the seven are genuine, and the Syriac an abridgment of them. An edition of the Greek text of the seven epistles was published at Amsterdam by Voss in 1646. An English translation by Archbishop Wake was published in 1693. Lightfoot's edition of the Greek text in his 'Apostolic Fathers, Part II.' (St. Ignatius and St. Polycarp, 1889), supersedes all others, and presents a complete discussion of the subject.

Ignatius of Loyola. See Loyola, Ignatius of.

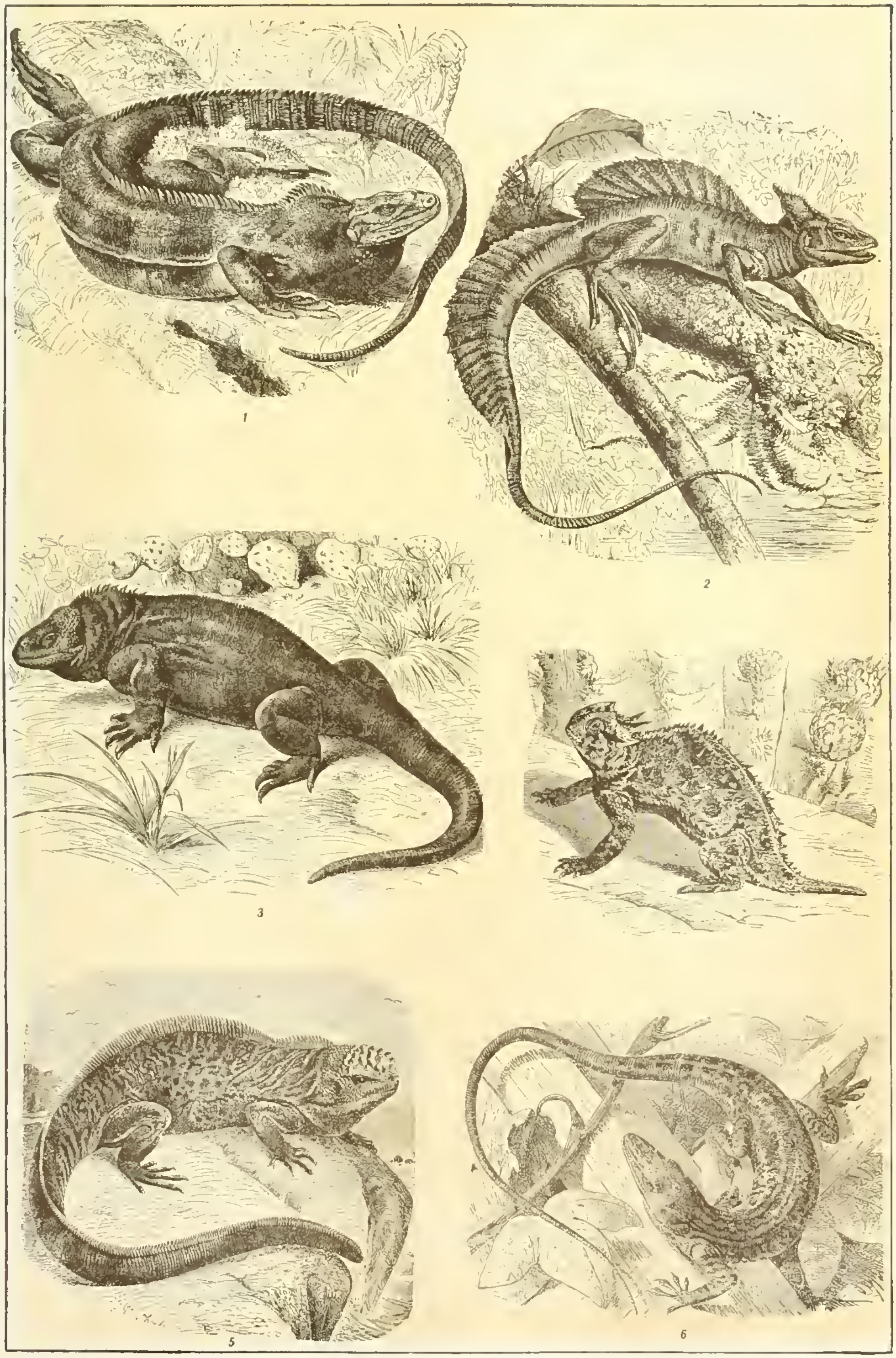
Igneous (ĭg'nē-ŭs) **Rocks,** the term applied in geology to those rocks the special structure of which is due to their having been once in a molten state, from which they were solidified into their present character. They include lava, basalt, granite (qq.v.), etc. Such rocks are not stratified, and may occur in connection with sedimentary rocks of any age, as the igneous rocks have usually been erupted from the heated interior of the earth and forced up toward, sometimes to, the surface. In petrological classification igneous rocks may be grouped under two heads — crystalline and fragmental — although petrography has not yet provided any method of classifying them which can be called complete or systematic. Many of the rocks considered as crystalline are rather to be classed as vitreous or glassy, while some others are partly of non-crystalline materials. Among the crystalline rocks, some of those called orthoclase contain much free silica (see Quartz). Most of the crystalline rocks called plagioclase contain less silica than the last-mentioned and a basalt to which close resemblance is found in nepheline and leucite rocks. Of the other crystalline rocks, the olivine and serpentine are generally rather basic, the former often showing much alteration into the latter. The fragmental igneous rocks consist of loose material which has been ejected from volcanic orifices. These rocks are frequently consolidated and, when fine-grained, it is sometimes difficult without the help of the microscope to distinguish them from compact crystalline igneous rocks.

Ignis Fatuus, ĭg'nĭs făt'ū-ŭs (Latin *ignis*, fire, *fatuus*, foolish), an atmospheric light or a luminous appearance sometimes seen in swamp-lands, in churchyards, and over stagnant waters. The light usually appears shortly after sunset; it is common in the north of Germany, in Italy, in the south and northwest of England, and the west of Scotland, and has been noticed in many other countries in undrained marshy districts.

The appearance generally resembles a flame; seen closely, the color appears as bluish, reddish, greenish, or yellowish, merging into purple, but never a clear white. Sometimes the flame seems fixed in position, shining steadily close to the ground or a few feet above it; again, it appears in rapid motion, sometimes rising high in the air, at others separating into smaller flames, which are seen advancing, retiring, recombining, etc.

Some supposed appearances of the ignis fatuus are probably due to luminous insects, or to the phosphorescence of decaying vegetable matter. By setting all such possible cases aside, both fixed and moving ignes fatui have been proved to exist, although the spectrum of the light seems not to have been fully observed. The common hypothesis that ignis fatuus is the flame of burning marsh-gas, CH_4, is untenable, for although this gas is produced abundantly in many marshy places, it cannot ignite spontaneously. The more plausible suggestion that phosphoretted hydrogen, PH_3, which is spontaneously inflammable, might be produced in churchyards or marshes where there is decaying animal matter does not account for some of the effects observed. The early supposition of a phosphorescent vapor is more reasonable, although excepting that of free phosphorus, which could not occur in nature, no such vapor is known to exist. The phenomenon was undoubtedly more common a century ago than it is now, and its disappearance in many localities may be directly traced to the draining of fens and marshes.

Popular names for the ignis fatuus — Will-o'-the-Wisp, Jack-a-Lantern, Spunkie, etc.— abound in folklore, and the superstitions regarding it are connected with many stories of travelers mistaking the marsh-lights for those of cottage windows, and with tales of evil spirits decoying men into dangerous places, often to their doom.



REPRESENTATIVE IGUANID LIZARDS.

1. Ring-tailed Iguana (Cyclura carinata).
2. Helmeted Basilisk (Basilicus americanus).
4. Horned toad Lizard (Phrynosoma cornutum).
5. Galapagos Sea lizard ([illegible]

Ignorance of the Law. Every person is presumed to know the laws of his own country, and what is termed ignorance of the law is a lack of understanding of those laws. Such want of understanding furnishes no excuse for their violation, and cannot be pleaded even in extenuation of their infraction. But this presumption does not extend to the municipal laws of countries or States other than that in which a person resides. Such laws are regarded as foreign and a knowledge of them on the part of one who disregards them must be established by proof in the same manner as any other facts are proved. This applies only to a non-resident of such foreign state, and as soon as a person becomes even a temporary resident thereof he is presumed to know its laws and to yield obedience to them. He cannot plead his want of opportunity to become acquainted with them.

Igorrote, ē-gôr-rō'tā, a name given to various wild tribes of Luzon, especially to a people of mixed blood and language living mainly in Venguet province. The name is also more loosely applied to other wild Filipinos.

Igor's (ē'gŏrz) **March, Song of,** an antique battle song, associated with the name of Igor, Prince of Novgorod, son of Prince Swajatoslaw II. of Tchernigof. Igor, in his fifty-first year is recorded to have engaged in an unsuccessful war with his neighbors (1202), and from that time has been looked upon as the national poet of old Russia, on account of a lyrical epic poem, or ballad, called in Russian, 'Slavo o Polku Igoreve' ('The Song of Igor's March'). It has come down to modern times, somewhat like the songs of Ossian. The poem was probably produced by one of the followers of Igor, and in 1795 was found by Count Alexis Mussin-Putchkin in a cell of a monastery in Jaroslav. It was discovered among some 14th century MSS., and was first published by the Count at Moscow in 1800. The original was lost in the fire of the Napoleonic campaign (1812), which destroyed the Count's fine library. Another copy with many variants was found in 1864 among the papers of Katharine II. and published at St. Petersburg the same year. It has been translated into several European languages. Consult: Wolfsohn, 'Schönwissenschaftliche Litteratur der Russen' (1843); Wjasemski, 'Bemerkungen zum Igorlied' (1875).

Iguana, ĭ-gwä'nä, a large lizard of the typical genus of the family *Iguanidæ*. This family is distinguished by having pleurodont teeth, a thick, villous, nearly immobile tongue, a round pupil, and by various skeletal characters. The 350 species belong to about 50 genera and, with the exception of a few in the Fiji Islands and Madagascar, are confined to America, in the warm parts of which they fairly swarm. Only one species (*Sceloporus undulatus*) reaches as far north as the Middle States. They vary greatly in appearance and habits; most are arboreal, many terrestrial, and one, the Galapagos *Amblyrhynchus*, is even marine; the majority eat insects, but some are herbivorous. The true iguanas, of which *I. tuberculata* is the best known, are rather widely distributed through the West Indies, Central and South America. Owing to the high crest or fringe which extends along the back and tail, the deep, fringed, gular pouch, and the loose-fitting skin, these animals present a remarkable appearance. The trunk and tail are covered with small granule-like scales, and the head with larger plate-like ones; the feet are large and powerful; the tail very long, slender, and compressed; and the teeth high and finely serrated. A length of five feet or more and a weight of 25 pounds is commonly attained. The iguanas are arboreal, their mottled green color serving admirably to conceal them among the foliage; but when alarmed they have the habit, remarkable in a lizard, of retreating into the water of the streams along which they live. The 20 or 30 large eggs are deposited in a burrow usually dug in the bank of a stream or sometimes in a hollow tree. Notwithstanding its formidable size and aspect, the iguana is a timid, harmless creature, and the stories sometimes told of its ferocity are pure fabrications; moreover it is purely vegetarian in its diet. The flesh is a favorite article of food with the natives, and many travelers have pronounced it to be white, tender, and sweet, and is regularly brought to the markets. Consult Wallace, Müller, Bates, Belt, Gosse, and other authorities on South and Central America. See LIZARD.

Iguan'odon, a dinosaur (q.v.).

Iguvium. See EUGUBINE TABLES.

Ik Marvel. See MITCHELL, D. G.

Ilagan, ē-lä'gän, Philippines, pueblo and capital of the province of Isabela, Luzon, situated on the Grande de Cagayuan River, 84 miles from its mouth at its junction with the Pinacanauan, 275 miles northeast of Manila. It has road and water connections with Bayombong and Manila; it is the trade centre for a large agricultural region, and also the industrial centre of the province. Pop. 13,800.

Iles, George, American author: b. Gibraltar 20 June 1852. He received a secondary education in Montreal, and from 1887 was employed in literary work in New York. His original works include: 'A Class in Geometry-Lessons in Observation and Experiment' (1894), and 'Flame, Electricity, and the Camera' (1900). He also edited: 'The Reader's Guide on Economic, Social and Political Science' (1891; with R. R. Bowker); 'A List of Books for Girls and Women and their Clubs' (1895; with A. H. Leypoldt); and 'A Bibliography of Fine Art' (1897), and gave $10,000 to the American Library Association to defray the cost of 'The Literature of American History' (1902), a bibliographical guide which appeared under the direction of the publishing board of the association.

I'lex, a tree often mentioned in the Latin classics, the evergreen oak or holm-oak (*Quercus ilex*). It is a native of the Mediterranean region, and often attains large dimensions. In general it grows singly or in small groups, and especially near the sea. Its leaves vary much in size, and from being very spiny at the edge to perfect evenness. Where it is indigenous, its astringent bark is used for tanning hides. Its wood is hard, heavy, and durable, and is useful for axles, pulleys, screws, etc. In modern botany Ilex is the generic name of the holly. See AQUIFOLIACEÆ.

Ilfracombe, ĭl'frá-kōm, England, a seaport and fashionable health-resort in North Devon, on the Bristol Channel, 41 miles by rail northwest of Exeter. It has a fine harbor and promenade, and the town built in terraces on a hill, is noted for its picturesque situation and the beauty of the surrounding scenery. Pop. (1901) 8,557.

Ili, il'ē, a river of Central Asia, flowing partly in China and partly in Russia. It is formed in Chinese Kuldja by two streams, the Tekes and Kunges, rising in the Thian-shan Mountains, and flows west, falling into Lake Balkash by several mouths after a course of 800 or 900 miles, half of which is navigable.

Iliad, in Greek literature, a celebrated epic poem, consisting of 24 books. Its composition is generally ascribed to Homer, of whose parentage, birth, and life nothing is known for certain. It is, however, a matter of dispute as to whether the poem is a homogeneous whole, or a series of ballads or rhapsodies on different episodes in the Trojan war, united into a continuous poem. It is further doubtful whether, in the latter case, the union was made by Homer himself, or by some person after his time. It is said that Pisistratus, tyrant of Athens, first collected and arranged the 'Iliad' and 'Odyssey' in the form in which we now have them. The chief subject of the poem is the wrath of Achilles, and the consequent troubles thence arising, whence we have the phrase *Ilias malorum* = an Iliad of woes or troubles, a world of disasters. The reader of the poem is assumed to know that the beautiful Helen has been carried off by Paris from her husband Menelaus. The action of the poem is confined to the 10th and last year of the siege of Troy. See HOMER.

Il'ion, N. Y., village, Herkimer County; on the Mohawk River, the Erie Canal, and on the West Shore and the New York C. & H. R. R.R.'s; about three miles west of Herkimer and 12 miles southeast of Utica. Ilion is in the vicinity of the locations of some of the old "castles" of the Indian tribes who inhabited the Mohawk valley. White people lived here in the early part of the 19th century, but no permanent settlement was made until 1828. It is situated in an agricultural county, but the village is noted for its manufacturing industries. The chief manufactures are typewriters, firearms, sewing-machines, filing-cases, bicycles, knit goods, flour, and some dairy products. Its export trade consists chiefly of the manufactured articles and farm products. It has a public library containing about 11,500 volumes, and a number of fine public buildings. Pop. (1890) 4,057; (1900) 5,138.

Iliniza, or **Ilinisa**, a mountain of Ecuador, [illegible] miles south-southwest of Quito. It is crowned by two peaks, the southernmost, as determined trigonometrically by Reiss and Stübel, being 17,400 feet high. Iliniza is presumably an extinct volcano, but there is no record of an eruption. The upper portion is covered with perpetual snow, and usually cloud-capped.

Ilissus, i-lis'us, a small river in Greece, flowing through Athens, famous in the classical age, but now unimportant and often wholly dry.

Ilithyia, il-ith-i'ya, in Greek mythology, the goddess who assisted women in childbirth. In after times she was almost identified with Artemis.

Ilium, or **Ilion**, a name of Troy, in Greece, which was founded by Ilus.

Iliyats, il'ē-yats, a nomadic Mohammedan race of Persia, Khiva, and Turkestan. The name Iliyat is the plural of *iel* (eel), a tribe equivalent to the Arabic *kabilah*. The Iliyats are mostly of Turkish, Arabic, and Kurdish descent, and form an important portion of the population of Persia and adjacent countries; their actual numbers are not known, but it is said that the Iliyat tribes tributary to Khiva number 195,000. They live in tents and have no settled habitations. They are of the Sunni sect, but are not very strict. The women are said to be chaste, and many of the best families in Persia are of Iliyat origin.

Illampu, or **Sorata**, a mountain of Bolivia, in the eastern Cordillera, overlooking Lake Titicaca; 50 miles north-northwest of La Paz. It is 21,484 feet in height, and is believed to be the highest mountain of the Bolivian Andes, though this distinction is also claimed for Illimani (q.v.); it is probably exceeded by the Cerro de Huascan in Peru and by Aconcagua in Chili. Illampu is a magnificent mass, with three principal peaks. Seen from Titicaca it is the grandest mountain in America. It has never been scaled.

Ille-et-Vilaine, ē-lā-vē-lān', France, a maritime department, formed out of the northeast portion of the old province of Brittany; area, 2,596 square miles; pop. 622,039, mostly of Celtic race. It is watered chiefly by the Vilaine and its tributary, the Ille, which unite near Rennes, the capital of the department. Ille-et-Vilaine consists of a granite plateau traversed by ranges of low hills. It is agricultural, cultivation having been greatly improved during recent years. The cider of this district is the best in France; the butter of Rennes is celebrated; the horses of the department are noted for their endurance, and are in great request for the army; and bee keeping is prosecuted. Iron is mined; slates are quarried; and salt is extracted. Saint Malo is the principal seaport.

Illegit'imacy, the legal status of children born out of wedlock, is a subject discussed under three points of view, moral, legal, and economic. As to what constitutes illegitimacy, is variously defined in different countries where great variety exists both in theory and practice. As to the legal status of illegitimate children from the moral point of view, see BASTARD.

Only in a few European countries are statistics available to show the extent of illegitimacy, and there are no statistics in Canada. In the United States there seems no efficient national system of registration of marriages and births. Some of the individual States record the illegitimate births, but the figures are misleading, because incomplete. Thus, the State of Indiana a few years ago, returned 38,370 legitimate and 560 illegitimate births — the illegitimate being only about 1.46 of the whole.

In the following table is shown the comparative prevalence of illegitimacy in the principal European cities:

ILLEGITIMATE BIRTHS TO EVERY 1,000 BORN.

Vienna	449	Leipzic	211	Ghent	144
Prague	439	Dresden	208	Hamburg	138
Munich	439	Milan	204	Frankfort	132
Stockholm	396	Rome	194	Turin	132
Moscow	300	Venice	189	Antwerp	129
Budapest	299	Breslau	186	Cologne	124
Copenhagen	279	Bucharest	175	Palermo	101
Paris	268	Liège	174	The Hague	99
St. Petersb'g	236	Christiania	162	Naples	86
Trieste	211	Berlin	154	Rotterdam	70

None of the above figures are presented as absolutely accurate. They can only be approximate in the best case, for in every country there must always be a large number of bastards who either are not registered at all, or who are registered as legitimate. But as far as they go the figures are instructive. They do not, however, enable one to form any conclusion as to the causes of illegitimacy in respect either of religion, of education, of industrial occupation, or of distribution of population. Neither can any theory be well evolved from a racial basis.

From the only available statistics the following table has been prepared showing illegitimacy in various countries, from 1881 to 1900:

	Per cent of illegitimates to total births.		Per cent of illegitimates to total births.
England and Wales	4.6	Portugal	14.00
Scotland	8.34	Roumania	5.00
Ireland	2.9	Russia	3.00
Austria (average)	14.89	Spain	5.40
Lower Austria	26.00	Sweden	14.88
Upper Austria	20.00	Norway	7.90
Dalmatia	3.50	Switzerland	4.80
Hungary	8.00	Brazil	25.00
Belgium	9.30	Canada	....
Denmark	10.00	Costa Rica	24.00
France	8.20	Guatemala—Whites	50.00
Germany (average)	9.47	Indians	25.00
Upper Bavaria	15.67	New South Wales	4.65
Prussia	8.24	Victoria	4.78
Alsace-Lorraine	8.10	Queensland	3.97
Greece	1.60	West Australia	3.95
Holland	3.22	Tasmania	3.40
Italy	7.45	New Zealand	3.12

In Scotland, where education is general, and thrift national, the rate of illegitimacy is notoriously high. And, as regards morals, it should be remembered that a high percentage of illegitimacy may mean that there is little or no prostitution. In Europe, generally, although not universally, there seems a tendency to decrease in the rate of illegitimacy; but how far that appearance may be due to moral causes it is impossible to say.

Illimani, ēl-yē-mä'nē, Bolivia, a volcanic mountain mass of the East Andean Cordillera, about 20 miles south of La Paz. It is a serrated ridge with four principal peaks, the loftiest of which, Condor Blanco, is 21,149 feet above sea-level. Illimani signifies "snow-mountain"; the line of perpetual snow commences at 15,000 feet, and there are glaciers on the north side at an elevation of 16,350 feet. At an altitude of 15,950 feet there is a considerable lake also bearing the name of Illimani. Among the first Europeans to make the ascent of the highest peaks are Wiener, Grumbhow, and Ocampo in 1877 and Sir Martin Conway in 1898.

Illinois, ĭl-lĭ-noi' or -noiz', the name given to a confederacy composed of five distinct Indian tribes, who at one time occupied what is now the State of Illinois and parts of Wisconsin, Missouri, and Iowa. The tribes were the Michegamia, Peoria, Cahokia, Kaskaskia, and Tamaroa. The confederacy was most powerful and many attempts were made to secure by war the lands of the Iroquois. In 1675 Marquette visited the Illinois tribes and established missions among them. In 1769 a member of the Kaskaskia tribe murdered Pontiac, the Indian chief, for which offense the Lake tribes destroyed the Kaskaskia and killed many of the members of the other tribes of the confederacy. In 1840 the remnant of the Illinois tribes was removed, by the government, west of the Mississippi. The few now in existence are in the Indian Territory.

Illinois, the eighth State admitted into the Federal union, and since 1890, the third in population. It is bounded upon the north by Wisconsin, upon the east by Indiana, upon the south by Kentucky, and upon the west by Iowa and Missouri. It is separated from the two last named States by the Mississippi River; by the Wabash and the Ohio from Indiana; and by the Ohio from Kentucky. Its water courses flow generally from the north and northeast, to the southwest and south. Its soil consists of a rich black loam, or mold, underlaid by drift deposits in many places of great depth.

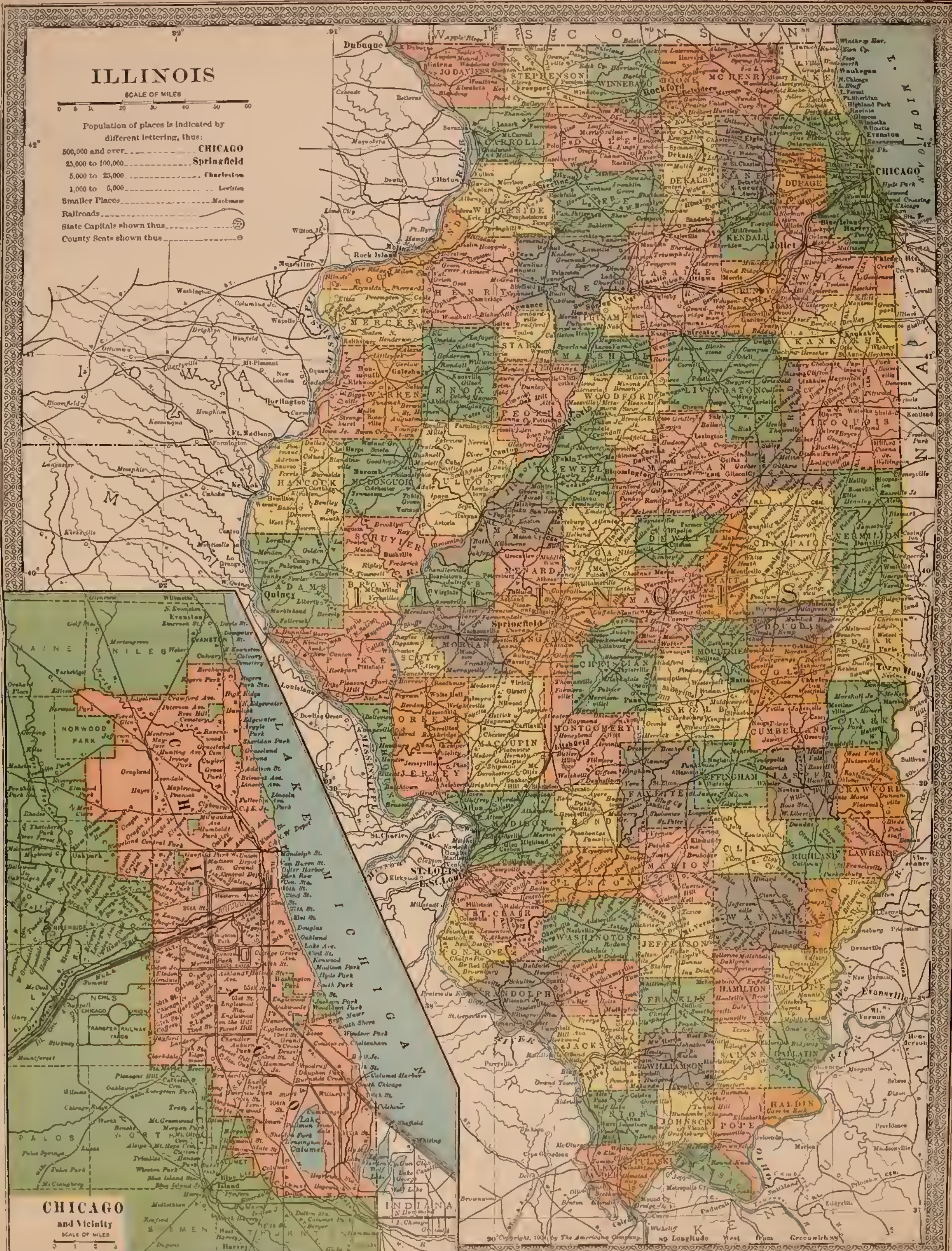
Topography.— By the enabling Act of Congress by virtue of which the State was organized, its boundaries were fixed as follows: "Beginning at the mouth of the Wabash River, thence up the same, and with the line of Indiana, to the northwestern corner of said State; thence east with the line of the same State to the middle of Lake Michigan; thence north along the middle of the lake to north latitude 42° and 30'; thence west to the middle of the Mississippi River, and thence down along the middle of that river to its confluence with the Ohio River, and thence up this latter river along its northwestern shore to the beginning" The total land area of the State is 56,000 square miles — 35,840,000 acres; its extreme length 385 miles, and extreme breadth 218 miles. With the exception of Georgia its area is greater than that of any one of the original States of the Union. It comprises a territory larger than England; larger than Belgium, Switzerland and Holland united. Illinois is no longer in the class of States denoted "western" upon the old maps, but is now chief of the great interior States of the Union. With two exceptions — Louisiana and Delaware — it is the most level of the States. Its greatest elevation is 1,150 feet above the sea, and its mean elevation 550 feet. The greater part of Illinois consists of level or slightly undulating prairies; a portion of the extreme northwestern part of the State is hilly, and there are occasional bluffs upon the Illinois and Mississippi rivers. The counties lying between East St. Louis and the Wabash River are the great apple growing region, and thence southward to its border other fruits are grown in large quantities. Of its total population in the year 1900, 2,459,638, or 51 per cent reside in its seventy principal cities and towns.

Population.— In 1810, one year after its organization as a territory, the population of Illinois was 12,282; in 1820, two years after its admission its population was 55,211, and in rank it was the 24th State in the Union; in 1830, population 157,445 and its rank the 20th; in 1840 population 476,183, and rank the 14th; in 1850 population 851,470, and rank the 11th; in 1860, population 1,711,951, and rank the fourth; in 1870 population 2,539,891, and rank the fourth; in 1880 population 3,077,871, and rank the fourth; in 1890 population 3,826,351, and rank the third; in 1900 population 4,821,550, and its rank still remains the third. Of the aggregate population given for the year 1900, 85,078 are negroes, 1,538 Mongolian, and 16 Indian; 3,854,803 of the population of the State are natives, and 966,747, foreign born. The excess of the male over the female population of the State as shown by the last census is 124,014. The population above the age of 10 years is, 3,727,745; of this number 1,804,040 are engaged in gainful occupations; 462,781 in agricultural pursuits; 96,321 in rendering professional service; 366,342 in domestic or personal service; 397,046 in trade or transportation; and 481,550 in manufacturing or mechanical pursuits. The total number of dwellings in the State is 845,836, and of families 1,036,158.

Cities.— The following cities of the State have each a population exceeding 10,000, viz.: Chicago, 1,698,575 (as shown by census of 1900, now exceeding 2,000,000 as appearing by local census reports of later date); East St. Louis, 29,655; Joliet, 29,353; Peoria, 56,100; Quincy, 36,252; Rockford, 31,051; Springfield, 34,159; Alton, 14,210; Aurora, 24,147; Belleville, 17,489; Bloomington, 23,286; Cairo, 12,566; Danville, 16,354; Decatur, 20,754; Elgin, 22,433; Evanston, 19,259; Freeport, 13,258; Galesburg, 18,607; Jacksonville, 15,078; Kankakee, 13,595; La Salle, 10,446; Moline, 17,248; Ottawa, 10,588; Rock Island, 19,493; Streator, 14,079. Fifty-seven other cities in the State have a population each, exceeding 3,000. The land surface in square miles of the largest county in the State, McLean, is 1,166; while that of the smallest, Putnam, is 176.

Manufactures.— The development of manufacturing in the State is unprecedented. This is due in large measure to its transportation facilities. There were 10,997 miles of railroad in the State in the year 1900, a mileage greater than that of any other State. Illinois now ranks third in the value of its manufactured products — the gross value thereof for the last mentioned year being $1,259,730,168. The greatest number of wage earners employed in manufacturing establishments at any one time in the year 1900, was 528,099, or 11 per cent of the total population of the State. As tersely stated in the last census report: "The communication with the East afforded by Lake Michigan and its connecting waters early made Chicago the great distributing centre for eastern products to all points in the West and Southwest, while the Mississippi River bordering the western portion of the State afforded communication with the entire Mississippi Valley. Superior railroad facilities were a direct result of the trade routes established by these operations for water transportation; for when railroad building began Chicago was the natural focusing point, and to reach that city all sections of the State were traversed and opened up to settlement." It holds the first place in the States of the Union in the manufacture of agricultural implements; its proportion of the entire capital invested in this industry in the United States being 39 per cent. It leads in the production of alcoholic liquors; the output in 1900 was 32,508,435 gallons. This industry is concentrated in a few large establishments located principally in the city of Peoria. An important factor to be considered in this connection, is the abundant supply of bituminous coal in many parts of the State. In 1900, the 24 leading industries of the State embraced 8,209 establishments; capital used $477,485,672; wage earners employed, 219,415; value of their products for the year mentioned was $810,636,482.

Agriculture.— Illinois takes high rank as an agricultural State; 32,794,728 acres — or something over 91 per cent of its total land area — are included in farms. The total number of farms in the State as shown by the last official report is, 264,151; the estimated value being $1,765,581,550; of this amount 14 per cent represents the value of buildings, and 8.6 per cent the value of the land, and other improvements; the value of farm implements and machinery in June 1900 was $44,977,310, and of live stock $193,758,037. The total value of farm products for 1899 exceeds that of the year '89 by $160,890,598. The average size of farms for the State is 124 acres. The larger farms are generally in the north and the smaller in the extreme southern portion of the State. The value of all live stock on farms in June 1900 was $193,758,037; of this amount 36 per cent represents the value of horses; 24 per cent that of neat cattle other than dairy cows; 17 per cent that of dairy cows, and 12 per cent that of swine. Twenty-eight counties each reported more than $1,000,000 received from the sale of live animals for the year last named. Of the total area of cereals in the year 1899, 61 per cent was devoted to corn, 27 to oats, 10 to wheat, and the residue principally to rye, barley and buckwheat. Some idea of the enormous yield of what is known as "the corn belt" can be gleaned from the following: for the year 1899 the corn product of the county of Iroquois exceeded 12,000,000 bushels; that of the counties of La Salle and Livingston, each exceeded 13,000,000, while the counties of Champaign and McLean each produced over 15,000,000 bushels. Twenty-seven other counties produced from 5,000,000 to 10,000,000 bushels of corn each. In the decade 1890 to 1900 the apple trees in the State increased 100 per cent in number, and of some other varieties of fruit the increase was even greater. Of the total number of fruit bearing trees in the State in 1900, 74 per cent were apple, 13 per cent peach, and 5 per cent pear trees. Apples were grown generally throughout the State, but the four counties of Clay, Jefferson, Marion, and Wayne produced one fifth of the entire amount. The entire vegetable product for the year 1899 exceeded $10,000,000 in value; of this amount 45 per cent represents the value of potatoes. The small


ILLINOIS
SCALE OF MILES
Population of places is indicated by different lettering, thus:
500,000 and over ... CHICAGO
25,000 to 100,000 ... Springfield
5,000 to 25,000 ... Charleston
1,000 to 5,000 ... Lewiston
Smaller Places ... Mackinaw
Railroads
State Capitals shown thus
County Seats shown thus
WISCONSIN
IOWA
INDIANA
KENTUCKY
LAKE MICHIGAN
CHICAGO
Springfield
CHICAGO
and Vicinity
SCALE OF MILES

fruits were grown upon 56,763 farms. Of late years there has been a steady decrease in tobacco production; in the year 1899 the total in tobacco being 2,242 acres; the total value of the production being $85,411; Saline County in the extreme southern part of the State taking the lead and producing near one third of the entire amount. During the last decade the broom corn product of the State has increased almost four fold; the total value of this product for the year 1899 was $2,357,066; five sixths of the amount produced was in the east central part of the State in the five counties of Coles, Douglas, Moultrie, Edgar, and Cumberland. Sugar beets were grown in 15 counties in the year 1899, 1,370 acres being devoted to this production, and the value of the total product being $36,223. The value of nursery stock sold in the last named year was $578,306; area in cultivation 7,760 acres, its valuation $1,442,220. The area devoted to the cultivation of ornamental plants and flowers for the year 1899 was 679 acres; the value of the product $1,894,960. The total expenditure for labor on farms in Illinois for the year 1899 was $22,182,550; this included the value of board furnished and averaged $84 per farm. The gross value of the agricultural products of the State for 1900 was $345,649,611 — placing it second in rank.

Rivers.— The Illinois, the principal river of the State is formed by the junction in Grundy County, 40 miles southwest of Chicago, of the Kankakee and Des Plaines. The last named river takes its rise in Wisconsin and flows in a southerly direction, while the head waters of the Kankakee are in northern Indiana. The Illinois empties into the Mississippi after a somewhat tortuous flow of near 500 miles, at a point 40 miles above the city of St. Louis. The Illinois is navigable for 245 miles, and is connected by the Illinois and Michigan canal with Lake Michigan. Other rivers in the State are the Kaskaskia, which flowing in a southwesterly direction empties into the Mississippi near the ancient village of Kaskaskia, the first capital of the State; Rock River, which flowing in a southwesterly direction from Wisconsin empties into the Mississippi not far from the city of Rock Island; of other smaller streams, are the Little Wabash and the Embarras, which flow into the Wabash in the southeastern part of the State, and the Vermilion and the Fox, tributaries of the Illinois.

Education.— Illinois has an excellent public school system. The number of persons in the State between the ages of 6 and 21 years 30 June 1902, was 1,601,175; of these, 811,724 were males, and 789,451 females. The number of persons enrolled in the schools during the year ending as above was 971,841; of these, 489,109 were males, and 482,732 females. The average daily attendance was 765,057. The number of school houses 12,865. The estimated value of the school properties is $52,764,922; this includes buildings, grounds, libraries and apparatus. The number of male teachers employed in the common schools in 1902 was 6,800; of female teachers 20,386; total 27,186. The amount expended for the years 1901–2 for the salaries of teachers and superintendents was $12,132,075. The Normal Universities of the State, five in number, are located as follows: the State Normal University at Normal; the Southern Illinois State University at Carbondale; the Northern Illinois Normal School at De Kalb; the Eastern Illinois Normal School at Charleston, and the Western Illinois Normal School at Macomb. These universities are appropriately located for the convenience of their patrons, and the attendance is large. The first to be organized was the State University at Normal, and the total number of students in attendance there for the years 1901–2 was 1,529. In addition to the above is the Chicago Normal School, which has since 1896 been maintained by appropriations made by the Chicago Board of Education. In large measure the teachers in the public schools of the State have received their training in some one of these Normal Schools. The purpose of the Normal Schools of the State will appear from the following clause in the organic act of one of the last to be organized: "The object of the said Northern Illinois State Normal School shall be to qualify teachers for the common schools of this State by imparting instruction in the art of teaching in all branches of study which pertain to a common school education, in the elements of the natural and of the physical sciences, in the fundamental laws of the United States and of the State of Illinois, in regard to the rights and duties of citizens." The University of Illinois (q.v.) is located at Urbana, and has in its various departments a total of near 3,000 students.

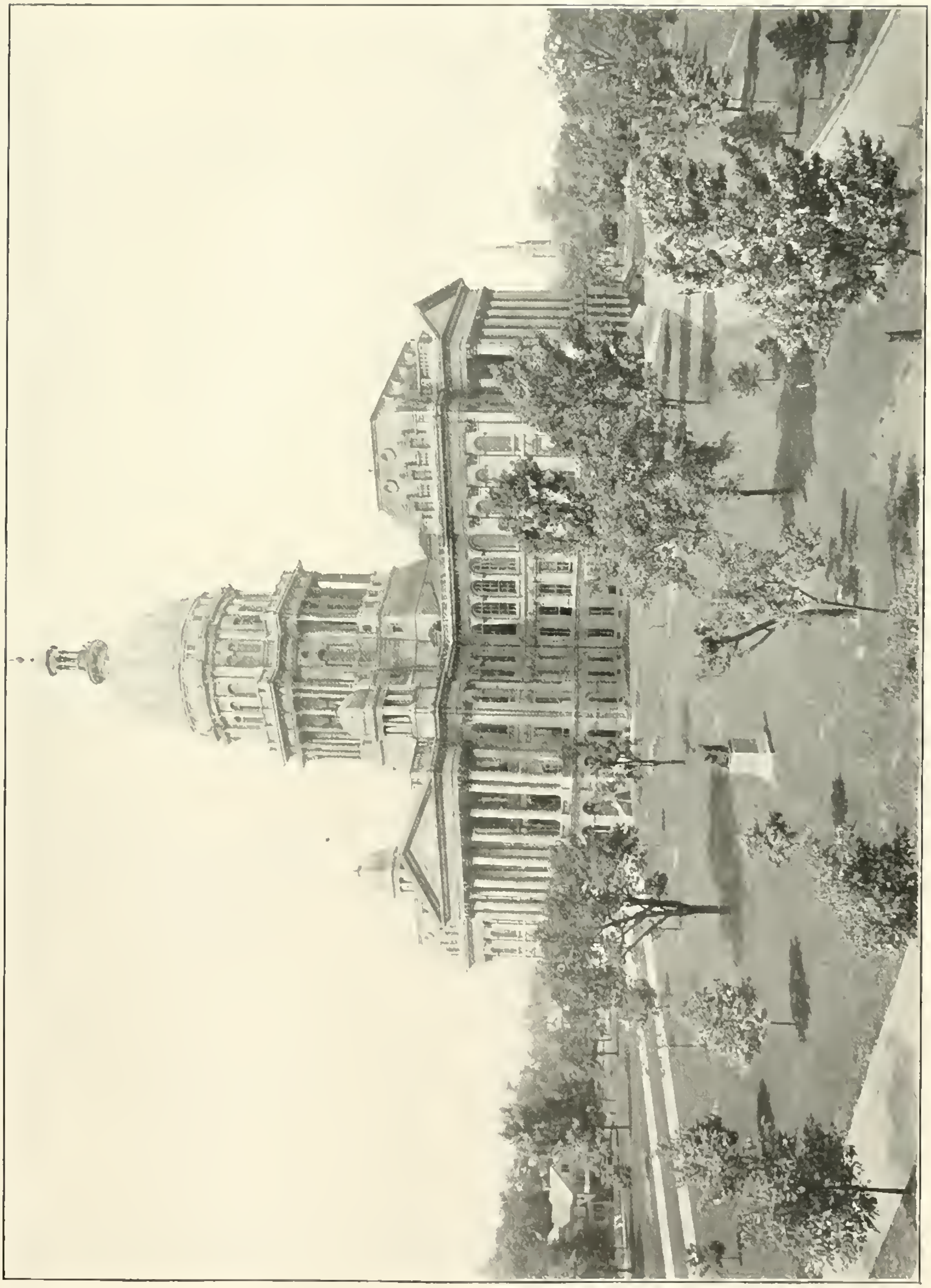
Charities.— The State charitable institutions, 16 in number, are as follows: Northern Hospital for the Insane at Elgin; Eastern Insane at Kankakee; Central Insane at Jacksonville; Southern Insane at Anna; Western Insane at Watertown; Incurable Insane at Bartonville; Criminal Insane at Chester; Deaf and Dumb at Jacksonville; Blind at Jacksonville; Feeble Minded at Lincoln; Soldiers and Sailors at Quincy; Soldiers Orphans' Home at Normal; Soldiers Widows at Wilmington; Eye and Ear at Chicago; Girls Training School at Geneva; Boys Home at St. Charles. The sums appropriated by the General Assembly for the two years ending 30 June 1903 for these institutions aggregated $4,438,024.92.

Penal Institutions.— The Illinois State Reformatory is located at Pontiac, has excellent buildings and appointments for the care of its inmates. The total number of inmates confined in this institution during the 21 months ending 30 June 1902 was 2,352, of whom one fifth had reached the age of 19 years. Under the law no one could be admitted who had reached the age of 21 at the time of the commission of the offense for which he was sentenced. Trade schools, and a farm are provided for in the act creating this institution, and every effort practicable made to reform its inmates. The total amount appropriated by the General Assembly for the support of this institution for the two years beginning 1 July 1901 was $400,000. The State penitentiaries, two in number, are located as follows: The Illinois State penitentiary at Joliet and the Southern Illinois penitentiary at Chester. The number of inmates in the former is about 1,300; and in the latter about 900.

History.— The name of the State is derived from "Illini," an Indian word signifying "men." The euphonic termination added by the early French explorers gives the name "Illinois." The veritable history of Illinois begins with the coming of the French explorers Marquette and Joliet.

Their names are inseparably interwoven with the early history of the great Mississippi Valley. In June 1673 they landed upon the east bank of the Mississippi upon the soil of what is now Illinois. Their first visit was to one of the villages of the "Illini," the ancient and once powerful tribe from which the State takes its name. It is said that upon the first appearance of Marquette and Joliet at the door of the principal wigwam of the village they were greeted by an aged chieftain with the words: "The sun is beautiful Frenchmen when thou cometh to visit us; thou shall enter in peace into all our cabins."

Upon this historic expedition Marquette and Joliet bore the commission of the French Commandant at Quebec — the seat of authority of France in the New World. The narrative of the adventures and discoveries of Marquette and Joliet savors rather of the romantic than of the real. But it was theirs to add the vast domain under the name "New France" to the empire of the Grand Monarch. After descending the Mississippi to a point possibly within 400 miles of the Gulf, these bold voyagers reluctantly turned their faces to the northward. After his separation from Joliet, Marquette visited the Indian villages near the Mississippi and established a mission of his church at the ancient village of the Kaskaskias. He died upon the banks of a small stream within the present limits of the State of Michigan and was buried at Saint Ignace in that State. The city of Joliet in northern Illinois, was named in honor of his daring fellow-voyager, while his own statue has been given place in the great historic hall in the Capitol at Washington. The names of Hennepin and La Salle likewise are associated with these events and times. The first was the scholarly historian and priest, the latter the knightly adventurer. Much, indeed, that is romantic surrounds the entire career of La Salle (q.v). Severing his connection with a theological school in France, his fortunes were early cast in the New World. From Quebec, the ancient French capital of this continent, he projected an expedition which was to add empire to his own country and to cast a glamor about his own name. It has been said, that his dream was of a western waterway to the Pacific Ocean. In 1669 with an outfit that had cost him his entire fortune, with a small party, he ascended in canoes, the Saint Lawrence, and a few weeks later was upon the broad Ontario. Out of the mists that envelop much of his subsequent career, it is impossible, at all times, to gather that which is authentic. It is enough, that with Hennepin as one of his fellow-voyagers, he reached the Ohio and in due time navigated the Illinois, meantime visiting many of the ancient villages. But his great achievement — and that with which abides his imperishable fame — was his perilous descent of the Mississippi from the falls of St. Anthony to the Gulf of Mexico. On 9 April 1682 upon the east bank of the lower Mississippi, with due form and ceremony, and amid the solemn chanting of the Te deum and the plaudits of his comrades, La Salle took formal possession of "the Louisiana country," in the name of his royal master, Louis XIV. of France. For the period of 92 years, beginning with the coming of Marquette and Joliet, Illinois was a part of the French possessions. Sovereignty over the vast domain of which it was a part, was exercised by the French king, by his commandant and his subordinate officers. First, the dependency of Canada, "the Illinois country," by decree of the Royal Council in 1717 passed under the government established for Louisiana. Subsequently in 1721 it became, by virtue of the same authority, one of the separate provinces into which the Louisiana country was then partitioned. A commandant and judge were duly appointed, and the seat of authority transferred to Fort Chartres. Population meanwhile gradually increased in the great American bottom, then embracing the French settlements in Illinois. Cahokia and the other villages were, in a measure, prosperous. In the words of one of our own historians: "The early history of the French settlements reads in these days of a higher civilization and broader culture, like a romance of Arcadia. The wants of the people were few and simple. In each hamlet was a rude chapel, with its attendant priest, who was not only in matters of religion, but in all the affairs of everyday life, 'the guide, philosopher, and friend, of his rude parishioners.'" The same writer referring to this period of foreign domination, truly said: "The French sought and claimed more than they had the ability to hold or possess. Their line of domain extended from the Saint Lawrence around the Great Lakes and through the valley of the Mississippi to the Gulf of Mexico, a distance of over 3,000 miles." Truly a magnificent domain, but one destined soon to pass forever from the possession of the French monarch and his line. Upon the North American continent, the ancient struggle for supremacy between France and her traditional enemy was to find bloody arbitrament. Great Britain claimed as a part of her colonial possessions in the New World, the territory bordering upon the Great Lakes and the rich lands of the Ohio and the Mississippi Valley. As to the merits of the French and English contention as to superior right by discovery, or conquest, it were idle now to argue. Our concern is with the marvelous results of the long continued struggle which for all time determined the question of race supremacy upon this continent. Passing rapidly the minor incidents of the varying fortunes of the stupendous struggle which had been transferred for the time from the Old World to the New, we reach the hour which was to mark an epoch in history. The time, 13 Sept. 1759 — the place, the Heights of Abraham at Quebec. Here and then, was fought out one of the pivotal battles of the ages. It was the closing act in a great drama. The question to be determined: whether the English speaking race, or their hereditary foe, was to be master of the continent. It was literally a struggle for empire — the magnificent domain stretching from the Saint Lawrence to the Gulf of Mexico. The incidents of the battle need not be told. Never were English or French soldiery led by more knightly captains. The passing years have not dispelled the romance or dimmed the glory that gathered about the names of Wolfe and of Montcalm. Dying at the self-same moment — one amid the victors, the other amid the vanquished — their names live together in history. By the treaty of Paris which followed, France surrendered to her successful rival, all claim to the domain east of the Mississippi River. In accordance with the terms of the treaty, Gage, the commander of the British forces in America,



STATE CAPITOL AT SPRINGFIELD.

took formal possession of the recently conquered territory. Proclamation of this fact was made to the inhabitants of the Illinois country in 1764 and a garrison soon thereafter established at Kaskaskia. Here the rule of the British was, for the time, undisputed. British domination in the Mississippi Valley was, however, to be of short duration. Soon the events were hastening, the forces gathering, which were in turn to wrest from the English crown no small part of the splendid domain won by Wolfe's brilliant victory at Quebec. An event of transcendent interest and one of great consequence is now reached. While our Revolutionary War was in progress, General George Rogers Clark planned an expedition whose successful termination has given his name to the list of great conquerors. Partly to mete out punishment to the savage bands whose depredations upon the sparse white settlements in Kentucky were unrestrained by the British commander at Kaskaskia, and partly for the purpose of reducing to possession territory claimed by an ancient charter of the colony of Virginia — the famous expedition was undertaken. Bearing the commission of Patrick Henry, governor of Virginia, with 200 followers equally brave as himself, the heroic Clark crossed the Ohio River and began his perilous march. After enduring great hardships, the undaunted leader and his little band reached Kaskaskia. The British commander and his garrison were surprised and quickly captured. This was on 4 July 1778, 15 years after the Treaty of Paris. The British flag was lowered — and the Illinois country taken possession of in the name of the commonwealth whose governor had authorized the expedition. Thus on the anniversary of our historic day, the symbol of British authority disappeared forever from the Illinois country. In the month of October following the capture of Kaskaskia, the House of Delegates of Virginia extended civil jurisdiction over what had previously been known as the Illinois Country. A law was enacted creating "the county of Illinois," and a commandant was appointed by Patrick Henry, who has, by one of our historians been called "Ex-officio the first Governor of Illinois." Courts were established at Cahokia and Kaskaskia and an election held for civil officers. This was the first election held in Illinois. The history of the next few years is enveloped in much obscurity. Evidently there was but little progress until the close of the Revolutionary War and the ratification of the treaty of peace between the colonies and Great Britain in 1783. The event now to be mentioned, was one of deep consequence and has been called the genesis of Illinois history — the cession by Virginia of the vast territory of which Illinois was a part, to the general government. The claim of Virginia to the vast area mentioned was controverted by some of the other colonies. In fact, this claim was for a time an obstacle to the ratification of the Articles of Confederation. Pending the ratification, the Continental Congress resolved: "That it be earnestly recommended to those States who have claims to the Western country, to pass such laws as may remove the only obstacle to the final ratification of the Articles of Confederation." This important resolution was, a few days later, supplemented by one declaring, "that the lands ceded to the United States pursuant to the above recommendation, shall be disposed of for the common benefit of the United States, and shall be formed into distinct republican States, which shall become members of the Federal Union, and have the same rights of sovereignty, freedom, and independence, as the other States." In response to the above, the House of Delegates of Virginia in January 1781, proposed to cede to the general government the lands mentioned upon the conditions named. After much discussion and delay the proposition of Virginia was accepted by the Congress and in time a deed of cession was duly executed. To this famous instrument — by virtue of which Illinois became a part of the United States — are attached as commissioners upon the part of Virginia, the historic names of Thomas Jefferson, Arthur Lee, and James Monroe. In the manner indicated, the territory out of which Illinois has since been carved became part and parcel of the Federal Union. The daring and successful expedition of George Rogers Clark and the subsequent act of Virginia, form a bright page in our history. As has been truly said "The timely campaign of Colonel Clark was the outgrowth of Virginia foresight, enterprise, and valor. But for this conquest, the Northwest, at the close of the Revolution, would have been in possession of the British and would have doubtless so remained as did Canada; and the western line of the United States would have been the ridge of the Alleghanies and the Ohio River, instead of the channel of the Mississippi.

Another milestone is now reached on the pathway of "the Illinois country," to the dignity and sovereignty of statehood; reference is had to what is well-known in our political history as the Ordinance of 1787. Not inaptly has it been called "the second Magna Charta." On the historic day, 1 March 1784 that Virginia ceded to the United States the domain stretching from the Mississippi to the Ohio, Mr. Jefferson proposed to the Continental Congress a plan for its government. His far-seeing statesmanship is unmistakably evidenced by two provisions in the plan he formulated. One, that slavery should not exist in the territory after the year 1800; the other, that the States to be carved from the territory were to remain forever members of the American Union. This plan failed to receive the sanction of that Congress — and in later days and by other hands, the great ordinance was destined to come into being. Antedating the Federal Constitution, the ordinance for the government for the Northwestern Territory was enacted 13 July 1787. As this was indeed the genesis of Illinois history under the Federal government, it may be well to note briefly some of the provisions of the great ordinance. By its terms, a government was established for the territory and a governor, secretary and judges duly appointed, with power to adopt such laws of the original States as were most convenient; a Legislature was authorized when the territory should have five thousand free male inhabitants; religious freedom and civil rights — not to depend upon religious belief — were guaranteed; likewise the writ of habeas corpus and trial by jury, and judicial procedure according to the common law; private property to be taken for public use only after just compensation; and provision to be made for the encouragement of education. Two of the provisions of the famous ordinance possessed a value that cannot be measured by words. One, the States to be formed from said territory, were to remain forever a part of the United States of America; the other, that neither slavery nor involuntary servitude should exist in the territory, otherwise than for crime whereof the party should have been duly convicted. The value of the great ordinance to that generation and to the millions who have since found homes within the limits of the vast area embraced within its provisions, cannot be overstated. In pursuance of the recommendation of Mr. Hamilton, Secretary of the Treasury, a General Land Office was established for the new territory and a surveyor-general, registers, and receivers duly appointed, and provision made for the sale of the public lands to actual settlers, in small holdings, and at nominal prices. The commission of General Arthur Saint Clair, the first governor of the Northwest Territory, bears date 1 Feb. 1788, and soon thereafter judges and other officers were appointed, and the new government duly organized. The first visit of Governor Saint Clair to Kaskaskia was in 1790, the county bearing his name meanwhile having been established. Five years later out of its territory, the county of Randolph was created and Kaskaskia established as its county-seat; Cahokia being that of the county of Saint Clair. Thus was the beginning of the historic counties — out of which so many have since been carved — and whose history is, in so large a degree, that of the two first decades of Illinois. Pursuant to the provision of the ordinance of 1787, the Northwest Territory having attained the requisite population, a General Assembly was convened in Cincinnati in February 1799. Illinois was now, for the first time, represented in a legislative chamber. In May 1800 the Congress of the United States provided by law for the division of the Northwest Territory, and the creation of a political division to be known as the "Indiana Territory." The new territory embraced the present States of Indiana and Illinois, and the seat of government was established at Vincennes. The first governor was General William Henry Harrison, at a later day the President of the United States. Of his wise and efficient administration of the affairs of the territory, too much cannot be said. By judicious treaties with the Indian tribes, peace was maintained and cession obtained of valuable grants which in time became the homes of the white emigrants. It is an interesting fact, that the fierce hatred of the great Shawnee chief, Tecumseh, to the whites, was at a later day, in a measure, the result of the grants already mentioned. His own tribe allied with the Pottawattomies and the Kickapoos failed to exterminate — as was the intention of Tecumseh — the white settlers, and ended in his own disastrous defeat at Tippecanoe in 1811, by which the power of these tribes was forever broken. Events were now leading up to the separation of Illinois from Indiana and its own organization as a territory. From the time of the presentation of the first petition to that end in 1806, the legislative chamber at Vincennes and the entire territory in fact, was the theatre of exciting controversy. Its culmination, however, was in February 1809, when by Act of Congress, "the territory of Illinois" was duly organized. The seat of government was established at Kaskaskia — and henceforth Illinois has a history, separate and apart. A wave of emigration from the older States had now reached the new territory, and additional counties were organized by the Territorial Assembly. The people were, in a measure, prosperous, and the question of statehood soon became the theme of earnest discussion. By the year 1818 the population of the Territory was near 40,000 and the General Assembly in January of that year forwarded a petition to Congress, praying the necessary legislation preparatory to its admission to the Union. The people were, indeed, fortunate in having as their Territorial delegate, Nathaniel Pope, eminent at a later day, as a United States judge. The bill providing for the legislation indicated, was introduced into Congress in April 1818. The valuable service rendered by Judge Pope to the future State, will now appear. The bill as reported back to the House of Representatives, by the committee to which it had been referred, fixed the northern boundary of the new State on the north parallel of 41°, 39′. Pending the consideration of the bill, Judge Pope offered an amendment to that part fixing the boundary, containing the significant words: Thence north along the middle of Lake Michigan to north latitude 42° and 30′. This amendment was adopted and became part of the bill. Thus amended, the bill became a law, under it a convention was held at Kaskaskia, a constitution framed, and in December 1818, Illinois was duly admitted as a State of the Federal Union.

During the first decade which followed the organization of the State, the habits of the people, in the main, were simple and their wants few. Barter in a large measure supplied the place of a medium of exchange. Commerce, in so far as it had an existence with the outer world, was by wagons across the Alleghenies, and by flat boats down the Ohio, and the Mississippi. The log cabin furnished protection to the pioneer from the winter's storm. With rude implements of his own construction, he cultivated his fields, and with his rifle defended his loved ones from the incursions of the savage. At the time of its admission, there were but 23 post-offices within the limits of the entire State. At the period indicated and for years afterwards, the frontiersman regarded himself as especially favored if located within a dozen miles of a post-office. The mails reached the settlements weekly or monthly upon horseback or by stage-coach. The log cabin with its puncheon floor supplied the double purpose of temple of learning, and place for public worship. Articles of apparel, were, with rare exception, of home manufacture. Railroads, colleges and universities were unknown. Less than 10,000 persons within the entire State were engaged in agricultural pursuits. Chicago had hardly a place upon the map. The rapid emigration which immediately followed its admission soon rendered the selection of a capital nearer the centre of population a necessity. The commissioners designated by the legislature, for this purpose, having in view the possible flow of emigration northward, chose a site for the new location, 140 miles north of the Ohio River, to which was given the name Vandalia — then a wilderness, but now a beautiful and prosperous city. During the two decades which followed the location of the capital at Vandalia, the population of the State increased to 476,000. The drift of emigration was to the Wabash, to the Sangamon, to the Vermillion, to "the Military Tract," to the rich lands drained by the Kankakee and the Fox, and to the grand prairies stretching northward and westward to Wisconsin and to the Mississippi. In 1836 Springfield became the seat of government. Then a village of but a few hundred inhabitants, it is now a splendid city and an honor to the commonwealth. Its nearness to the geographical centre of the State; its accessibility and the erection of a superb State House, renders the present location, for our time at least, permanent.

Constitution.— Three constitutions have been in force in Illinois since its admission as a State. The first was formulated by a convention of 32 delegates — representing the fifteen counties of the territory — which assembled in Kaskaskia in August 1818. This constitution — under which the State was admitted — remained the organic law of Illinois for 30 years, and until the adoption of the constitution of 1848. Meanwhile the State had gradually increased in wealth and in population. Many new counties had been organized and the northern boundary of actual settlement extended from the county of Madison to the Wisconsin line. Chicago and other cities unknown to the framers of the first constitution, had sprung into being. An attempt to procure the calling of a convention to frame a constitution to supplant the first, was made in 1823. By Article 7 of the latter, the legislature was empowered, by a two thirds vote thereof, to submit to the electors of the State, the question of calling a convention to alter or amend the existing constitution. By the legislature of 1823 there was such submission under the above provision. The purpose of the originators of this movement unquestionably was to secure by constitutional provision, the introduction of slavery into the State. For more than a year this was the all-absorbing topic of debate. Political leaders and newspapers were divided and fierce personal antagonisms engendered. The discussions at the fireside, in the public press and upon the hustings, touched all phases of the question from the standpoint of material advantage, as well as from the high plane of right. The verdict of the people was rendered 2 Aug. 1824 against the proposed convention and the introduction of slavery into Illinois. The question of calling a convention was again submitted by the legislature in 1846; the returns showed a large majority favorable, and delegates were chosen in April 1847. This convention consisting of 162 members assembled in Springfield in June of that year and its deliberations were concluded 31 August. Unlike the first constitution, this was submitted to the people. It met popular approval and by its terms went into operation on the first Monday of April 1848. This remained in force until the adoption of the present constitution. The latter was formulated by a convention consisting of 85 members which assembled in Springfield 13 Dec. 1869. The constitution it framed was submitted to popular vote and approved, and has since August 1870 been the fundamental law of the State. The existing constitution is in large degree an improvement upon both of those which preceded it. Some of its most important provisions are: the division of the powers of the government of the State into three departments — the legislative, the executive, and the judicial; vesting the legislative power in a General Assembly to consist of a Senate and House of Representatives, both to be elected by the people; senators required to be 25, and representatives 21 years of age; also to be citizens of the United States, and five years resident of this State; no person convicted of infamous crime or a public defaulter to be eligible as senator or representative or to any office of profit or trust in the State; in addition to the ordinary official oath each senator and representative is required to swear in substance that his election has in no manner been secured by bribery; the number of senators was fixed at 51, and of representatives at 153; minority representation was provided for in the election of members of the House; senators to be elected for four years and members of the House for two years; a majority of the members elected to each House shall constitute a quorum; bills may originate in either House subject to amendment in the other; upon the final passage the yeas and nays shall be taken upon each bill separately; every bill to be read at large upon three different days in each House; no act to embrace more than one subject and that to be embraced in its title; no money to be drawn from the treasury except in pursuance of an appropriation made by law; the General Assembly permitted to make appropriations for expenditures incurred in suppressing insurrection, or repelling invasion; compensation of senators and members fixed at $5.00 per day during the session; the General Assembly prohibited from releasing the indebtedness, liability or obligation of any corporation or individual to the State, or to any municipal corporation therein; to have no power to authorize lotteries or gift enterprises for any purpose. Two important mandatory provisions upon the General Assembly were incorporated in the constitution: one requiring legislation protecting coal miners, and the other the passage of liberal homestead and exemption laws. Under the former constitution, the State and people had suffered from special legislation. To the end that such legislation be discontinued and general laws when necessary enacted, the General Assembly was prohibited from passing local or special laws in any of the following cases, viz.: for granting divorces; changing the names of persons or places; laying out, opening, altering and working roads or highways; vacating roads, town plats, streets, alleys and public grounds; locating or changing county seats; regulating county and township affairs; regulating the practice in courts of justice; regulating the jurisdiction and duties of justices of the peace, police magistrates and constables; providing for changes of venue in civil and criminal cases; incorporating cities, towns or villages or changing or amending the charter of any town, city or village; providing for the election of a board of supervisors; summoning and impaneling grand or petit juries; providing for the management of common schools; regulating the rate of interest on money; the opening and conducting of any election or designating the place of voting; the sale or mortgage of real estate belonging to minors or others under disability; the protection of game or fish; chartering or licensing ferries or toll bridges; remitting fines, penalties, or forfeitures; creating, increasing or decreasing fees, percentage or allowance of public officers during the term for which said officers are elected or appointed; changing the law of descent; granting to any corporation, association or individual the right to lay down railroad tracks or amending existing charters for such purpose; granting to any corporation, association or individual, any special or exclusive privilege, immunity or franchise whatever.

Government.— The supreme executive power of the State is vested in a governor, "who shall take care that the laws be faithfully executed"; his term of office fixed at four years: he is required to be 30 years of age and for five years next preceding his election, a citizen of the United States, and of this State: he is required at the commencement of each session to give to the General Assembly, information by message of the condition of the State, and recommend such measures as he shall deem expedient: he can, by proclamation, convene the General Assembly upon extraordinary occasions: may remove officers of his appointment for incompetency, neglect of duty or malfeasance in office: may grant reprieves, commutations, or pardons after conviction for all offenses: shall be Commander-in-Chief of the Military and Naval forces of the State — except when they are called into the service of the United States; is vested with a qualified negative upon all bills passed by the General Assembly, but bills can be passed over his veto by a two-thirds vote of each House: in case of his death, resignation, or conviction upon impeachment, the duties of his office devolve upon the lieutenant-governor: the last named officer is president of the senate, and is, with the secretary of state, auditor of public accounts, treasurer, superintendent of public instruction, and attorney-general, elected in the same manner, and except the treasurer, for the same length of time as the governor: two years is the term of the treasurer. The judicial powers of the State are vested in a supreme court, circuit courts, county courts, justices of the peace, police magistrates, and in such courts as may be created by law for cities and incorporated towns; the supreme court consists of seven judges, and their term of office is nine years; the terms of the circuit judges fixed at six years, inferior appellate courts of uniform organization and jurisdiction to be composed of circuit judges, to be created.

Suffrage.— One year's residence in the State necessary to its exercise: voting to be by ballot; persons convicted of infamous crimes to be excluded from the right of suffrage.

Revenue.— The General Assembly to provide for needed revenue by levying a tax, by valuation, so that every person and corporation shall pay a tax in proportion to the value of his, her, or its property; certain property, religious, charitable, etc., may by general law be exempt from taxation.

Corporations.— No corporation to be created by special laws, except those for charitable, educational, penal, or reformatory purposes, and these to be under State patronage and control: the General Assembly to provide by general laws for the organization of all corporations hereafter to be created: no State Bank hereafter to be created, nor shall the State own any stock in any corporation for banking purposes; every stockholder in a banking corporation to be individually liable to its creditors for double the amount of his stock; the rolling stock and all other movable property of all railroads in the State, to be considered personal property, and subject to execution for the debts of such company: railroad corporations prohibited from consolidating with parallel or competing lines; all railroads in the State declared to be public highways, and free to all persons for the transportation of their persons and property thereon, under such regulations as may be prescribed by law — the General Assembly to establish reasonable maximum rates of charges for the transportation of passengers and freight: the right of eminent domain by the State against such corporations never to be abridged: the General Assembly by appropriate legislation to prevent unjust discrimination and extortion in the rates of passenger and freight tariffs on all railroads in the State; appropriate legislation authorized for the protection of producers, shippers and receivers of grain and produce. By a two thirds vote in each House the General Assembly may submit to the electors, the question of calling a convention to alter or amend the Constitution, to be voted upon at the next general election: by the same vote in the General Assembly proposed amendments to the constitution (without the intervention of a convention) may be submitted to the electors for adoption or rejection. The General Assembly prohibited from releasing the Illinois Central Railroad Company from its charter obligation to pay the State the agreed percentage of the gross earnings of said company; no county, city, town or township permitted to become a subscriber to the capital stock of any railroad, or private corporation, or to make donations to, or loan its credit in aid of any such corporation.

Politics.— Under the recent apportionment by virtue of the 12th census of the United States, Illinois has 25 representatives in Congress. The electoral vote of the State at successive Presidential elections, since its admission has been cast as follows, viz.: In 1820, for Monroe; in 1824 one vote for Adams and two for Jackson: in 1828 and 1832 for Jackson: in 1836 and 1840 for Van Buren: in 1844 for Polk; in 1848 for Cass: in 1852 for Pierce: in 1856 for Buchanan: in 1860 and 1864 for Lincoln: in 1868 and 1872 for Grant: in 1876 for Hayes: in 1880 for Garfield: in 1884 for Blaine: in 1888 for Harrison: in 1892 for Cleveland: in 1896 and 1900 for McKinley. The vote of Illinois in the electoral college during the 85 years of its existence as a State, has increased from 3 to 27. The Black Hawk war of 1831–2 and the Mormon war of 1844 are chief among the interesting historical events of the State. As the result of the first, Indian depredations ceased, and the remnants of once powerful tribes disappeared forever from the State. What is known in local history as "the Mormon War" occurred in Hancock County on the Mississippi River. Nauvoo in the last named county was the Mormon city, the home of Joseph Smith, "the prophet" and head of the church; it was the seat of Mormon authority, and the site of a splendid temple. The assassination of Joseph Smith by an anti-Mormon mob in 1844 was soon thereafter followed by the complete exodus of his followers from the State.

Bibliography.— Ford, 'History of Illinois'; and a 'History of Illinois' by Davidson and Stuve; Moses, 'History of Illinois'; the twelfth census of the United States; the several official reports of State officers published by authority of the General Assembly.

Adlai E. Stevenson,

Illinois Central Railroad. The history of the Illinois Central Railroad embraces many interesting episodes, some of which bore directly in their effect on the building up of the nation, of the State of Illinois and of the city of Chicago. Prior to the incorporation of this line, the State of Illinois had vainly endeavored to establish an effective and profitable central railroad. In doing this, a large State debt accumulated and the outlook for wiping out that debt was not at all promising when the act to incorporate the Illinois Central Railroad Company was approved by Governor French, on 10 Feb. 1851. As events have proved, this act produced results more momentous in the history of the State and of the United States than any act approved by an Illinois Executive before or since.

The inception of this important enterprise dates back to 1835, when two of the State's most famous men, Hon. Sidney Breese and Hon. Stephen A. Douglas, first discussed publicly the advisability of penetrating the centre of the State by means of a railroad and thus opening up a vast territory which at that time was an uninhabited and partially unexplored wilderness. On 16 Jan. 1836, the State Legislature passed an act incorporating "The Illinois Central Railroad Company." Two years later an attempt was made to start this road, which was intended to run 457 miles. The sum of $3,500,000 was appropriated for the route, but within a few months the difficulties surrounding the situation in the matter of actual track-laying became so great that, after an expenditure of $506,000, principally on surveys and preliminary work, the plan was abandoned.

In 1843, a private corporation entitled "The Great Western Railroad" secured a charter and began work, but soon became discouraged and surrendered their charter. In 1849 this charter was renewed, only to be again surrendered to make room for the road now operating and known as The Illinois Central Railroad. At the time the road was commenced by the present corporation, it was estimated that the aggregate cost would be about $15,000,000. The actual cost for construction, including all extension up to the present time, has been nearly $50,000,000.

Original Charter Directors.— The twelve directors selected in 1851, under the charter and known as the "Charter Directors" included nine prominent New York men and three well-known citizens of Boston. The directors from New York were Robert Schuyler, George Griswold, Governeur Morris, Jonathan Sturges, Thomas W. Ludlow, John F. A. Sanford, Henry Grinnell, Joseph W. Alsop and Leroy M. Wiley. Those from Boston were Franklin Haven, Robert Rantoul, Jr., and David A. Neal.

Population.— In 1850, shortly before the chartering of the railroad, Illinois stood 11th in population and 17th in wealth among the States. The marked difference during the following 10 years is worthy of note as showing the direct effect of improved and extended railroad accommodation. In 1860, Illinois stood fourth in population among the States, also fourth in wealth.

Railroad Conditions in 1851.— In 1851, when the charter of the present road was granted, the population of Chicago was 30,000. That city had no railroad connection with the east nor in any other direction. In the same year the Hudson River Railroad, 140 miles, from New York to East Albany, was opened. Other events of importance during 1851 were the extension of the Baltimore and Ohio Railroad to Cumberland and the opening of an Erie Railroad line from Pierpont on the Hudson to Dunkirk on Lake Erie. Wisconsin had 20 miles of railroad at that time. The railroad mileage of Indiana was 228 miles, and of Kentucky, 78 miles. Just prior to the chartering of the Illinois Central there were 111 miles of railroad track in the State. When the 50th anniversary of the road was held at Chicago in 1901, it was announced that the company was then operating railroads in 13 States.

Development.— The first section of the road, covering 705.50 miles, and running from Chicago to Cairo and from Centralia to Dubuque, was opened on 27 Sept. 1856, being about five and one half years after the issuing of the charter. Since the opening of this main line other lines have been purchased, including part of the Saint Louis, Peoria and Northern railroads from Springfield to East Saint Louis, Illinois, in 1900. This purchase was followed by a number of other purchases and absorptions.

Roads Acquired by Purchase, etc.— From Springfield to East Saint Louis, Ill. (part of the Saint Louis, Peoria and Northern); Indiana Division of the former Peoria, Decatur and Evansville, extending from the Illinois State line to Evansville, Ind., with a branch to New Harmony, Ind.; Evansville and Mattoon, from the State line to Mattoon, Ill. This was formerly a division of the Peoria, Decatur and Evansville; Chicago, Madison and Northern; Kankakee and Southwestern; Chicago and Springfield; Saint Louis, Alton and Terre Haute; Chicago, Havana and Western; Mound City; Chicago and Texas; Riverside and Harlem; the parts of the Rantoul and Illinois and Indiana railroads lying in the State of Indiana, extending from West Lebanon to State line and from Switz City to State line.

Leased Lines.— The leased lines of the Illinois Central Railroad are Chicago and Eastern; South Chicago; Blue Island; Peoria, Decatur and Mattoon; Peoria and Pekin Union; Dubuque and Sioux City; Chicago, Saint Louis and New Orleans, and the Canton, Aberdeen and Nashville railroads.

Mileage.— The corporation now controls one of the most important groupings of railroad lines in the United States. The total mileage operated, according to the latest official report available, is 4,374.04, exclusive of the Yazoo and Mississippi Valley Railroad (1,209.91 miles). The length of the main line, from Chicago to Cairo, Illinois, is given as 364.73 miles; Omaha Division, from Chicago to Council Bluffs, Iowa, 513.96 miles; New Orleans Division, from Cairo to New Orleans, Louisiana, 547.79; Louisville Division, from Memphis, Tennessee, to Louisville, Kentucky, 398.12 miles; other lines owned or leased operated in the system, 2,549.12.

Additional Tracks.— The length of line having two tracks is 654.33 miles; third and other additional main tracks, 72.56 miles; sidings, etc., 1,514.04. The gauge of this system is 4 feet 8½ inches. The average weight of steel rails is 72.78 lbs

Charter Tax.— The charter of the company, reserved to the State of Illinois, calls for payment, in lieu of taxes, of 7 per cent of the gross receipts of the 705.50 miles of road originally built under that charter. The total amount paid to the State of Illinois under the provisions of this charter, from the opening of the road in 1855 to 30 June 1904, was $22,359,316.21.

Dividends.— Between the beginning of operations in 1851 and 30 June 1904, the stockholders received $118,403,601.59 as dividends out of the earnings of the company.

Rolling Stock.— The rolling stock of the company, 30 June 1904, included 1,086 locomotives, 444 passenger and chair cars, 14 cafe dining cars, 148 baggage, mail and express cars, 42 postal cars (3 of these partly owned), and 52,957 freight cars, making a total, with minor items under this head, of 55,809 cars.

Earnings.— The earnings of the road, for the year ending 30 June 1904, amounted to $46,831,136, or $10,789.72 per mile. These earnings were divided as follows: Passenger traffic, $9,554,743; freight traffic, $31,692,575; mail and express service, $1,694,280; miscellaneous earnings, $3,889,538. For 1905, the total earnings were $49,508,649.

Net Earnings, Receipts and Dividends.— The net earnings of the road for the year ending 30 June 1904, were $14,037,885, or 29.48 per cent; for 1905, $14,396,943; net receipts from land sales, $41,053; investments and miscellaneous profits, $2,675,495.72; surplus dividend fund (30 June 1903), $1,178,186.92; surplus dividend fund, 30 June 1904, $1,225,766.92.

Expenses.— The total expenses of the road for the year ending 30 June 1904, amounted to $32,793,251.31, or $7,555.44 per mile; for 1905, $35,111,706. The amount paid for taxes, rents, interest and sinking fund during the same period was $7,888,506; in dividends at 6 per cent, $5,702,400.

Bonded Debt.— The bonded debt of the road, including 25 investments, aggregates $137,599,525. Of this total the first issue yet to mature is $88,000, issued in 1880 and maturing in 1910. An issue of $2,800,000, placed in 1869, matures in 1917. The next, following in order, is an issue of $968,000 made in 1881 and maturing in 1921; an issue of $470,000 made in 1883 and maturing in 1923; an issue of $538,000, made in 1886 and maturing in 1931; an issue of $241,000, made in 1887 and due in 1932.

Opening up of the State.— The beginning of active operations in establishing the line marked the beginning of State development throughout a vast area which, up to that time, had been inaccessible to traffic of any kind except by means of the most rural contrivances, utterly inadequate for any but the most restricted local demands. The new move toward opening up commercial possibilities immediately doubled the price of public lands. These tracts were readily bought up as conditions improved and steadily increased in value year by year.

At a critical juncture in the nation's history, when it became necessary to move regiments brigades and divisions of western troops to the scene of active civil war operations, the Illinois Central Railroad provided the only available means of adequate rapid transportation. At the same time, the existence of that railroad and its excellent management made the prompt supply of rations and forage possible.

Payment of State Debt.— As mentioned in a previous paragraph, the attempt of the State to operate successfully a central railroad ended in utter failure. In 1851 the people of Illinois were under a burden of some $60,000,000 as the outcome of the experiment. The establishment and active operation, with ever continuing development of the road, enabled the whole of that debt to be paid off in due course with proper interest.

Other Benefits to State and City.— The persistency of the railroad authorities in extending their own lines and giving added vitality to smaller railroads made possible the cultivation of the Grand Prairie, previously waste, thereby raising the prestige of the State as a productive national factor of extraordinary importance. It is on record that over $3,000,000 has been expended since about 1836 by the railroad company upon the construction of dikes, piers and breakwaters to protect the city against lake encroachments. Very great benefits, too, have been derived by Chicago from being brought into close commercial touch with prairie lands and the agricultural area of the Lower Mississippi Valley. Chicago has also gained an outlet by rail to the Gulf of Mexico. It is said, to the credit of the Illinois Central Company, that the extent and vigorous administration of its affairs during the period extending from the inception of the World's Fair in 1893 until its close made the success of that enterprise possible by furnishing ample transportation within its jurisdiction for the immense passenger and freight traffic which impended there from start to finish.

Statistical.— The States in which the Illinois Central Railroad is now operating are Illinois, Indiana, Wisconsin, Iowa, Minnesota, South Dakota, Kentucky, Tennessee, Mississippi, Louisiana, Missouri and Alabama. The present total mileage of the road, including leased lines and the Yazoo and Mississippi Valley Railroad, is nearly one-half the railway mileage of the State. The total number of stockholders in the company, according to the latest report of the Interstate Commerce Commission, is 9,123. The value of stock outstanding, according to the latest quotations, 1905, is $95,040,000. The highest rate at which stock was quoted in 1904 was 159; lowest 125¾. The highest rate quoted for 1905 was 183; lowest 152½.

Other lines operating in Illinois are the Santa Fe; Baltimore and Ohio; Chicago and Alton; Chicago and Northwestern; Chicago, Burlington and Quincy; Chicago Great Western; Chicago, Indianapolis and Louisville; Chicago, Milwaukee and St. Paul; Chicago, Rock Island and Pacific; Cleveland, Cincinnati, Chicago and St. Louis; Erie; "Frisco System"; Grand Trunk; Great Central Route; Iowa Central; Lake Erie and Western; Lake Shore and Michigan Southern; Louisville and Nashville; Michigan Central; Missouri Pacific; Mobile and Ohio; New York, Chicago and St. Louis; Pennsylvania; Southern; Toledo, St. Louis and Western; Vandalia; Wabash, and Wisconsin Central.

Illinois College, an institution located in Jacksonville, Ill., the oldest college in the State, founded in 1829, largely through the efforts of the "Yale Band of Seven," an Eastern organization of college men. The courses of study are arranged according to the group system, which permits a fair amount of choice. In 1902 the attendance was 125 students with 17 instructors. In 1903 the college was affiliated with the University of Chicago. The same year the endowment fund was increased from $155,000, in 1902, to nearly $500,000. The college library contains 12,000 volumes, and the literary societies 4,000, available for reference.

Illinois River, an affluent to the Mississippi, formed by the confluence of the Kankakee, Des Plaines, and Du Page rivers, in Grundy County, about 44 miles southwest of Chicago. Its entire course of over 350 miles is within the State, through a fertile, undulating country, rich in bituminous coal deposits. It flows first westward to Ottawa and Lasalle, at Depue bending southwestward past Lacon, Chillicothe, Peoria, Pekin, Havana, and Beardstown, and near Naples turning due south and joining the Mississippi about 18 miles above Alton, at the mouth of the Missouri. The river is 1,200 feet wide at its mouth and is navigable throughout to Lasalle where a ship canal about 120 miles long connects it with Lake Michigan at Chicago, thus ensuring a clear waterway from the Great Lakes to the Mississippi and the Missouri. The Illinois has numerous tributaries of which the Fox and Sangamon rivers are the chief.

Illinois State Normal University, located at Normal, a suburb of Bloomington, Ill., was founded in 1857. It is the oldest State normal school in the Mississippi Valley, and has furnished principals or instructors for nearly all of the younger normal schools in the central and western States. Up till 1904 it had given instruction to 15,652 normal students, nearly all of whom have become teachers. Its graduates number 1,549. The school occupies three buildings upon a beautiful campus of 57 acres. It is well equipped with library, laboratories, gymnasium, and apparatus for instruction in all the various branches of study. Its revenue, about $60,000 per year, appropriated from the State treasury, includes the interest derived from the College and Seminary Funds granted by the Federal government in 1818. It is governed by the Board of Education of the State of Illinois, a body of 15 appointed by the governor. The State superintendent of public instruction is *ex-officio* secretary of the board. Its sole purpose is to prepare teachers for the schools of the State, accordingly students are required to sign a pledge declaring their intention to teach. Tuition is free. The programmes of study leading to graduation vary from two to four years, according to the preparation of the student. The required work includes courses in pedagogy, psychology, and general method, history and philosophy of education, school management and the Illinois school system and one year of practical teaching in the training department. Along with these are provided courses in special method in the various branches of elementary and high school course. Special courses are provided in manual training, art, vocal music, kindergarten and elementary agricultural science. The attendance in 1902–3 was 1,014, besides 502 in the training department. The faculty of instruction numbers 31. The presidents of the institution have been: Gen. Charles E. Hovey (1857–61); Richard Edwards (1862–76); Edwin C. Hewett (1876–90); John W. Cook (1890–99); Arnold Tompkins (1899–1900); David Felmley (1900——).

David Felmley, *President.*

Illinois, University of, the State university situated at Urbana. It was founded in acceptance of the national land grant of 1862 (see Colleges, Land Grant), and was incorporated in 1867 as the Illinois Industrial University. In 1870 women were admitted; in 1877 the State legislature granted power to confer degrees; and in 1885 the name was changed to the University of Illinois. It was the first American university to give shop instruction, a mechanical shop being equipped in 1870. It is governed by a board of trustees, consisting of three *ex-officio* members, including the governor, and nine elective members. The undergraduate department includes the college of literature and arts, of engineering, of science, and of agriculture; corresponding graduate courses are given; other departments of the university are the academy, State library school, the school of music, the college of law, the college of medicine, the school of dentistry, and the school of pharmacy, the three latter being situated in Chicago. The university has a number of valuable scientific collections; the agricultural experiment station organized under the Federal law of 1887 is controlled by the university trustees, but is separately supported by the national appropriation; the general university library numbers 71,039 volumes besides pamphlets; other libraries under university control are the library of State Laboratory of Natural History (15,000 volumes), the library of the college of law, and the special collection of the department of education (1,500 books and 3,000 pamphlets). The annual income amounts to $900,000; the number of students in all departments was 3,725 in 1904–5, the number of professors and instructors, 392.

W. L. Pillsbury,
Registrar University of Illinois.

Illinois Wesleyan University, founded in 1850 under the auspices of the Methodist Episcopal Church, at Bloomington, Ill. The college courses provide for the degrees of B.A., B.S., Ph.B., LL.B., M.A., Ph.D., and two honorary degrees. It has, also, a preparatory school. In 1902 the number of students was over 1,400, of which 478 were non-residents; professors and instructors, 38; volumes in the library about 11,000.

Illit'erates, those unable to read or to write, or to do either. The percentage of illiterates indicates the average intelligence, or at least of education, in the people of a country. The United States, Hungary, Italy, and Portugal, and the Australian colonies of Victoria and Tasmania, have attempted to take an exact census of illiterates; all children below six years of age were excluded, except in the United States, where all children below 10 years of age were excluded. The following gives the result:

	Per cent
United States (1880)	22.15
Italy (1881)	54.30
Hungary (1880)	57.14
Portugal (1878)	79.07

But the most exact results are gained by estimating the number of men and women who are unable to sign their names in the marriage registers. From this estimate the following are the results for 1886:

	Men	Women	Mean
England and Wales..	9.60	11.50	10.55
Scotland	4.65	8.28	6.46
Ireland	23.40	25.30	24.35
Victoria	2.00	1.98	1.99
New South Wales...	3.76	4.20	3.98
Queensland	4.52	6.71	5.62
South Australia	3.04	3.49	3.26
New Zealand	1.92	2.89	2.40
Prussia (1884)	3.31	5.11	4.21
France (1882)	14.39	22.62	18.50
Italy (1887)	42.36	62.80	52.58

The subjoined table gives the number of conscripts of the countries named who were illiterate in the fullest sense of the term:

	Per cent		Per cent
Baden (1884)	0.02	Holland (1887)	8.5
Würtemberg (1884)..	0.02	France (1886)	10.30
Bavaria (1884)	0.08	Belgium (1887)	13.87
Saxony (1884)	0.15	Austria (1888)	25.00
Sweden (1883)	0.27	Hungary (1888) ...	38.60
Denmark (1881) ...	0.36	Italy (1888)	42.98
Germany (1884) ...	1.27	Russia (1882)	78.79
Switzerland (1888)..	1.3	Servia (1881)	79.31
Prussia (1884)	1.97		

At the last general election in Great Britain and Ireland there voted in England and Wales 38,587 illiterate persons, in Scotland 4,836, in Ireland 36,722, giving a percentage of 2.69 out of a total of 2,969,381 voters. Illiteracy among voters, both white and black, increased greatly in the South between 1870 and 1880. In Texas in 1870 there were 17,500 illiterate voters; in 1880 there were 33,085. But between 1880 and 1890 the illiteracy in the States was reduced to 13.4 per cent of the total population.

Illuminati, ĭ-lū-mĭ-nā'tī ("the illuminated"), the name given to themselves by an association of people who professed to have attained to a higher knowledge of God, and heavenly things, and a deeper insight into the spiritual world than the rest of mankind. They were represented by the *Alombrados* in Spain and the *Guérients* in France. In the last half of the 18th century a sect of mystics rose in Belgium which from its foundation 1 May 1776 at Ingolstadt, spread over a large portion of Catholic Germany. At first they called themselves "Perfectibilists." Their founder was Adam Weishaupt (q.v.), a professor of canon law at Ingolstadt.

Illuminating of Manuscripts. See Books; Manuscripts, Illuminating of.

Illusion. In mental pathology it is necessary to distinguish the term "illusion" from the terms "delusion" and "hallucination." In common parlance these terms are often confused, and many persons in using them have not very clear ideas of what they wish to express by them. But this is not so among writers in psychiatry, for in this science these three terms are very clearly and very strictly demarcated. And it is highly necessary that these distinctions should be observed, because these terms stand for very different phenomena in mental disease — phenomena of different value and importance, and each with its own special significance as to the patient's welfare.

By an illusion is meant a misinterpretation of a sensory impression. Ordinarily, when the mind is acting in a perfectly normal way and there is nothing to confuse its impressions or to obstruct its proper perceptive powers, a sensation, whether of the eye, ear, taste, or skin, is conveyed to the consciousness and is recognized correctly. Thus a sound, as the note of a bird or the voice of a friend; or the sight of some object, as of an animal moving in the distance, is properly conveyed to the intelligence and is properly recognized. But this process may be interfered with in various ways. The senses, notoriously, are not always to be relied upon. Even the normal mind may make mistakes in the interpretation of sensations, and still more so may the mind that is impaired. It thus happens that all illusions are not necessarily evidences of a diseased mind; this faulty action of the senses, or of the perception, may and often does happen in the cases of persons of sound mind. For instance, a person walking along a path in the dusk may mistake a bush for an animal; he simply misinterprets an object, and this object is not imaginary but has a real existence. So, too, the mirage which sometimes appears at sea, might lead a perfectly ignorant person to maintain that he saw a ship inverted sailing in the sky. These are instances of illusions in which the normal mind may be temporarily deceived. But the normal mind tends to correct its illusions, and this it does sooner or later according to its opportunity and its degree of knowledge. In this respect the insane mind differs from it; the illusions of the insane are usually firmly believed in; there is no spontaneous tendency on the part of the insane mind to correct its illusions. On the contrary, they are firmly embraced, and are often made the starting point of a train of associated morbid ideas, whereby the mental disorder is all the more confirmed.

An hallucination differs from an illusion in the fact that it is entirely subjective. In a strict sense it is a disorder of perception in which the external sense organs do not participate, and it leads to a belief on the part of the patient that he perceives some external object, whereas in fact there is no such object corresponding to the perception. In other words, it is a disorder of perception giving rise to a false belief in a sensation. For instance, a person believes that he hears the voice of an acquaintance speaking to him, when there is no voice either of the acquaintance or of any one else; or, again, a person thinks he has a vision of a deceased friend or of some other spiritual being, whereas there is no external object or person whatever giving rise to this or any other sensation. The whole process, therefore, is subjective, or within the patient's own mind; it is without any objective equivalent. It is thus readily seen that an hallucination is much more deeply seated than an illusion, and is a much more direct evidence of a disorder of the mind. Some authorities doubt indeed whether a true hallucination ever occurs in a normal person; what appears to be so in any given case would probably be found on strict inquiry to be an illusion. Although this may be an extreme position, the fact remains that hallucinations are very rare in the sane and very common in some forms of insanity; and that, as in the case of illusions, the sane tend to correct them, while the insane adhere to them with unswerving belief. The most common hallucinations of the insane are the visual and the auditory, and they are sometimes very grave symptoms. Auditory hallucinations are especially dangerous, for they may lead the patient to commit acts of violence in response to their suggestions.

A delusion differs from both an illusion and an hallucination in the fact that it is not a sensory disorder — but a derangement entirely within the intellectual sphere. It is an erroneous belief, but one which is due entirely to mental disorder. The latter part of this definition is essential, because a delusion is essentially something more than a mere error of belief or judgment. It is an erroneous belief that is due to insanity, or to a disordered mind. Mere errors of belief may and do occur in persons who are sane: no person, in fact, is exempt. Such errors may be due to ignorance, prejudice or faults of education, but they are not evidence of insanity; otherwise the whole world would be insane. In the case, however, of an insane pauper who believes that he is a multi-millionaire, or that he is emperor of the United States, there is obviously something more than a mere erroneous belief in the sense of an error of judgment or opinion. Such a patient has developed an idea which no sane man in similar circumstances could have developed; in other words, he has a delusion, and he is not insane because he has the delusion, but he has the delusion because he is insane. The insanity or mental unsoundness is the fundamental fact, and is shown usually by other symptoms besides the tendency to form delusions. As in the cases of illusions and hallucinations, the insane cling to their delusions with great tenacity; no argument, no logic moves them. The delusions of the insane are usually distinguished as systematized and unsystematized. In the former the delusion has a certain consistence, coherence and endurance; in the latter the ideas are more or less incoherent and changing. Delusions again may be expansive or depressive, according to the emotional tinge. See also IMAGINATION; INSANITY.

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Illustra'tion of Books, the art of making and reproducing pictures to supplement or adorn the text. In England book illustration may be said to have reached its culminating point as regards engraved and etched plates, in the first half of the 19th century, in the series of annuals, keepsakes, and the higher class books illustrated by such masters as Stothard, Turner, etc. The revival of wood engraving by Bewick and his pupils gradually led to the restoration of that art as an illustrating medium. In this it was greatly aided by the facility with which wood-engravings can be printed along with the text, together with the advance made in typographic printing. The series of Christmas books illustrated by John (afterward Sir John) Gilbert and Birket Foster had no small share in that advancement. Among the artists who have helped to raise the art to its present high position may be mentioned Cruikshank, H. K. Browne ("Phiz"), Doyle, Leech, Tenniel, Millais, F. Walker, W. J. Linton, Herkomer, etc. The development of what has been called the American school of wood-engraving has still further increased the influence of that branch of art for illustrative purposes.

Relief-Block Processes for Book Illustrations.— Many processes have been invented to produce relief blocks with a view to supersede wood-engraving in book illustration. The object aimed at is to reproduce drawings in line or wash, in fac-simile, on a relief block capable of being printed from the surface on the type-press. That is, the lines or parts which impress the paper are to be left in relief, while the white parts are cut out so as to leave the paper unprinted. "Process" relief blocks may be divided into two kinds, those reproduced from black-and-white, or line drawings in pen and ink; and those from half-tone photographs, or wash drawings. When pen-and-ink drawings, engravings, or any other drawing in line are to be produced the subject is photographed to the required size. This process allows the drawing to be made of any convenient size, while a drawing on transfer paper must be of the exact size required. There are also several gelatine processes, all of which are based on practically the same principle. The production of relief blocks from ordinary photographs or drawings made by washes of black and white baffled all efforts till the invention of Meisenbach's process. In relief block every part which touches the paper prints black, and every part which does not touch the paper leaves it white. Some method had to be devised of turning the smoothly graded tones of a photograph into pure black and white. The method sought after was to break up the photo-tones into a grain, stipple, or line, which should be closest in the darkest parts, and become more open as the lights were approached. That patented by Meisenbach of Munich in 1882 as the one on which nearly all the most successful subsequent processes are based, may be briefly explained. A glass plate is prepared with fine parallel lines. This is exposed between the lens and the sensitive plate in the camera, at a very short distance from the plate, and when the exposure is half completed the cap is put on the lens, the lined plate is taken out and put in with the lines in the reverse direction, and the exposure is completed. The resultant negative is thus broken into minute regular dots. In a successful process invented by Mr. Ives, of Philadelphia, and patented in 1884, a swelled gelatine relief is taken of the subject, and on a plaster cast of this a stipple is impressed by means of an elastic stamp, which gives the operator greater control over the effect. He is then able to ink the plaster cast and transfer an impression of it to a sheet of india-rubber, and from that to a plate of zinc. A "grained" photograph being finally obtained by means of any of the thousand and one processes, it is transferred to zinc and etched. Besides these photo-chemical processes there are various mechanical methods of producing relief blocks. Some of them are very technical. Dawson's typo-etching process, an improvement on Palmer's glyphographic process (patented in 1848) is very extensively used for the production of maps, plans, diagrams, etc. This process is carried to great perfection in the United States, where most beautiful maps are produced by it.

These processes, though simple enough in theory, give great scope for skill in manipulation, and much of their success depends on the ability of the operator. The rapidity with which they can be produced has rendered the daily illustrated paper a possible and accomplished fact. As to cost, blocks can be produced for from 8 to 30 cents a square inch of surface, according to the nature of the drawings — the stipple process being the more expensive. In France, Germany, and the United States the processes have been much more employed as a means of book illustration than in Great Britain, though even there every year shows rapid advance in their use. As to the comparative merits of wood-engraving and the processes, opinions differ greatly. Generally, it may be said that the processes are more suited for subjects on a large than on a small scale, unless they are very slight, in which case they can never pretend to be more than sketches. In wood-engraving the photograph can be transferred direct to the wood and engraved without further expense for drawing, and the result, both artistically and from a printing point of view, is much more satisfactory. Though within its limits the process makes good work and the future is before it, the fact remains that as yet for finished picture work, good wood-engraving has not been superseded. See BOOKS: ENGRAVING; LITHOGRAPHY; MANUSCRIPTS, ILLUMINATION OF; PHOTO-ENGRAVING; PHOTOGRAVURE

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Illyria, ĭ-lĭr'ĭ-ạ, or **Illyricum,** a name anciently applied to a considerable region on the east side of the Adriatic Sea, the inhabitants of which were the ancestors of the modern Albanians. In 228 B.C. it became a Roman province. After various vicissitudes under different rulers it formed part of the Franco-Napoleonic empire as the Illyrian provinces. In 1815 it reverted to Austria and became the kingdom of Illyria, a title it retained until 1849, when it was divided into the provinces of Carinthia, Carniola, and the Coast-lands.

Il'menite, or **Menaccanite,** also known as titaniferous iron ore, is a black, heavy, mineral crystallizing in the hexagonal system. It is widely distributed, occurring in diorites and many other igneous rocks. It is an oxide of iron and titanium containing when pure 36.8 per cent iron and 31.6 per cent titanium, and is frequently associated with magnetite. Iron ores containing ilmenite occur in vast masses in the Adirondack region of New York, in Quebec, Canada, and in northern Minnesota, and ilmenite is a common constituent of the black sands found on some ocean beaches. The presence of titanium decreases the fusibility of an iron ore, hence the failure of many attempts to work black sands in the blast furnace. It is likely, however, that the titaniferous iron ores will become important sources of iron by the development of special methods for their treatment. See TITANIFEROUS IRON ORES.

Ilocos Norte, ē-lō'kōs nōr'tā, Philippines, a province of Luzon, occupying the northwestern part of the island; greatest length, 79 miles; area, 1,265 square miles (including the dependent islands). Two mountain chains inland extend parallel with the coast; the surface otherwise is much broken by foothills, but it is fertile and well watered. Among the natural wonders of the province is a grotto 39 acres in extent and of great beauty, situated in Lice Mountain. The products include rice, cotton, chocolate, corn, sugar, and a fair grade of tobacco; there are deposits of iron and copper in the mountains, the latter having been worked by the natives. The chief industries are agriculture, horse and cattle raising, fishing, and the weaving done by the women. Civil government was established in September 1901; the people of the province are among the most progressive and industrious of the native races, and the new government was received with general satisfaction. Pop. 164,000, mostly Ilocanos.

Ilocos Sur, soor, Philippines, a province of Luzon, on the west coast, bounded on the north by Ilocos Norte and on the south by Unión; length 70 miles; area 492 square miles (including dependent islands). The eastern boundary consists of a chain of mountains which slope toward the coast in terraces; the rivers are small. The coast road runs through the province from north to south, connecting the important towns and villages. The soil is fertile, the principal products are rice, corn, sugar, indigo, chocolate, peanuts, and vegetables; the chief industries, other than agriculture, are the weaving of cotton cloth, the manufacture of baskets, hats, card cases, and pipes, and cattle raising. There is also considerable trade, carried on mainly through the native markets in the different towns, and some export. Civil government was established 1 Sept. 1901. Pop. 180,000, mostly Ilocanos.

Iloilo, ē-lō-ē'lō, Philippines, province of Panay, including the eastern and southeastern coast of the island; greatest length, 111 miles; area 2,102 miles (with dependent islands). A range of mountains follows the northern and western boundary lines; the rest of the surface is undulating, sloping to the sea. There are several large rivers, the most important being the Jalaur and the Jaro. This province has some of the best roads in the archipelago; the principal towns are connected with the capital, Iloilo, and some of the rivers are navigable for native boats to the foot of the mountains. The products include sugar-cane, corn, rice, coffee, chocolate, tobacco, and hemp; there are also in the province deposits of gold and iron, stone quarries, and extensive forests. The chief industries are live-stock raising, the weaving of fabrics of pineapple fibre (piña) and cotton, and the manufacture of sugar. In 1899 the United States troops occupied the province, immediately began operations against the insurgents who were located there with headquarters at Santa Barbara, and succeeded in dispersing their forces. In April 1901 civil government was established. The inhabitants are mostly of the Visayan race and are generally Catholics, though some of the mountain tribes are still heathen. Pop. 423,500.

Iloilo, Philippines, capital of the province of Iloilo, Panay, situated on the Iloilo Strait at the mouth of the river of the same name. It is irregularly built, but the public buildings and the houses are of good construction. It has an excellent harbor, and is the second town of the Philippines in commercial importance; it is the centre of the trade of the province and has also a large foreign trade, exporting tobacco, rice, coffee, hides, and hemp, and importing Australian coal and general merchandise. There are also several industries, chief among them being the manufacture of piña, jusi, and simay. In February 1899 the insurgents who were in possession of Iloilo fired upon the United States gunboats Petrel and Baltimore; the town was then bombarded and taken by the Americans. Pop. 10,500.

Ilopango, ē-lō-pän'gō, **Illabasco,** or **Cojutepeque,** San Salvador, Central America, a lake of volcanic origin, 6 miles southeast of the city of San Salvador, about 14 miles long by 6 miles broad. It is surrounded by high, precipitous hills, composed of scoriæ and volcanic stones, and has several islets, one of conical shape about 400 feet high, formed during a volcanic eruption in 1879–80. Fish abound, although the waters exhale a disagreeable sulphurous odor, and are unpotable. The surface of the lake is 1,200 feet below the level of the surrounding country; when ruffled by a breeze the waters have a singularly brilliant parrot-green color.

Image, in optics, the picture or impression produced by the luminous rays from an object reflected or refracted in mirrors or lenses when they enter the eye of an observer as if they had proceeded from a representation of the object. More correctly, the image is the locus of the foci (or circles of least confusion. See FOCUS) of rays from consecutive points of the object. When the light rays actually pass through the points of the image the image is real and may be thrown upon a white screen. If no screen is interposed the image can be seen by an eye placed in the pencil of rays which pass through it. When the light rays do not actually pass through the points of the image, but diverge from one another on leaving the mirror or lens, the image is said to be virtual, and cannot be thrown upon a screen; it becomes visible to an eye placed in the pencils of rays which appear to have passed through it. See MIRROR; LENS.

Images, Veneration of, the practice of venerating and honoring in public or private graven or painted representations of sacred things or persons. Because of the general prevalence of idolatrous worship of images, the Jews in the Old Law were forbidden the making of images, although evidence of the lawfulness of the practice is afforded in the positive command to «make two cherubim of beaten gold on the two sides of the oracle,» to «make a brazen serpent and put it up for a sign.» The walls of the catacombs, which were the refuge of the first Christians in times of persecution, show many sacred pictures, and after the period of the persecutions the use of sacred images or paintings became open and undespised. Consult Damascene, 'Treatise on Holy Images,' translated by M. H. Allies (1898).

Imaginary Quantity, the result of an algebraic calculation, when the application of the rules for resolving equations leads to an operation that cannot be performed. The operation referred to is the extraction of the square root of a negative quantity. Thus in the equation

$$x^2 = -a^2,$$

to find the value of x we should require to take the square root of $-a^2$; and this is impossible. To indicate this impossibility the roots of the equation above are written thus: $x = +\sqrt{-a^2}$, $x = -\sqrt{-a^2}$, or more frequently and more neatly $x = +a\sqrt{-1}$, $x = -a\sqrt{-1}$. The name imaginary quantity is given to the $\sqrt{-1}$, and any algebraic expression containing $\sqrt{-1}$ is called an imaginary expression: thus $a + b\sqrt{-1}$ is an imaginary expression.

These imaginary roots have proved of great importance in algebraic geometry. In fact, the employment of imaginary quantities systematically is the foundation of some of the greatest modern discoveries and improvements in geometry. Even in algebra, although it is impossible to obtain a value for the expression, or to explain the meaning of it, yet it may prove of use in indicating how to alter the statement of a problem so as to obtain a real solution.

Imagination, that mental power which, according to McCosh, puts in new forms and dispositions what had been previously in the mind. It is therefore not a productive but a reproductive power, for it cannot create anything *de novo*, but can only reproduce in new forms those ideas or images of which it has derived the elements from previous experience. This is in accord with Locke, who says that man's power is much the same in the material and intellectual worlds, the elements in both being such as he hath no power either to make or to destroy.

The imagination differs from the memory, which is also one of the reproductive powers of the mind, in the following way. The memory reproduces what had formerly been before the mind in the form in which it first appeared, but the imagination separates and combines the mental contents in various ways. An act of memory is also accompanied with a belief in the past reality of what the mental picture represents, but an act of imagination (at least in the normal mind) is not accompanied with such a belief. As McCosh has expressed it, the memory may be compared with the mirror which reflects exactly what is before it; whereas the imagination may be likened to the kaleidoscope which reflects objects in an infinite variety of shapes and colors.

When an attempt is made to analyze the workings of the imagination, it is found that this faculty, like all the other mental functions, is governed by certain laws. First in importance among these are the laws of association of ideas. According to these laws the ideas which are summoned up and utilized by the imagination arise according to the principles of contiguity and correlation. By the association of ideas is meant the tendency of ideas to recur in the order or groups in which they naturally stand, either by virtue of some resemblances or some identities of time and place. Thus by correlation is meant the association of ideas in the mind because of some mutual resemblances of parts or qualities; and by contiguity is meant such association because of the proximity in time and place, and not because of any mutual resemblances. In analyzing any act of the imagination it will be found that it follows one or other of these laws of association, although they can be variously grouped and subdivided.

The uses of the imagination and its moral and hygienic relations open up vast questions which can scarcely be more than named here. It is almost enough to recall the activity of this faculty in the realms of poetry, of fiction and of art, but its offices are not confined to these fields, for in science also its activity is very great and of first importance. Imagination goes before theory, and theory points the way to new discoveries in science. Of such widespread activity is this faculty that practically it is almost impossible to dissociate it from the other mental functions. It is always manifesting itself in some way in even the most prosaic affairs of daily life. The conduct or control of the imagination is a subject that suggests many moot points in psychology, in psychiatry and in ethics. That the imagination is subject to control within certain limits may be granted, although these limits are not fixed, and outside of them the imagination may often run riot without the possibility of control. Its action, in fact, like that of most mental faculties, is largely automatic, and its control by the will, the intelligence and the conscience, is often a matter of the mental training and mental health of the individual. In ethics the control of the imagination, or at least its guidance, so that it shall not minister to sensuous or immoral pleasures, even though these be purely imaginary, is a self-evident rule of conduct, but one which is doubtless often broken with some degree of impunity. In mental discipline its control is also essential, for its too great or mere idle indulgence is no doubt unwholesome and wasteful.

In psychiatry, the imagination, like most or all of the other faculties, is found to be subject to derangement, and this in various degrees, according to the patient and the form of disease. That it is active in the formation of delusions, and is much disturbed in both depressed and exalted states of the mind, is quite evident. In all insane states, except the advanced dements, the kaleidoscopic function of the imagination is apparent. The mental pictures are broken reflections of past mental contents, arranged often at seeming haphazard, and often of only the most sombre and melancholy tints.

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Imam, ī-mām, or -mām', a Mohammedan chief or leader; a title given to the four successors of Mohammed, and to the twelve great leaders of the shiites. In Turkey, applied to the functionaries who call the people to prayer from the minarets, perform circumcision, etc. They are chosen by the people, and confirmed by the secular authority, under whose jurisdiction they also are in criminal and civil affairs.

Imbriani, Vittorio, Italian poet: b. Naples 24 Oct. 1840; d. 1 Jan. 1886. He pursued historical and philosophical studies at Naples, Zürich, and Berlin, but later became a soldier, serving in the wars of 1859 and 1866. The best known of his works are 'Canti populari delle provincie meridionali' (1871–2); 'Dodici canti pomiglianesi' (1876); and 'La novellaja fiorentina' (1877).

Im'bricated Snout-beetle. See Snout-beetle.

Imbros, an island in European Turkey, west from the entrance to the Dardanelles. It is 18 miles long, east to west, 8 miles broad, and terminates west in Point Aufiaka, and east in that of Basse. It is mountainous, rising in its loftiest peak to the height of 1,959 feet; well wooded, and intersected with richly-fertile valleys, producing wine, honey, oil, cotton, and lead. It has only two towns — Flio and Castro. Pop. 10,000, mostly Greeks.

Imide, ĭmĭd, or -mĭd, a chemical substance derived from ammonia, NH_3, by replacing two of the hydrogen atoms by a divalent radical. If all three of the hydrogen atoms of the ammonia are replaced by one trivalent radical, the compound is called a nitrile. When one or more of the hydrogen atoms of the ammonia are replaced by a corresponding number of monovalent radicals the compound thus formed is called an amide or an amine, according to the nature of the radical by which the hydrogen is replaced. See Amide; Amine.

Imitation. Imitation is the process of reproducing by one's own act the observed actions of others. Its beginnings lie therefore in perception. It is the result of a desire to change from the role of spectator to that of actor. Imitation may be of two kinds (1), a primitive and (2) a developed form. The primitive form is an unconscious copying of some object of perception; and is simply a reaction in response to the outer stimulus which excites it. The best example of this kind of imitation is to be found in the sounds which a baby is wont to repeat when it has once heard them. It is a peculiar characteristic of the primitive imitation that the sound, for instance, when once imitated becomes in turn a new stimulus to start the process over again, the result being that the imitated sound is repeated rapidly again and again until the organs are wearied, or the attention is diverted. The exercise is evidently found to be pleasurable, and is therefore continued indefinitely. Mr. Baldwin has given the name «circular reaction» to this kind of imitation, the phrase indicating a sort of self-perpetuating process. The name also of «suggestive imitation» has been given to this class of acts which appear imitative to an observer, but are not consciously felt to be so by the imitator.

The second form of imitation is more complex, and marks a more developed stage of consciousness. The imitation has now become a conscious act. The object perceived has aroused some degree of interest, and there is consequently a conscious effort to reproduce it with the original set before one as a model. In imitation which is of this form, we find the process intimately connected with the attention. In attention there is always a conscious striving for a more accurate knowledge of the object of perception, and imitation serves to gratify this desire, inasmuch as one comes to closer quarters as it were with any act when one tries to reproduce it. Knowledge of it comes then from the inside. This means a concentration of attention, and a consequent result of more definite and satisfying knowledge. Moreover, attention will vary as the interest, for that which one attempts to do himself is always far more interesting than merely that which is observed.

In the development of consciousness imitation as a social factor plays a most conspicuous part. Through it a child acquires all of its social tendencies, and becomes a part of the social organism in which it is to live and move and have its being. Its education starts with the first rudimentary efforts at imitation; and is carried on from this initial stage to the very highest and most advanced forms in constant dependence upon the imitative tendencies. Through imitation the knowledge of one generation is acquired by the succeeding, and a continuity in development is assured which makes for the progress of the race.

In this connection, it is to be noted, however, that with the imitative impulse there are two other tendencies which have free play and a wide scope. These tendencies must be reckoned with also. They are the tendency to social opposition, and the tendency to inventiveness. The tendency to social opposition is a desire for self-assertion, an impulse primarily to do something different from that which others are doing merely from a feeling of native opposition. This impulse is seen in very young children, and remains throughout life. It is often recognized as unreasonable, but nevertheless irresistible. It is a fertile source of the differences of opinion which so early develop in childhood. It prevents a slavish imitation and the loss of initiative in action. However in order to act in a manner which differs radically from one's social environment, there is implied a preliminary training of an imitative sort; for there must be a basis of common activity in order that a departure from the accepted mode may have any significance, and there must be also a body of common beliefs, in order that there may be any such thing as a real difference of opinion. The other tendency is a more pronounced and a more definite form of opposition to imitation; it is the tendency to inventiveness, not for the sake of opposition, nor as the result of an inevitable clash of opinion in one's social setting, but for the sake of producing that which is suggested from within, and not from without. It is the working out of one's own individuality without waiting for a copy or model. It is a shifting of the centre of interest from some object which is perceived, to some object of the inner sense, a fancy born within the brain, an idea which has its origin in the depths of one's own consciousness. This tendency is seen even in early acts of imitation, a tendency to depart from the copy, to introduce variations of design, to improve upon the model.

Here again in order that there may be increased power of independent production, there must be a previous schooling in the art of exact imitation. The original artist is not one who has never copied from a model nor studied the works of the masters. It is the interplay of the imitative impulse with the tendencies to social opposition, and to inventiveness which make progress possible. Progress is not repetition nor is it on the other hand activity which swings clear of any past. Where there is progress there is imitation, but the kind of imitation which allows full range for inventive play, and independent opinion.

There is a special form of imitation which appears on a large scale in the so-called mob impulse, where individuality seems merged in the tendencies of the mass, and imitation is in the nature of a reaction. The individual is swept along with the crowd, not because he wills it necessarily, but because the action of the crowd carries him away as with a flood. This kind of imitation has been given the name of "plastic imitation." Much study has been devoted of recent years to the relation of imitative impulses in animals to congenital tendencies. The instinctive furnishes a strong predisposition to imitation, and in many of the early activities of animals it is most difficult to draw a line of distinction between instinct and imitation.

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Immaculate Conception of the Blessed Virgin Mary, a doctrine of the Roman Catholic Church whereby it is declared that "The Blessed Virgin Mary, at the first instant of her conception, was, by a singular privilege and grace of Almighty God, in virtue of the merits of Jesus Christ, Savior of mankind, preserved immaculate from all stain of original sin." In these words is the doctrine proposed for the acceptance of the faithful in the Apostolic Letter of Pope Pius IX., dated 8 Dec. 1854. Previously, for at least 600 years, the doctrine of the Immaculate Conception had been canvassed in the theological schools, and had from an early period in the Church's history been entertained with more or less definiteness by eminent Fathers of the Church and other ecclesiastical writers. The most notable passage from the writings of any of the Fathers relating to this subject is, doubtless, that quoted from St. Augustin's treatise on 'Nature and Grace' (c. 25) in which he makes an exception of Mary when he declares that all mankind are in sin because of Adam, "except the Holy Virgin Mary," he writes, "concerning whom, for the honor of the Lord, I would have no question at all raised in treating of sin — *nullam prorsus, cum de peccatis agitur, haberi volo quæstionem.*"

In the 12th century the great St. Bernard protested vigorously against the usage of certain churches of France in commemorating by an annual festival the Conception of the Blessed Virgin; but the ground of St. Bernard's complaint was, not that the belief in the Immaculate Conception was erroneous, but that the See of Rome had not signified its approval. At the same time St. Bernard refers the whole matter of his dispute with his opponents, the canons of Lyons, to the judgment of the Holy See. The authenticity of his letter has been disputed, but on grounds, as Benedict XIV. implies, absolutely insufficient. Throughout the 13th and following centuries the doctrine of the Immaculate Conception was a subject of keen disputation in the theological schools, its chief advocates being theologians of the order of the Franciscans, its opponents the children of St. Dominic. But the doctrine won ground steadily. In 1439 the Council of Basel declared it to be "A pious doctrine consonant with Catholic faith"; the Council of Trent abstained from formally approving it as an article of Catholic belief; but in their definition of original sin, the Tridentine Fathers took care, with St. Augustin, to except the Blessed Virgin out of the number of those bearing the stain of original sin.

At last, in 1849, Pope Pius IX. judging that the time had arrived for expressing the mind of the Church upon this question, addressed letters to all the bishops of Catholic christendom inviting them to report the opinion and feeling of their respective churches regarding the expediency of declaring the doctrine to be an article of Catholic belief. Five years were allowed to elapse before the next step was taken — that of pronouncing with the unanimous consent of the chief pastors throughout the world and of the churches, the dogmatic definition that "the doctrine was revealed by God, and therefore should firmly and constantly be believed by all the faithful." To catholic-minded men, says Cardinal Newman (Apologia p. 279), "there is no burden at all in believing that the Blessed Virgin was conceived without original sin: indeed it is simple fact to say, that Catholics have not come to believe it because it is defined, but it was defined because they believed it."

JOSEPH FITZGERALD.

Immigration to the United States. The subject divides itself broadly into seven heads: (1) the general history of the foreign influx, its numbers, fluctuations, and causes; (2) its relation to the previously existent population; (3) its sources, and the changes in them; (4) its distribution, the changes in it, and the constituents of the population due to it; (5) its industrial character; (6) its social effects, in occupations and wages of the native population, politics, crime, insanity, pauperism, and illiteracy; (7) the legislation with regard to it, and the public feeling which produced the legislation.

1. The same causes which were bringing a small but steady stream of European emigrants to this country before the Revolution continued to operate after it. From 1783 onward, it was estimated at 4,000 a year till 1794, when the French-English war raised it to 10,000. It dropped again to about 6,000 a year till 1806, when the British and French Continental blockades and the American Embargo practically annihilated it for a decade. (See EMBARGO.) In 1810 the passenger arrivals (including returned Americans) numbered toward 8,000, in 1817 22,240. The numbers and hardships from overcrowding drew out legislation noted later; and from 1 Oct. 1819 account has been kept at all customs ports of the number, sources, and conditions of arriving aliens. The following table gives the number in each year since.

IMMIGRATION TO UNITED STATES BY YEARS.

Year ending 30 Sept.		Year ending 30 Sept.	
1820	8,385	1843	52,496
1821	9,127	1844	78,615
1822	6,911	1845	114,371
1823	6,354	1846	154,416
1824	7,912	1847	234,968
1825	10,199	1848	226,527
1826	10,837	1849	297,024
1827	18,875	1850	310,004
1828	27,382	1850 (1 Oct. to 1 Dec.)	59,976
1829	22,520	1851 (Jan. to Dec.)	379,466
1830	23,322	1852	371,603
1831	22,633	1853	368,645
1832 (to 31 Dec.)	60,482	1854	427,833
1833 (Jan. to Dec.)	58,640	1855	200,877
1834	65,365	1856	195,857
1835	45,374	1857 (to 30 June)	112,123
1836	76,242	Year ending 30 June	
1837	79,340	1858	191,942
1838	38,914	1859	129,571
1839	68,069	1860	133,143
1840	84,066	1861	142,877
1841	80,289	1862	72,183
1842	104,565		

Year ending 30 June		Year ending 30 June	
1863	132,925	1884	518,592
1864	191,114	1885	395,346
1865	180,339	1886	334,203
1866	332,577	1887	490,109
1867	303,104	1888	546,889
1868	282,189	1889	444,427
1869	352,783	1890	455,302
1870	387,200	1891	560,319
1871	321,350	1892	579,663
1872	404,806	1893	439,730
1873	459,803	1894	285,631
1874	313,339	1895	258,536
1875	227,498	1896	343,267
1876	169,986	1897	230,832
1877	141,857	1898	229,299
1878	138,469	1899	311,715
1879	177,826	1900	448,572
1880	457,257	1901	487,918
1881	669,431	1902	648,743
1882	788,992	1903	857,046
1883	603,322		

Totals since 1820, 20,952,467. But it must be remembered, first, that up to 1856 the record is of all "alien passengers arrived," without discriminating passengers from immigrants, so that much should be abated from this total; second, that the immigration overland from Canada and Mexico is not counted in — and in 1900 Canada was put down as the birthplace of 1,183,255 persons, and Mexico 103,445 — so that a great amount should be added to the total. On the whole, it seems probable that these accessions have far more than balanced the above duplications, though not the other duplications of the same emigrants coming and going.

IMMIGRATION BY DECADES.

1821-1830	143,439	1861-1870	2,314,824
1831-1840	599,125	1871-1880	2,812,191
1841-1850	1,713,251	1881-1890	5,246,616
1851-1860	2,598,214	1891-1900	3,844,420

Since 1900, 1,993,707, or half as much in the past three years as in the whole previous decade. The number of arrivals reported in 1903 exceeds the largest number for one year (1882) by 68,054.

The barest glance at the first table shows that it has eight well-marked periods, though with notable fluctuations within them. The first is from the beginning to 1826 inclusive, with a slow increase to about 10,000 in 1794. Thence to the end of 1831 it rather more than doubles; probably from reports of the fertile lands just reaching a wider stratum of peoples, and the miserable European industrial conditions of the time of the Holy Alliance. Then with a sudden bound it almost trebles, and with a sharp drop after the panic of 1837, rises to seven-fold in 1846; the first leap perhaps due to the opening up of the West by steamer navigation, the steady increase due to the same and to railroads making the central lands easy of access. The Irish famine then begins to swell it to a torrent, shortly increased by the California gold discoveries, which do not exhaust their effect till 1854. The sudden drop then, and its continuance later, may be laid to several causes. The anti-foreign agitation in this country, owing to the flood of foreigners demoralizing politics and industry, probably had much effect; then the business depression of 1857 and the following years, merging into the War, kept it down in spite of the efforts of the steamship agents, now penetrating every country for business. Later in the War, the scarcity of labor here, owing to the drain of the able-bodied, drew in a larger immigration of laborers; but the new period fairly begins only after the War. From 1866 to 1873, the great inflation time, when countless new enterprises were started and new railroads built by thousands of miles, was naturally a palmy time of immigration. Then the great panic and the ensuing hard times struck it down and kept it down till 1879. The revival in 1880 brought it back instantly to the mark of eight years before, and two years later it reached a climax not again attained till 1903; and it has never gone down to near its old mark except for two years, 1897 and 1898, the drop 1894–8 being due to the panic and hard times. Of course each increase tends to widen the next, arrivals encouraging others to come.

2. The following table shows the number and proportion of the foreign-born for the past half-century, and also the native-born of foreign parentage, single or mixed, for 30 years, indicating the foreign strain in American blood.

Census years	Total Pop.	Foreign-born		One or both parents foreign	
		Number	Per cent	Number	Per cent
1850	23,191,876	2,244,602	9.7	....	......
1860	31,443,321	4,138,697	13.2	....	......
1870	38,558,371	5,567,229	14.4	10,892,015	28.2
1880	50,155,783	6,679,943	13.3	14,922,744	29.8
1890	62,622,250	9,249,547	14.8	20,676,046	33.
1900	76,303,387	10,460.085	13 7	26,198,939	34.3

Comparison of this table with the first two shows some striking facts. In 1850, of the 2,500,000 (about) who had come into the country since 1815, only one tenth were dead or had re-emigrated in the 35 years. It is true that nearly one half the whole had come in within five years; but even so, this is a suspicious showing, and suggests a large overland emigration from Canada (especially during the gold fever 1849–50) which does not figure on the records. Every succeeding census has shown a large and increasing discrepancy between the arrivals and the remaining foreign population, the falling-off being sometimes difficult to explain except by duplications, re-emigrations, and a heavy death-rate. As the grandchildren of the arrivals of two generations ago are now "Americans," the percentage of foreign-born is not rising, and even that of the whole foreign-parentage class is but little greater than that of old, under the enormous flood of immigrants.

3. Most of the early arrivals came from Great Britain; about 110,000, or 76.5 per cent, from 1820 to 1830, while Germany sent about 10,000. In 1850 the foreign-born of Anglo-Saxon blood, English, Scotch, and Canadian, must have been over 750,000, while that from Celtic Ireland was probably 650,000 — about 60 per cent from all Great Britain; the Germans furnished 584,000, or 36 per cent. The Teutonic blood was overwhelmingly dominant still, and the Anglo-Saxon largely so. In 1860 the elements were still much the same: Great Britain claimed nearly 2,500,000, or 60 per cent, Germany 1,276,000 or over 30 per cent. None others were of much account. In 1870 the totals were much larger for the older elements, but the British percentage was dropping, and other elements coming forward: Great Britain and Canada showed 3,120,000, or about 55 per cent; Germany 1,690,000, about 30 per cent as before; but there were nearly 250,000 Scandinavians against some 60,000 the decade before, and 40,000 Bohemians. Of the Canadians, probably 150,000 were French. In 1880 the still increasing British and English-Canadian contingent showed about 47.5 per cent; the German holding its own well, some 30 per cent; making over 2,000,000 in all. But there were 85,000 Bohemians, 48,000 Poles, 440,000 Scandinavians, 44,000 Italians, and 35,000 Russians. In 1890 the change was marked, though the Teutonic strain was still farther to the fore: the Germans and German Swiss and Austrians footed up nearly 3,000,000, or about 33 per cent, Great Britain and English Canada furnished about 2,700,000, now only about 29 per cent. But Poland, Russia, and Bohemia now showed nearly 450,000; Italy, 182,500; Hungary, 62,435; Austria, 123,271, much of it Slav; Scandinavia, 933,000. In 1900, the tendency had become so striking as to necessitate a further grouping for clear perception of its meaning: Poland, Russia, Bohemia, and Hungary — in a word the Slav countries — were the birthplaces of over 1,000,000 Americans, nearly 10 per cent of all our foreigners; Italy of nearly 500,000; Mexico of over 100,000; Scandinavia of over 1,000,000; France and French Canada of about 500,000: the whole representing nearly as great a share as Great Britain. If the showing is by immigration and not by the masses still living from the old immigrations, the account is far more impressive: the percentage of Great Britain had sunk in half a century from over half the total to 19.4 per cent; of Germany, from 38 per cent to 14: while the Scandinavian had risen from a neglectible quantity to about 10 per cent of the whole, and the East European, from practically nothing, had risen in the decade to 1,186,000, or nearly 31 per cent. The following table for half a century by decades, and for 1901–3 separately, tells its own story:

	England and Scotland	Ireland	Germany	Norway and Sweden	Italy	Russia including Poland	Austria-Hungary
1851-1860..........	423,974	914,119	951,667	20,931	9,231	1,621	......
1861-1870..........	606,896	435,778	787,468	109,298	11,728	4,536	7,800
1871-1880..........	548,043	436,871	718,182	211,245	55,759	52,254	72,969
1881-1890..........	817,357	655,482	1,452,970	568,362	307,309	265,088	353,719
1891-1900..........	342,357	403,496	543,922	325,943	665,668	588,866	597,047
1901-1903..........	64,065	94,542	90,041	144,547	544,993	328,697	491,380

A still further condensation will present the essential elements even more clearly:

	Teutonic and Anglo-Celtic	South and East European
1871-1880	1,914,341	179,982
1881-1890	2,494,171	926,116
1891-1900	1,615,718	1,841,581
1901-1903	393,195	1,365,070

Nearly as many have come from southern and eastern Europe in the past three years as in the entire preceding decade; while the Teutonic strain, even when reinforced by the great Scandinavian flood, has dropped to less than a fourth of that, and less than a sixth of what it was 20 years before.

4. The distribution of this mass of immigrants in the United States may be considered in various aspects — of foreigners as a whole, and of special races; of foreign-born as bearing on politics and industry, and of all with immediate foreign blood as bearing on heredity and sociology. Here we shall consider both; the latter to some extent, but the second first. In the last census, of 25,928,462 persons of foreign parentage, about seven eighths were in the North Atlantic and North Central divisions, where are the great manufacturing cities and abundance of fertile land. The first division had slightly the more. Only 1,059,009 were in the South Atlantic and South Central divisions together. Of cities, too many to mention have a majority of this population of foreign parentage; of cities with 25,000 and over, by the census of 1900, 93 had over 50 per cent, and 18 over 75; while 6 — Fall River, Holyoke, and Lawrence, Mass., Hoboken, N. J., Woonsocket, R. I., and Milwaukee, Wis. — had over 80 per cent. The highest percentage was in Fall River, 80.1. Of Massachusetts' 20 cities of this size, only 1, Haverhill, had less than half of foreign parentage, and that had 48.9.

Of course these figures, which seem very large, have no bearing on the question of Americanism in feeling or action. The children of foreign parents are not less intensely American than those of natives; it is their own country. The figures of actual foreign birth are very different. North Dakota still leads, but with only 35.2 per cent; Rhode Island 31.1, Massachusetts 29.9, Connecticut 26.1, New York 25.9, Minnesota 28.8, Wisconsin 24.8. Of cities, none have a majority of foreign-born, and but one over 40 per cent. But this concentration of the foreign-born in the cities is precisely one of the gravest elements in the problem. In 101 principal cities in 1900 was nearly half — 49.2 per cent — of the total foreign-born, making 26.1 of their population, against 9.4 per cent of the total in the rest of the country.

Of the nationalities which have formed "colonies" in the different places, those with the less understood tongues are of course the most prominent. Religion is occasionally potent, as well as proximity; thus the French Canadians keep together as Roman Catholics, and mostly in New England as nearest home. The Italians, city more than farming folk, are most numerous in New York, Boston, Chicago, New Orleans, and San Francisco; the Norwegians, mostly agriculturists, in Wisconsin, Minnesota, and the Dakotas; the Poles, city men, chiefly in New York, Boston, Philadelphia, Chicago, Milwaukee, Detroit, Minneapolis, and St. Paul; the Bohemians in New York, Chicago, and Cleveland; the Swedes in New York, Boston, the Connecticut cities, Philadelphia, Illinois, and Minnesota; the Welsh, not as Celts but as miners, mostly in the Pennsylvania mines. In 20 cities of which the census gives a special report, the Germans predominate over all other foreigners in [illegible]; the greatest actual number being in New York, which had 322,343; though the greatest percentage, [illegible] of the whole foreign population, is in Cincinnati, Milwaukee having 60.5, Louisville 57.8, and St. Louis 52.8. The Irish have a majority in 9, the chief lead being in Cambridge, Mass., 36.9. The French Canadians predominate in Fall River and Lowell, Mass., cotton-mill cities, with 40.3 and 35.8 per cent. The Swedes have the greatest number in Minneapolis, 32.8 per cent.

5. The question of occupations of the foreign-born is of the first importance, as bearing on that of wages, which they are supposed to lower. We have to discriminate between several facts in this: (1) their distribution between occupations; (2) the total number of working age; (3) their concentration in cities where most of the manufacturing is carried on. The last has already been shown. For the others, the government volume dealing with the census of 1900 is not yet issued; but that of 1890 in this regard probably differs little. The report of the occupations assigned by intending immigrants year by year gives little help, as they drift into various occupations; but it may be said that in 1902, of 495,500 male adults, only 80,000 were skilled laborers, and less than 3,000 professional men. This is natural, the best men being fairly placed at home, as a rule. In 1890, while the foreign-born over 15 formed 22 per cent of the whole population of that age, they formed 36 per cent of the domestics and menials, and 34 per cent of the hands in the manufactories. In special employments, they showed far more striking totals. They formed 71.12 per cent of all tailors, 59.52 per cent of bakers, 53.13 per cent of hucksters and peddlers, 49.00 per cent of restaurant and saloon keepers, 47.02 per cent of leather-workers, over 46 per cent each of stone-cutters, textile-mill hands, and cabinet-makers, and 44.5 per cent of gardeners, florists, and that class.

6. As to social effects, where the foreign-born are of moderate numbers, and do not increase faster than the general development of industries, they can hardly depress wages much; and two of the complaints made against them — that they lower wages by willingness to accept a poor standard of living, and demoralize industry by readiness to strike — cancel each other. They cannot at once be satisfied with poor pay and unsatisfied with fair pay. But when concentrated into special occupations in the cities, as the enormous tailoring contingent in the sweat-shops, where for a time they are willing to work for starvation wages to get on their feet, they can and do for a considerable time ruin all decent workers' prospects, depress wages below an endurable point, and drive natives or better-grade foreigners out of the trade, after extreme distress.

Politically, facts do not warrant the belief that the foreign element exercises the corrupting influence, either by ignorance or venality, that is often attributed to it. There are no worse governed or more corrupt cities in the Union than some where the foreign element is relatively small; nor is there any evidence that as a whole they are more easily swayed by appeals to selfishness. They are, however, the chief ingredient of political and industrial mobs.

Regarding crime, the usual statistics are misleading both for and against the immigrants. On the one hand, they restrict the records to the serious crimes, in which the native-born "tough," from his rearing and training into thorough knowledge of his surroundings, and superior chances of escape, naturally takes the lead; while the foreigner, from his great predominance among those with short sentences, seems to swell heavily the volume of petty crime. It is believed also, probably with truth, that the native-born of foreign parents are worse than their fathers and vastly worse than the native white. On the other hand, the statistics of crime are for the whole population, not for the adult males of youth and middle age, who mainly commit it; on the same basis, the foreign portion makes no worse showing than the native. Still again, it is believed that the fact of the foreign population being mostly of the lower orders in wealth and social position has much to do with it, and that, class for class, there is little difference.

In pauperism, there can be no question that the foreigners, mostly coming with nothing and having no friends to care for them, should swell the pauper population immensely. In 1890 there were over 3¾ times as many foreign-born as native-born paupers.

As to insanity, there is a considerably larger tendency to it in the foreigner than the native; most likely from greater average debility of constitution, which shows in the brain as well as in other organs. Between the ages of 25 and 55, the period which furnishes most of the patients, there was in 1890 a percentage of insane foreigners more than half as large again as that of natives.

With regard to illiteracy, while the foreign-born white is naturally much less educated than the native, his children average fully as well.

7. The first legislation in the United States on the subject of immigration was of 2 March 1819, and merely provided that a record should be kept of the number of passengers arriving in each customs district, with their sex, age, occupation, and country of birth. For many years there was no thought of anything but exultation in the number of arrivals, as increasing the wealth of the country, and providing an asylum for the poor and oppressed. Even the Know-Nothing agitation of the fifties, prompted by political reasons (see American Party), led to no restrictive legislation. In 1864 the first immigration act was passed by Congress, and was to promote and not restrain it; this was repealed 1868. Several States established immigration bureaus to encourage it and draw it their way. On 3 Aug. 1882 the first restrictive act was passed, but only to bar out criminals, insane, paupers, etc. Head taxes were imposed as a fund for relieving the distressed, etc. Foreign convicts (non-political), lunatics, idiots, and those liable to be a public charge, were to be returned at the expense of the owners of vessels on which they came. On 26 Feb. 1885 a more drastic one was passed, which was well meant, but from its sweeping character has been, as enforced by fanatical or interested persons, the source of much useless hardship, and has tended to make the country ridiculous. This was to prohibit any laborer coming over under contract to work; it did not except professional men or skilled laborers, and while it was aimed at strike-breakers and cheap gangs, was enforced against artists, musicians, architects, etc., and even clergymen, to the discredit of the country's good sense. It has since been somewhat modified. In 1891 the act of 1882 was extended to other classes, and to all "assisted" immigrants not affirmatively shown to be without the terms of the act. This act took the entire matter into the hands of the general government. The act of 3 March 1903 still further amended it by requiring a preliminary inspection at point of departure, and giving the government the right to deport the immigrant landed in defiance of the act within two years after arrival; it also extended to all persons advocating the overthrow of all governments and the assassination of public officials. The number of persons deported under the act of 1882, mainly for pauperism, had been 28,184 from 1891 to 1900, out of 3,844,420 immigrants.

The Law of 1907.—By the provisions of an act of Congress which took effect 1 July 1907, the tax levied upon every alien entering the United States is $4, instead of $2 as heretofore. This law provides that the tax shall not be levied upon aliens who shall enter the United States after an uninterrupted residence of at least one year immediately preceding such entrance in Canada, Newfoundland, Cuba, or Mexico. Others exempt are such as are otherwise admissible residents of any possession of the United States, and aliens who have been lawfully admitted to the United States and who later go in transit from one part of the United States to another through foreign contiguous territory. Aliens arriving from Guam, Porto Rico, or Hawaii are excluded from the above exemption provisions, under special conditions.

The exclusives include, under the law of 1907, imbeciles, feeble-minded persons, epileptics, persons afflicted with tuberculosis and persons not in the above and other named classes who are found by the examining surgeon to be mentally or physically defective, such mental or physical defect being of a nature which may affect the ability of such alien to earn a living. Persons who admit having committed a felony or other crime or misdemeanor involving moral turpitude are excluded by the new law, also persons who admit their belief in the practice of polygamy; women or girls coming for the purpose of prostitution or for any other immoral purpose; persons who procure or attempt to bring in those of this last named class and persons called contract laborers, coming under some inducement.

An important provision of the Act of 1907 is that which declares "Wherever the President shall be satisfied that passports issued by any foreign government to its citizens to go to any country other than the United States or to any insular possession of the United States or to the canal zone are being used for the purpose of enabling the holders to come to the continental territory of the United States to the detriment of labor conditions therein, the President may refuse to permit such citizens of the country using such passports to enter the United States."

For statistics, see 'Monthly Summary of Commerce and Finance,' by the government; and U. S. Census, 1890 and 1900. See also 'Reports of the United States Industrial Commission on Immigration,' and the article 'Restriction of Immigration,' by Francis A. Walker, in the 'Atlantic Monthly,' LXXVII., 23.

Forrest Morgan.

Immortality (Lat. *immortalitas, in + mortalis*, 'not mortal'). The doctrine that the soul continues to exist after death, or more specifically the doctrine of eternal personal survival. To the question 'What becomes of the soul after death?' various answers have been given by different philosophers and civilizations. The most noteworthy of these answers may be grouped as follows: (1) Complete annihilation (the Materialists); (2) Survival of the soul for an indefinite period in a world of filmy shadows (Aboriginal); (3) Eternal existence in a moral world of retribution (Christian and certain idealistic philosophies); (4) Transmigration (India, as early as the Upanishads; the Egyptians, Plato, the Pythagoreans, and sporadic amongst Aborigines); (5) Absorption into an Infinite or Absolute Being (Pantheism; the Buddhistic Nirvana, where the individual is annihilated only in the sense that the seed is annihilated in the fully developed plant,—the seed's life-goal); (6) The survival of the individual in the form of the posthumous influence of his personality and achievement, which is scarcely more than a metaphorical use of the term Immortality (many Evolutionists and Positivists; cf. also Ostwald, Münsterberg); (7) Merging or diffusion of the psychic energy of the individual into an unseen hypothetical etheric energy (quasi-materialistic).

Belief in some form of immortality is widespread, although not universal. It is found in all stages of civilization from the lowest form of aboriginal life to the highest occidental culture. The doctrine varies from a belief in an indefinite survival-period after death to the belief in eternal personal life, the latter being the legitimate use of the term Immortality.

Aboriginal Civilization.—Amongst primitive peoples, belief in the survival of the soul is due mainly to four things: (1) Their prevailing animism, which ascribes a soul to everything; (2) The phenomena of dreams and apparitions; (3) The instinctive will to survive and the instinctive aversion to annihilation; (4) The belief in the substantial character of the soul as an entity. 'Looking at the religion of the lower races as a whole, we shall at least not be ill-advised in taking as one of its general and principal elements the doctrine of the soul's future life' (Tylor, 'Primitive Culture,' Vol. II., p. 19). By "future life" is not meant immortality in the strict sense, but simply the soul's survival after death. Amongst aboriginal peoples we find two forms of the doctrine: Transmigration and the independent personal existence of the soul. It must be noted, however, that the dominant idea in the lowest civilization is simply the continuance of the soul in a new life similar to the present life. The abode of souls is usually in some distant part of the earth, less frequently in the nether world or the sky (some Hindus represent the seat of happiness to be vast mountains on the North of India), where it pursues a life modeled after this life, without ethical coloring. To some aborigines the idea of a bodiless existence is unintelligible or ludicrous (cf. Lubbock, 'Origin of Civilization,' 5th ed. p. 378). In the Tonga Islands, the chiefs are thought to be immortal, while the common people are held to be mortal. Amongst the Fijians the belief prevails that everything has a spirit, and they even hope that every cocoanut will be made anew in Paradise (Peschel, 'The Races of Man,' 2d ed. p. 259). They do not restrict future life to man or even to animals. So also the Itelmes of Kamschatka believe in the rebirth of all creatures "down to the smallest fly" (Peschel, *op. cit.* p. 259). The Fijians think that as is their condition at death, so will their condition in the next world be. The infirm and diseased will find it difficult to make the long journey to Mbulu; consequently it is a custom to put the aged to death before they become too weak to travel. A common belief amongst some primitive peoples is that the individual has several souls, as amongst the Chippewa Indians, the Khonds of Hindustan, and in Madagascar. The Sioux Indians believe that man has four souls, as has also the bear (in their view the most human of animals). The Totemism of the Indians rests on the theory that the souls of ancestors have passed into the bodies of animals. Certain Eskimos put a dog's head in a child's grave, because the dog is skilful in finding its way and can guide the child's soul to the spirit-land (Tylor, *op. cit.* p. 424). The Hottentots place the body of the deceased in the same position as the embryo occupied in the mother's womb, symbolizing thereby their belief that in the womb of the earth's darkness the dead will mature and come to birth. The lower races, in general, regard the soul as a filmy body, *i. e.*, a corporeal entity capable of life and action, and needing, consequently, no bodily renewal. The idea of a resurrection of the body is, however, often found amongst primitive peoples, although it forms no important feature of their belief, as it does in the doctrine of immortality in Persia, later Judaism, and the Pauline Epistles. On the whole, one may say that the difference between the conception of lower races and that of higher civilizations regarding the immortality of the soul, is that the former look upon the future life as a continuance of the present type of sense-life, with activities analogous to the present crass activities, a corporeally refined shadowy state, with a decrease in the struggle for existence and an increase in the amount of pleasure. The higher civilizations, on the other hand, make the doctrine of judgment and retribution paramount, spiritualize the conception of the soul and its future life, eliminate geographical definiteness from the soul's abode, and correlate the conception of immortality with a system of religion and ethics.

The Egyptians.—In the earliest known civilization of Egypt, the problems of religion and eschatology were central interests. In the remotest period of their history, the Egyptians believed in an invisible deity or deities and in the future life of the soul. The human soul is of the divine substance, an emanation from Ammon-Ra. At death it passes to the seat of judgment at the gateway of Amenti (the Hellenic Hades) and there it is adjudged by the 42 assessors (representing the 42 sins of which the soul must be innocent) of the dead, before the supreme tribunal of Osiris. The soul that is proved pure at the judgment returns to its divine origin, while the soul that has led an impure life is condemned to reincarnation and passes into an animal life to attain purification through probationary metempsychosis. The theory of the future life of the soul amongst the Egyptians is based on the metaphysical view that the soul is an emanation from an original cosmic soul, on the ethical view that the present life is a probationary period, and on the conception of the moral fitness of the soul for reabsorption into its original source, the sun-god Ra,—the head-spring of all light and life. (See 'Book of the Dead.')

Hebrews.—Sheol, or the realm of shadows, appears in the early history of the Jews to be an amplification of the idea of the grave, as the dark abode of departed spirits, where souls dwell bodiless, unconscious, without feeling. The references in the early part of the Old Testament Scriptures to a future life are rare and vague, and the doctrine of the immortality of the soul is nowhere explicitly taught in the early books. The rites of necromancy were discouraged by the prophets and lawgivers of ancient Israel as antagonistic to belief in the God of life, whose realm excluded Sheol (or the realm of the dead), until post-exilic times. Eternal life belongs to God alone, and to those celestial beings who have eaten of the tree of life and live forever. In connection with the Messianic hope and under the influence of Greek and Persian ideas, the later Jews adopted a doctrine of resurrection of the body which made room for belief in the soul's continuous life. The Cabalists took up the doctrine of transmigration (Gilgul, "rolling on" of souls) according to which the soul of Adam passed into David and shall pass into the Messiah, as is mystically set forth in the letters of that name (Ad[a]m). The Platonic doctrine of preexistence is also found in the rabbinical philosophy. Immortality conjoined with the dogma of the resurrection is the prevailing conception in the post-exilic literature, the latter (resurrection) becoming fixed in the Mishna and liturgy. Since the time of Moses Mendelssohn, who rehabilitated the doctrine of Plato in his 'Phædon,' progressive Judaism tends to lay less emphasis on the resurrection of the body, and greater emphasis on a purely spiritual immortality, the former dogma being discarded in the Reform rituals.

The Greeks.—The origin of the doctrine of immortality amongst the Greeks is lost in the remotest antiquity. It is found in the early traditions of the Orphic and Dionysiac mysteries, in the poems of Homer and Hesiod, and forms a central tenet in the philosophy of Pythagoras, a contemporary of Buddha-Siddhattha and Lao-Tze. The view of Pythagoras includes the doctrine of transmigration, which may have been suggested to him by the theology of the Orphic mysteries or by Pherecydes, rather than by the Egyptians (cf. Zeller, 'Pre-Socratic Philosophy,' Vol. I., pp. 71. 514). The great problem of a man's life is moral purification, which he pursues in a divinely governed Cosmos, where his chief end is to become like God. The soul is imprisoned in the body because of sins committed in a preëxistent state, and after death passes into a superior or inferior state, according as it has served Good or Evil. In the ascending stages of metempsychosis the soul is prepared for moral redemption. Although the belief in some form of immortality prevailed amongst the Greeks throughout their history, and probably came into their philosophy from their religion, it was not until Plato that a philosophic basis was furnished to the doctrine. The Platonic arguments for the immortality of the soul may be summarily stated as follows: (1) The fact that the mind brings to the study of truth a body of interpretative principles and axioms with it, as part of its native endowment, shows that they can be only reminiscential and, therefore, derived from a preëxistent state; (2) The soul is an ultimate unity (*i. e.* monadic in character) and, therefore, not being composite or divisible, it cannot be disintegrated; (3) The soul (ψυχή) means the "principle of life," having the idea of life essentially immanent in it, and inseparable from it, and therefore it must exclude the opposite idea, death; (4) The soul is self-moving, deriving its activity from within; consequently its motion and therewith, its life, must be perpetual; (5) The soul as an immaterial reality is essentially related to the immaterial, invisible, eternal idea; and as the former is akin to the latter in nature, so is it also akin in duration; (6) The superior dignity and value of the soul argue for its survival of the crass body, and even the crass body persists for a time; (7) The cyclical movement of nature shows everywhere the maintenance of life by opposition, as night, day; sleeping, waking; the dying seed, the germinating flower. This is an argument from analogy: out of the decay and death of one living organism, a new life is generated; (8) The instinctive aspiration of the soul towards a future existence shows that the belief is founded in natural law; (9) Things that are destructible, are destroyed by their peculiar evil or disease; the peculiar evil of the soul is vice, which corrupts the soul's nature, but does not destroy its existence; (10) The world as a moral and rational world demands a future life of rewards and punishments for the rectification of inequalities in this life, else the wrong would ultimately triumph, as in a bad play. This argument is based on the ethical claim that there must be a final equivalence between inner worth and external condition or reward. The views of the Greeks, and especially the views of Plato, have had a profound, an incalculable influence on Christian thought, on early theological formulæ, and on the sum of occidental philosophy. Plato was not merely a framer of philosophy, an intellectual interpreter of reality, but still more a man of religion, a seer.

The question of the preëxistence or survival of the soul is not a scientific problem. Positive science is impotent either to prove or disprove the dogma. It is a problem for religion, and its ultimate appeal is to faith. So long as science keeps within its borders, it is neither philosophy nor religion, and has no verdict to pronounce upon ultimate reality. The dogma of immortality in the higher civilizations is largely based on the philosophical theory of the ideality of human life, and on the demand for an ideal completion of experience which involves a transexperiential world. It is a postulate of purposiveness, of teleology in the ethical realm.

The general tendency of modern biological science and cerebral physiology has been to discard the doctrine of immortality, although the relations between molecular movements of the brain, on the one hand, and thoughts and feelings on the other, are known to science merely as concomitants, and in no case as [illegible] or effects. James (Human Immortality, 1898) has endeavored to "draw the fangs of cerebralistic materialism" by ascribing to the brain a "transmissive" function, instead of a "productive" function. Tait and Stewart (The Unseen Universe, London, 1894) postulate an unseen world, from which the known visible world has arisen and to which we must resort for the origin of molecules as well as for an explanation of the forces that animate these molecules; and it is reasonable to suppose, as these physicists say, that the ultimate unseen universe is connected by bonds of energy with the visible universe and is capable of receiving energy from it and of transforming the energy thus received. To say that the visible world is either eternal or has the power of originating life, contradicts the result of observation and experiment (*op. cit.* p. 220). Therefore, the hypothesis of an eternal unseen universe is necessary to explain the evolution of the matter and life of the visible world and the only method of avoiding a break in the continuity of reality. The law of the conservation of mass and of energy, the law of biogenesis (every living being presupposes an antecedent life), and the law of continuity (there is no break in reality, the universe is of a piece) make the assumption of an unseen universe the easiest mode of explaining the empirical. Further, the postulate of a rational cosmic energy is necessitated by the ordered character and inherent teleology of reality. The law of continuity and conservation of energy necessitate the further conclusion that the psychic energy of the individual is not lost, but transmuted into the unseen world.

During the 18th century and the early part of the 19th, the dogma of immortality was widely discussed. The French materialists denied the doctrine in every form, regarding the psychic life purely as an organic function. In the system of Identity (Schelling) and Spinozism no place for the doctrine is found. In Fichte's idealism the creative Ego is not the individual, but the absolute Ego; the individual Ego realizes itself only by negating its individuality, by universalizing itself, and the Ego thus exemplifying the conceptual life of truth, continues to all eternity, as an indestructible part of the reality of the Absolute Ego. Hegel paid little attention to the problem, but the early Hegelians split into two factions, the one affirming and the other denying the doctrine (cf. Feuerbach, Richter, Weisse, Göschel, Conradi). In Lotze's teleological idealism the immortality of the soul (which is hardly more than casually mentioned) is based on the principle of value: that thing will continue forever which by reason of its excellence should be an abiding constitutive part of the Cosmical Order. Yet Lotze cannot say that all human souls are immortal. This idea of a conditional immortality, determined by ethical value, reappears in later discussions (cf. McConnell, The Evolution of Immortality), *i. e.* immortality is simply a moral achievement.

According to Kant, scientific demonstration is not applicable to these three truths: the Existence of God, the Freedom of the Will, and Immortality. They are postulates of morality. The worth of man as a moral being, with infinite potentialities, *i. e.* infinite perfectibility necessitates an infinite time for their realization. The laws of the moral life are drawn from a transcendental sphere, free from conditions of time and space, and so the very essence of man's moral being is invested with the eternal. Man is infinitely progressive and perfectible in his moral and intellectual evolution, and this fact points indubitably to a further existence. If death were the end, the moral ideal would be illusory, and man would perish a fragment. An infinite moral imperative implies an infinite moral ability. Duty demands moral perfection. Further, the moral ideal is a character-ideal, an ideal of personal aim, which implies a personal destiny, and the non-illusoriness of the moral life implies the possibility of realizing its ideal.

One may fairly say that since the time of Kant the dominant note in the discussion of immortality has been ethical. The main postulates on which faith in the dogma has been based in the late literature of the subject are the moral perfection of a World-Governor, the basic rationality of the universe, and the worth of human life (cf. Gordon, Immortality and the New Theodicy, p. 46).

The advocates of psychical research claim to find in spiritistic phenomena a proof not only for the existence of disembodied spirits, but also for their power to communicate with spirits still incarnate. The examination of these phenomena, however, is as yet in an unsatisfactory stage, and in any case the phenomena, so far as we know, have no bearing on the problem of the duration of survival.

The chief traditional arguments adduced in support of the doctrine are: (1) The ontological argument, which bases immortality on the immateriality, simplicity, and irreducibility of the soul-substance; (2) The teleological argument, which employs the concept of man's destiny and function, his disposition to free himself more and more from the conditions of time and space, and to develop completely his intellectual and moral potentialities, which development is impossible under the conditions of earthly life; (3) The theological argument; the wisdom and justice of God guarantee the self-realization of personal beings whom he has created; (4) The moral argument, *i. e.* the moral demand for the ultimate equivalence of personal deserts and rewards, which equivalence is not found in this life; (5) The historical argument; the fact that the belief is wide-spread and ancient, showing it to be deep-seated in human nature, and the historical fact of the resurrection of Christ and the statements of the New Testament Scriptures.

As to the attitude of men in the present time towards the doctrine, Osler (Science and Immortality) happily groups them into three parties: (1) The Gallionians (cf. *Acts of the Apostles* xviii. 14), *i. e.* the Scientists who study the How of the universe and who regard the dogma as without the pale of science, neither affirming nor denying its truth, although tending to reject it; (2) The Teresians (Saint Teresa 1515-1582), *i. e.* the seekers of the Why of the universe, the mystics who "live by faith" and have the "will to believe," who read a purpose in human destiny and teleology in the world; these are of the spirit of Plato; (3) The Laodiceans, who study neither the How nor the Why of the universe, who are absorbed in empirical problems and the sense-life; these have no practical concern with the doctrine.

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Immortelle. See Everlasting Flowers.

Immunity. It has been a common observation that certain individuals are prone to the infectious diseases, and others not. Some children in a family always "take things hard," while others are not susceptible. This resistance to the poisons of the infectious diseases, or to the bacteria that cause the poisoning, is termed immunity. It is a relative quality of living matter, and is not confined to man alone, for lower animals, and even plants, show marked variations in their reactions to chemical and organic poisons. Thus certain plants are capable of growing in soils impregnated with metallic poisons of sufficient strength to destroy animal life; many animals are immune to poisons that would kill man; thus birds are comparatively immune to strychnine; young children can take comparatively larger doses of belladonna than adults; the diseases of plants are almost unknown among animals, and *vice versâ;* certain diseases affect the lower animals and are rare or unknown in humans, and the reverse condition also holds true; thus swine-plague is comparatively unknown in other animals than pigs, and such human diseases as typhoid fever and cholera are not common in lower animals; thus plants, lower animals, and man, individually and collectively, enjoy certain relative immunity from destruction when exposed, under ordinary circumstances, to disease-producing agencies.

Natural immunity may be so modified as to be lost entirely, certain forms of disease predisposing the sufferer to ready secondary infection, as, for instance, is seen when tuberculosis follows measles; or a partial immunity be made more effective, or a new immunity conferred. This has been termed acquired immunity. The evolutionary doctrine would tend to interpret natural immunity as an inherited acquired immunity. In the case of man immunity sums up those powers of resistance which the body naturally possesses, or which it acquires in the struggle with infectious diseases, both in endeavoring to destroy the bacteria—bacteriolytic power—and to counteract the toxins—antitoxic power. Modern pathology has shown that the battle-field is a large one, and that the opposing forces are numerous and their powers largely unknown; and it must be remembered that the struggle has been going on perhaps for millions of years.

The observation that certain diseases—as measles, scarlet fever, smallpox—once acquired, confer a marked immunity, led up to vaccination, this inoculation against smallpox being the first conquest of disease by such means. It is certain that others will follow. Certain diseases—notably pneumonia, influenza, erysipelas—confer an immunity, but it is not lasting; thus demonstrating the principles of variability in the "immune bodies" as a class, and of an active and a passive immunity which may be conferred by various means, an active immunity being acquired by the animal for itself by direct adaptation, a passive immunity being conferred by a body made in the blood-serum of another animal.

Former theories for explaining the varied picture in this rapidly widening study have been numerous. They may be classed under the *exhaustion theory* of Pasteur, which assumed that the bacteria used up the available food-supply and died; or, as the laity often express it, "the disease wore itself out." This theory has been thoroughly disproved. The *retention theory*—that the bacteria are killed by their own products—is also untenable. The *mechanical, humoral,* and *phagocytosis* theories, which teach that the bacteria are destroyed by the humors or cells of the body, are partly true, but do not convey the whole truth, which in fact may never be known. The most popular theories of the present time are chemical, and that known as Ehrlich's *side-chain theory* is uppermost in discussion. This theory is extremely elaborate, but its fundamental principle is that the blood-serum of man and other animals may be so modified, in whole or in part—experimentally played upon, as it were—that it can be made to overcome the effects of infections, of poisons, or of both. The development of the diphtheria antitoxin in the blood-serum of the horse, to counteract the effects of the toxin of the diphtheria bacillus in man, was the first important practical deduction of this great principle. It was the first illustration of the production of a successful passive immunity in human pathology. In the discovery of the diphtheria antitoxin it was hoped that all the infectious diseases were conquered, but this hope was premature, as it was learned that other diseases involved other factors of a more elusive character than the simple toxin. The destruction not only of the bacteria within the body, but the neutralization of the poison as well, was found necessary, and hence the terms bacteriolytic immunity and antitoxic immunity. Ehrlich's side-chain theory tries to explain antitoxic immunity in chemical terms. He assumes that the cell-body has a number of side-chains upon it — receptors, as they are termed. These are capable of combining with food-products for the metabolism of the cell. There are certain receptors that can combine with toxic products as well, with damage to the cell. Antitoxins, according to Ehrlich, consist of surplus receptors made by the cell and cast off in the blood-serum. These unite with the toxin in the serum, and thus save the receptors of the cell for their normal food-taking properties. Any surplus of receptors over and above those combined with the toxin molecules floating in the blood are available as free antitoxins in the treatment of toxin-caused disease.

The other phase of the subject of immunity is concerned with the ability of bodies themselves to destroy bacteria — bacteriolytic immunity. It is known that if the blood-serum of certain animals is injected into an animal of a different species, the red blood-cells of the injected animal are destroyed This process has been termed hæmolysis, and is observed under other conditions, as in poisoning by drugs, such as acetanilid, sulphonal, etc. A similar action of blood-serum on certain bacteria can be brought about by artificial means, thus manufacturing a *bacteriolytic* serum for use in destroying given bacteria in the human body. The various terms that are used in elaborating this hypothesis may best be expressed in the form of a chart, since in medical literature so many synonyms have been in vogue.

Table showing various forms of adaptation products with their relationships and synonyms. (From Prudden.)

A

The body-cells in adaptation to alien substances of protoplasmic origin may elaborate	Antitoxins Antiferments Cytolysins (Cytotoxins) Agglutinins Precipitins	Hæmolysins Bacteriolysins Special Cytotoxins	Formed of two substances	COMPLEMENT Alexin Addiment Cytase. AMBOCEPTOR Immune body Intermediary body *Substance Sensibilatrice* Copula Desmon.

B

The "Antibodies"	Cytotoxins Agglutinins Precipitins	May lead to the formation of anti-antibodies.	Anticytotoxins Anti-agglutinins Antiprecipitins.	Anti-complement Anti-amboceptor.

As Prudden writes, "there seems to be abundant ground for the belief that the protective agencies which are evoked in both natural and artificial immunization are simply those which the body makes use of in its normal metabolism, exaggerated and diverted to different ends, it is true, in the face of emergencies, but giving evidence of the birth of no new physiological capacities." "The new methods of research and the far-reaching conceptions which they have stimulated and fostered seem likely to mark a new era in physiological chemistry, and to link more closely than any other extension of knowledge in our time some of the most subtle and urgent problems of medicine to the wider outlooks of general biology."

Consult: Welch, 'Recent Studies on Immunity' ('Medical News,' 18 Oct. 1902); Prudden ('Medical Record,' 14 Feb. 1903); Ritchie ('Journal of Hygiene,' Vol. II., Nos. 2, 3, 4, 1902): and for general works, Flügge, 'Die Mikroorganismen'; Muir and Ritchie, 'Manual of Bacteriology' (1903); Kolle and Wassermann, 'Bacteriology' (1903).

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Im'pact, the action which results on the coming together of two bodies, one or both of them in motion. If an ivory ball fall on a marble table which has a thin coating of oil, after impact the ball is found to have on its surface a patch of oil, which shows by its size that the ball must have been compressed at the moment of impact. When two bodies come into collision they compress each other at the points that touch until they have each the same velocity; during this time of compression each body acts upon the other with exactly the same impulse, the momentum lost by the one being gained by the other; if now the bodies are perfectly inelastic no further mutual rebound will take place; if the bodies are elastic they will regain their old shape, and the mutual impulsive forces of restitution will cause separation. The impulsive forces of restitution are found to be less than those of compression; that is (see IMPULSE), the momentum lost or gained by either of the bodies during the second or restitution part of the impact is less than the momentum lost or gained in the first or compression part of the impact in a certain ratio which is called the elasticity of the bodies. In a perfectly elastic body this ratio would be equal to 1, in a perfectly inelastic body it is 0.

Thus, when one ivory ball comes into direct collision with another of equal size at rest, the first comes to rest and the second moves in the direction of motion of the first before impact, but with a slightly diminished velocity. When two equal ivory balls come together with equal and opposite velocities each returns on its old path with a velocity slightly lessened. When one perfectly inelastic body overtakes or meets another directly the common velocity after impact is equal to the sum or difference of momenta of the bodies before impact divided by the sum of the masses.

In a collision of two balls not perfectly elastic it may be shown that the total energy of motion (see ENERGY) of the two balls after collision is less than it was before, some of it having been converted into heat.

Impeach'ment, the accusation and prosecution of judicial and executive officers for misdemeanors involving an abuse of their official functions, or immediately connected with those functions. In Great Britain the tribunal before which impeachments are tried is the House of Lords, and the impeachment is made by the House of Commons. The person impeached may be either a peer or a commoner; but while a peer may be impeached for any crime whatever, a commoner cannot be impeached for a capital crime. The method of procedure is this. A member of the House of Commons charges the accused with high crimes and misdemeanors, and moves that he be impeached. If the motion is carried the member is ordered to go to the bar of the House of Lords, and lay the impeachment before that tribunal. The lord high-steward presides at the trial. After the charges have been laid, and the answers of the accused heard, the lord high-steward puts the question whether the accused be guilty or not guilty of the crimes charged in the first article of impeachment to each of the peers in succession, beginning with the junior baron, and each of the peers answers "guilty" or "not guilty," as the case may be, "upon my honor." The lord high-steward gives his own opinion after all the other peers. The same question is then put with regard to all the other articles of impeachment successively, and the result is declared by the lord high-steward. The question of guilty or not guilty is decided by a majority of votes.

By the Constitution of the United States the House of Representatives is given the sole power of impeachment; and the Senate has the sole power to try all impeachments, and provides that at the trial of a President the chief justice of the Supreme Court shall preside. Section 4 of Article II. provides that the President and Vice-President and all civil officers of the United States shall be removed from office on impeachment for and conviction of treason, bribery, or other high crimes or misdemeanors, and the trial of officers by impeachment has been attempted seven times in the history of the United States. First came the Blount case. William Blount, United States Senator from Tennessee, was in 1797 impeached for conspiring with British officers to steal part of Louisiana from Spain for England's benefit. The Senate expelled him, after putting him under bonds for trial, but his defense being that a Senator was not a civil officer liable to impeachment, on the question of jurisdiction he was acquitted. John Pickering, judge of the Federal district court for New Hampshire, being impeached in 1803, for drunkenness and profanity on the bench, was convicted and removed from his office. Samuel Chase of Maryland, a justice of the Supreme Court of the United States, in 1804 was charged with having indulged in "highly indecent and extra-judicial reflections upon the United States government," in the course of a charge to a Maryland grand jury, and with other improper conduct on the bench. The impeachment proceedings, instigated and managed by John Randolph of Virginia, were political in their origin and animus. Judge Chase was acquitted. The prosecution failed to obtain a two thirds vote against him on any one of the eight articles of impeachment and, resuming his seat on the bench, he held it as long as he lived. Judge West H. Humphreys of the Federal district court of Tennessee, joined the Confederacy at the opening of the Civil War, and accepted office under it, without previously sending his resignation to Washington. He was impeached, mainly in order to vacate the office, and convicted on 26 June 1862. Andrew Johnson was impeached on 4 March 1868. He was charged in 11 articles with violating of the Tenure of Office act, with violating of the Constitution, conspiring to prevent the execution of the Tenure of Office act, and with utterances tending "to bring the high office of President into contempt, ridicule, and disgrace." This memorable trial lasted for nearly three months, and the fiercest of political passions were excited by it. Thirty-six votes were needed to convict. No vote was ever taken except on the three strongest articles, the 2d, 3d, and 11th, and on each of these the Senate stood 35 for conviction to 19 for acquittal, impeachment failing by a single vote. The seventh impeachment recorded was that of William W. Belknap, secretary of war under President Grant. He was accused in 1876 of corruption in office, and the House voted unanimously to impeach him. He resigned before the passage of the resolution, but, although his resignation was accepted by the President, the trial proceeded. The impeachment proceedings failed by the lack of a two thirds majority in the Senate for conviction.

Imperative Mandate. See REFERENDUM.

Impe'rialism, the national policy which tends toward the expansion of national domination and national ideas over a geographical area wider than that of national boundaries. Thus ancient Rome extended her dominion and system of government, attended with her laws and language first over the whole of Italy, then over Sicily, Northern Africa, Spain, Gaul, Greece, and parts of Asia. Charlemagne's idea was to hold France, Germany and Spain under one imperial head. Napoleon wished his empire to comprise all Europe. English nationalism has been partly a wide scheme of colonization, and partly as in India a plan for subjugating and Anglicizing a cluster of Oriental races. In the United States the term imperialism has been used in a more or less factitious sense. The avowed object of the government at Washington in the Spanish War was the liberation of Cuba from the Spanish yoke. The term "imperialism" was employed as a political catchword in the presidential campaign of 1900, especially with regard to the purchase of the Philippines. Yet the United States cannot scientifically be styled an empire, or likely to develop into an empire. The Supreme Court on 2 Dec. 1901 has, however, decided on the constitutionality of expansion. The principles settled by the decision are thus to be stated: (1) The Constitution does not follow the flag till it is planted on new territory by special act of Congress. (2) The extension of the sovereignty of the United States to new territory guarantees the enjoyment of liberty, the right to property and the protection of the United States to the people thus affected in securing justice and public order and promoting peaceful progress. (3) The islands acquired from Spain by the treaty of Paris are 'property of the United States,' and Congress can dispose of these islands in any way conducive to the interests of the people of the United States and of these islands.

A corollary of these propositions finds expression in the statement that the territory of the United States may be described under three heads: (1) The States. (2) Incorporated territories. (3) Unincorporated territory, belonging to the United States.

This gives to the nation three different classes of people dependent upon it: (1) Citizens vested with full political power, or the residents of the States. (2) Citizens of the incorporated territories, who are not vested with full political power as long as they are residents of the incorporated territories. (3) The people of the 'territory belonging to the United States,' as such, who cannot become citizens of the United States till Congress extends to such territory they occupy the privileges of the Constitution.

Impetigo, im-pē-ti'gō, popularly known as Pustular Tetter, Honey Scab, and Honey Sickness, a skin disease found mostly in children, consisting in an eruption of itching pustules, appearing in clusters, and terminating in a yellow, thin, scaly crust. They appear chiefly on the head and face, and sometimes on the hands. Feverishness and sensations of chilliness accompany the disease. The treatment is both external and internal, the former consisting in the application of ointments, etc., and the latter in the administering of various medicines calculated to improve and maintain the health of the patient.

Impeyan (im'pi an) **Pheasant**, a pheasant of the genus *Lophophorus* generally; specifically the species (*L. impeyanus*) of southern Kashmir, first brought to notice by Lord and Lady Impey. These are among the most splendidly clothed of birds, rivaling the humming-birds in the brilliance of their metallic hues. There are four or five species, each restricted to a particular region in southeastern Asia. The Himalayan species or Monal (*L. refulgens*) is the best known and is often exhibited in zoological gardens. The male is perhaps the most gorgeous of the *Phasianidæ*, presenting a wonderful combination of sparkling metallic purples, blues, browns and greens, with golden and coppery reflections and contrasting patches of snowy white and deep black; on the head is a crest composed of long racquet-shaped feathers. The female is plainly colored. High up in the mountains near the snow line the monal lives during the summer, breeding up to an elevation of 12,000 feet, but in the autumn, as the weather becomes cold, it gathers into flocks and descends to the deep woods or, in very severe weather, even to the cultivated lowlands. It both runs and flies swiftly, but is chiefly terrestrial, and feeds largely on roots and grubs dug from the ground. The impeyan pheasant has the black and white areas replaced by golden green.

Implements, Agricultural. See Agricultural Machinery and Implements.

Im'post, in architecture, the point at which an arch rests on the column, pier, or wall. It is often marked by horizontal moldings, though these may be absent. Imposts have received various names, according to their character. Thus, a continuous impost is one in which the moldings are carried perpendicularly down the pier, as in the later decorated Gothic; a discontinuous impost, one where the moldings abut, and are stopped on the pier; shafted imposts are those in which the arch moldings spring from a capital and differ from those of the pier.

Im'potency, a diseased condition of the male; in common law failure to consummate the marriage relation within three years is presumptive evidence, and constitutes a sufficient ground for divorce, or annulment of marriage.

Impress'ionism, the style of painting adopted by the Impressionists, a group of modern French painters, who held their first exhibition in Paris in 1877. This coterie included Claude Monet, Alfred Sisley, C. Pissarro, Auguste Pierre Renoir, and Berthe Morisot. These artists professed to have cut themselves free from all traditions of color, line or technique, and to paint things, not from what they had learned about things from other painters, but from what they saw in things. Their one immediate impression of a landscape, or a group of figures, they would transfer to the canvas without modifying one jot or tittle. «The Impressionist,» says Theodore Duret, one of their earliest critical interpreters, «sits down on the bank of a river, and the water takes its tones, in accordance with the condition of the sky, the angle of vision, the hour of the day, the stillness or agitation of the air. Without hesitation he sets upon his canvas exactly all the tints and tones which he sees in the water. The sky is overcast, the weather showery, he paints the water steely gray, dull, opaque. The sky is clear, the sun brilliant, he paints the water sparkling, silvery, azure blue. The wind blows, he paints the myriad hues of the rippling surface. The sun sets and darts his last rays into the water. The Impressionist smears yellow and crimson on his canvas. The winter comes. The Impressionist paints the snow, and as he sees that shadows cast upon the snow are blue he unhesitatingly paints blue shadows. Certain clayey soils seem to clothe the plains in lilac. The Impressionist therefore paints lilac landscapes. In the summer sunlight under the dim-lit arcades of green foliage, skin and clothes take a violet tint. The Impressionist paints them violet.» The French Impressionists claim Corot, Courbet and Manet for their fathers in art. It is certain that they owe much to Japanese masters. «Before our acquaintance with Japanese art,» says the critic already quoted, «painting kept on its course of falsehood, and Impressionism was impossible.»

Nevertheless, Impressionism is dying out, if it is not already dead in Paris, as Quilter some years ago stated. It has not taken any root in England, where the Pre-Raphaelite movement, with its idealism, linked to its freshness and originality of style, was the most recent dominating innovation. Among American artists it did, however, obtain some foothold, and Whistler, a great Anglo-American painter, began his

IMPEYAN PHEASANT (*Lophophorus impeyanus*).

career as an Impressionist, and though he did not continue on the extreme left of this radical school, he always was their friend and was willing to learn all they could teach him. In New York there are some survivors of the school, and Twachtner and Childe Hassam were for some years its exponents, and the death of the latter so early in life removed a really sincere and quickening influence in American art. It is certain that Twachtner never went to the extremes of the French Impressionists. He was one who felt their influence rather than a blind and literal follower of their theory. He was delicate and refined, as well as bold in color, and he cultivated to perfection what the French Impressionists sometimes seemed to neglect,— the sense of form as defined by the invisible line that divide the tones in a picture and in life, and which great painting defines with a magic and unerring accuracy that cannot be secured by daubing on the canvas a mass of tints in which color and value are everything and line nothing. Impressionism is chiefly notable as being a revolt from academic stiffness and conventionality, from slavery to certain pigments and methods of technique, long in use. It is a movement which has added fresh life to art by teaching the painter to use his eyes, and to trust them. Compare Sabrin, 'Science and Philosophy in Art' (1886); Duret, 'Les Peintres Impressionistes' (1878); 'French Impressionism' (in 'The International Monthly,' Vol. V. 1902); Duranty, 'La Nouvelle Peinture.'

Impress'ment, The right of changing one's natural allegiance (see CITIZEN; EMBARGO) was not acknowledged as a legal right in the 18th and early 19th century by any nation but the United States, which lacked power to enforce it against the world. Great Britain denied it, and Chancellor Kent early in the 19th century admitted that the denial was common law. During the Napoleonic wars, that country in its struggle for life especially on the seas, demanded the help of all its citizens; and not only refused to recognize any ceremonies of naturalization, but seized its alleged subjects wherever it found them, searching neutral vessels on the high seas and impressing into its service whoever were claimed as such. The naval officers were the reverse of particular whether they made mistakes and kidnaped born Americans, and many hundreds of the latter were impressed in this way. Not only this, but the right of search in itself, were rasping grievances which worked up the national temper to the pitch of explosion, resulting in the War of 1812; the right of search resulted in the bloody outrage of the Leopard on the Chesapeake (q.v.), which was one of the chief agencies in bringing about the Embargo.

Impris'onment is one of the three classes of punishment for crime, death and penal servitude being the other two. It has always been a power inherent in courts of justice to imprison for contempt of their authority, and under certain conditions for non-payment of debt. In criminal proceedings a person may, by a warrant of a justice of peace or magistrate, be imprisoned before trial, provided the justice considers it is not a proper case for allowing bail; and though in minor offenses an accused person may insist on being discharged on tendering sufficient bail, yet in more serious crimes it is in the discretion of the justice to accept or refuse the bail tendered, and on his refusal application may be made to judges of the common law courts to accept bail. Imprisonment may be with or without hard labor, or it may be solitary. Penal servitude may be inflicted for life, or any shorter term, but in the case both of imprisonment and penal servitude the convict can at any time apply for commutation or remission. In police and other petty offenses tried summarily at common law and under a variety of statutes, imprisonment is usually awarded with the option of a fine. The unlawful detention of the person by any one, or "false imprisonment," constitutes a personal injury, and may be treated as a criminal or as a civil offense. See DEBT.

Imprisonment for Debt is the restraint of the liberty of a debtor in a civil action. An arrest for debt is usually made by some mandate of a court having jurisdiction, after the nature and amount of the debt has been established by due process of law. But sometimes a debtor is restrained of his liberty on a preliminary proceeding, by order of a court, for the purpose of holding him to bail. In the United States, imprisonment for debt is made only by virtue of statutory regulations, several States having constitutional provisions prohibiting it under certain circumstances, and seven of them having absolutely prohibited restraint in any form of personal liberty on account of debt, by such provisions; namely, Alabama, Georgia, Maryland, Mississippi, Missouri, Tennessee, and Texas. Several of the States provide in their constitutions that there shall be no imprisonment for debt except in cases of fraud on the part of the debtor. In some of the States acts have been passed providing for imprisonment founded on contracts deliberately entered into, while others have provided that only absconding debtors shall be subject to imprisonment. The tendency of modern legislation is adverse to imprisonment for debt. Many of the States have provided in case of imprisonment that the restraint shall be made as free from indignity as is consistent with the safe-keeping of the debtor, and that his restraint shall be considered more in the nature of misfortune than as punishment for an offense.

Improved Order of Red Men, an American civic society, with benevolent and social characteristics, organized 14 Oct. 1833. Founded upon the manners, traditions and customs of the aborigines of the Western World, the Order adopted their unique figures of speech, which it transmits with historical accuracy. Knowing that some time the Indian race will become extinct it intends to occupy an original place in public interest as the repository of Indian customs, Indian traditions, and Indian nomenclature. The Order's motto is "Freedom, Friendship, and Charity." Its interpretation, as promulgated by official authority, may be concisely stated in these words: Freedom, in honor of that race to whom the forests, the plains, the hills, and the valleys of this land were as free as the air to the eagle, and in memory of the early struggles to wrest these United States from dependency to foreign rule. Friendship, to commemorate the unswerving loyalty with which an Indian maintained a noble and unselfish affection for him to whom it was plighted, and which makes sweet and lasting the relations that one member bears to another. Charity, the love expressed to a brother by those who meet around the brightly burning council fire; the sympathy which is pleased at his success, and the fraternal affection that grieves over his sorrows and disappointments.

Government.— The Order is organized along the familiar lines of civic societies. Its supreme power is the Great Council of the United States, and from this body emanates all authority for the establishment of local branches in towns and cities: also Great Councils in States and Territories and in the Dominion of Canada. State and Provincial Great Councils, under restricted delegated authority, exercise governmental oversight,— within their respective jurisdiction,— similar to that of the Great Council of the United States. Local branches of the order are: Tribes, Degree Councils, and Councils of the Degree of Pocahontas. The Great Council of the United States has for its chiefs, or officers, the presiding and executive official, who is called the Great Incohonee; the Great Senior Sagamore, second in authority; Great Junior Sagamore, third officer; Great Prophet, who is often a Past Great Incohonee; the Great Chief of Records, or Grand Secretary; the Great Keeper of Wampum, or Grand Treasurer; Great Tocakon, the messenger of the presiding officer, or Grand Marshal; the Great Minewa, an officer in charge of the inner wicket; and the Great Guard of the Forest, guardian of the outer door. State Great Councils have chiefs whose duties correspond to the officers of the supreme body, as follows: Great Sachem, presiding chief; Great Senior Sagamore, Great Junior Sagamore, Great Prophet, Great Chief of Records, Great Keeper of Wampum, Great Sannap, Great Mishinewa, Great Guard of Wigwam, Great Guard of Forest. The chiefs of a tribe are: The Sachem, who presides; Senior Sagamore, Junior Sagamore, Prophet, Chief of Records, Keeper of Wampum, Collector of Wampum, First and Second Sannap, four Warriors, four Braves, the Guard of the Wigwam, and Guard of the Forest. In Degree Councils the chiefs governing them are similar to those of a tribe. The Councils of Pocahontas admit white women to membership, and those of the order who have attained to the Chief's Degree. The chiefs of the council,— whose duties are defined in an ornate ritual,— are: Pocahontas, presiding officer; Wenonah, Powhatan, Keeper of Records, Collector of Wampum, Keeper of Wampum, First and Second Scout, First and Second Runner, two Counselors, four Warriors, Guard of Wigwam, and Guard of the Forest. Provision has also been made for the establishment of State Great Councils of the Degree of Pocahontas, similar in authority to those of the Tribal Branch, the officers of which run parallel with local councils. The names of the chiefs have the prefix of "great," and these Great Councils are given jurisdiction over this degree, all under the sovereignty of the Great Council of the United States. After various attempts to organize a branch for the "display element," legislation created, in 1899, the Red Men's League, with a uniform resembling the "Continental," and a perfect military code. Into this organization were merged prior uniformed bodies and beneficial councils. The adoption of consistent laws at once secured a continued increase in this branch of the Improved Order of Red Men.

Ritual.— The ceremonies of the Order are purely American. The ritual stands, and must ever stand, unique, and distinct, growing more valuable as the only realistic demonstration of those mystic ceremonies of the aborigines, which otherwise might fade into oblivion. Founded, as has been stated, on the manners, traditions, and customs of the American Indian, it portrays an existence more fascinating the longer it is studied, and gives the keynote to those bursts of eloquence which were at once the wonder and the admiration of the early missionaries, and of which the renowned "Black Hawk" is a shining example. The work of the Order is divided into three sections or degrees— the Adoption, the Warrior's, and Chief's,— each of which illustrates a phase of the characteristics mentioned. The degrees of the auxiliary branches of the Order are written in harmony with the general theme of the original ritual.

Nomenclature.— The attention arrested by the recital of this Order's official life is greatly enhanced when its terminology is considered. The expressions used not only differentiate the Improved Order of Red Men from other civic societies, but these form links connecting it with prior organizations of Red Men. This is further outlined in the "history" following. Time is not computed as in the common era, but according to a phraseology that has a hidden meaning and significance to the "initiated." Up to 1865, the Jewish style, namely, the year of the world, was used in dating documents. This was superseded by a revised system and "G. S. D.," or Great Sun of Discovery, was adopted, the year 1492 being considered G. S. D. 1. For convenience the year begins with that of the common era, and the enumeration follows: A year, *Great Sun;* a month, *Moon;* January, *Cold Moon;* February, *Snow Moon;* March, *Worm Moon;* April, *Plant Moon;* May, *Flower Moon;* June, *Hot Moon;* July, *Buck Moon;* August, *Sturgeon Moon;* September, *Corn Moon;* October, *Traveling Moon;* November, *Beaver Moon;* December, *Hunting Moon;* a week, *seven suns;* a day is a *sun*, and a night is a *sleep*. Morning is called the *rising of the sun;* evening, *setting of the sun;* noon, *high sun;* midnight, *low sun;* an hour is a *run*, and a minute a *breath*. Examples: 30 July 1903 A.D. would be expressed as "30th Sun, Buck Moon, G. S. D. 412," 1903—1491 = 412. "Tribes . . . shall, within two seven suns after the last council sleep in Hot and Hunting moons, transmit," etc. Wampum Belt signifies treasury, and wampum or money is computed as follows: *Fathom*, one dollar; *feet*, a dime, and an *inch* is one cent. To illustrate: "In case the wampum shall at any time be reduced to a less amount than five feet for each member, or to less than 50 fathoms, the tribe," etc. Non-members are called *pale faces;* tribal jurisdictions are *hunting grounds;* Great Councils govern *reservations;* opening and closing meetings consist of *kindling* and *quenching council fires;* minutes are called *records;* addresses or reports, *talks* or *long talks;* attending to business is *following the hunt*, and wronging another, *crossing the path*. *Wigwam* and *tepee* signify the halls of meeting, and *council chamber*, a room therein. Voting is called *twigging*.

History.— An attempt has been made to establish a succession from the patriotic societies of the American Revolution to the Improved Order of Red Men, but without much historical basis. That such organizations existed, there is no doubt. Moreover, the War of 1812, with England, served to foster the assembling and banding together of men fired with patriotic ardor. It is quite likely these associations may have led to the formation of the societies of Red Men,— possessing the terminology hereinbefore mentioned,— known to have flourished between the years 1813 and 1830, of which fragmentary records have been preserved. The impulse also may have come from the Tammany societies of the national period prior to 1812. A society of Red Men existed in Philadelphia, Pa., in 1824, and there were branches in other cities and States at earlier and later dates; but the movement, which began in Baltimore, Md., in 1833–4, really seems to be the authentic date of foundation. The Improved Order of Red Men was anti-convivial in its character, and was first brought into public prominence by the observance of Saint Tammany's Day (still on the calendar), 12 May 1837. The Order spread, and, on 20 May 1835, the Great Council of Maryland was instituted, and soon became an incorporated body. On 30 Jan. 1847 the Great Council of the United States was formed as the supreme government, and this, in turn, became a corporation, by special charter from the legislature of Pennsylvania, approved 30 March 1866. The policy of the Order has been to possess a legal standing in the State; and a brotherly hand extended early secured the adherence of the scattered bands of Red Men to the «improved» institution, so that unity of effort soon promised much for the future. The fortunes of the «Improved Order,» however, were fluctuating at first, and, until 1881, when it began to assume its present proud proportions of 350,000 members, embracing the entire republic, and reservations in Canada.

Consult: 'Official History,' edited by Charles H. Litchman, revised by Charles C. Conly (1893–9), and 'Documentary History of New York'; 'Constitutions and Digest, I. O. R. M.'

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Impulse. This is a term used in mechanics to designate the «time integral» of a force. If the force is constant, the impulse it produces in a given time is the product of the force and the time in question. If the force is variable, its time of action may be divided into an infinite number of equal intervals. Then the impulse will be the sum of the products of each variable value of the force by the common infinitesimal time interval just defined. Impulse is a quantity of the same kind as momentum; that is, it is the product of mass and linear velocity.

It should be observed that in the cases of impulses in nature the forces are never infinite and their times of action never infinitesimal, though it is sometimes convenient to adopt these fictions in analysis. For the theory of impulses see especially Thomson and Tait's 'Natural Philosophy,' part I.

Imputa'tion, as a term in Protestant theology, is used to signify three things, first the imputation of the sin of Adam to all of his posterity, second the reckoning of the sins of man to Christ, third the reckoning of the righteousness of Christ to believers. Thus, on the theory of imputation the sin of Adam is so attributed to each individual of the human race as to be considered in the Divine counsels as the act of that individual, who is thus rendered guilty of it. When sin is spoken of as imputed to Christ it is meant that the condition or state which was actually man's becomes by imputation judicially his, and thus in law Christ became fitted to be a sacrifice and sin-offering for man. Had he not been man's substitute by the imputation of sin he could not have become his substitute in the endurance of the penalty of sin. The two are inseparably connected. In the very same sense in which Christ was made sin men are made the righteousness of God in him. According to this view he was made sin, not actually and personally, but by imputation; and men are made righteousness, not actually and personally, but by imputation.

Imus, ē'moos, Philippines, pueblo of the province of Cavite, Luzon, eight miles southeast of Cavite, the provincial capital; it is an important road centre. In 1896 it was the stronghold of the insurrection, Aguinaldo and other chiefs having their headquarters in its principal building. Pop. 14,700.

In-breeding, Evils of. See Breeding.

In Cœna Domini, ĭn sē'nä dom'ĭ nĭ, a papal bull, so called from its first words, it being annually read «at the Lord's Supper» on Holy Thursday. Its earliest form was that promulgated in 1363 by Urban V. against all heretics and favorers of heretics. The bull was annually promulgated at Rome till the year 1770, when a much modified document took its place, this in its turn being withdrawn by Pius IX. in 1869.

In Personam, spoken of legal rights, means such as are maintainable only against a specific person, and not against the whole world (see *in rem*). Rights *in personam* arise out of a specific engagement between individuals, or out of domestic or fiduciary relations. But the majority of rights *in personam* spring from the violation of rights either *in rem*, or *in personam*. A right once violated, a right of action against the violator immediately arises. An action brought against the violator is also called an action *in personam.*

In Rem, spoken of legal rights, means such rights as are not only maintainable against a specific person (see *in personam*) but can be maintained against the whole world. Nor are rights *in rem* limited to property rights, but include all rights, such as freedom from personal assault, from causeless imprisonment, from trespass. The term includes the right not only of suing for damages but of seizing and detaining certain articles. In admiralty practice this is a common resort, though in ordinary processes for the recovery of land or goods, it is rarely made use of nowadays.

Inagua, ē-nä'gwä, **Great and Little,** two of the Bahama Islands in the West Indies, at the southern extremity of the group. Great Inagua has an area of 660 square miles, and Little Inagua 36 square miles. The latter has few inhabitants. There is a considerable town on Great Inagua called Matthew Town, pop. (1900) 1,500.

Inaugura'tion Day, the day set aside for the inauguration of the President of the United States every four years on 4 March. It is said that Benjamin Franklin selected this date because in the next two centuries it would fall less often on Sunday than any other day in the year. President Washington took the oath the first time on 30 April, and Taylor and Hayes were inaugurated on Monday, 5 March. The same is true of Monroe's second inauguration, but his first was on the regular day. The second Adams, Pierce and Garfield were inaugurated on Friday. Five inaugurations have been on Monday and five on Wednesday.

Incandes'cence. See ELECTRIC LIGHTING.

Incandescent Gas-light. See ILLUMINATING GAS.

Incarnation (from later Latin, *incarnatio*, first used by Irenæus, A.D. 180, derived from *in* and *carnem*, into flesh), the permanent assumption of human form or human nature by a divine personage. In the Christian religion, the incarnation signifies the assumption of human Nature by God in Jesus Christ. The classical statement is John 1:14, "And the Word became flesh, and tented among us." This is the central teaching of the Christian religion, and the source of its claim to universal acceptance and to finality. Very intimately bound up with it, though distinguishable from it, are the important teachings of the divine sonship of Christ, his sinlessness, his pre-existence and virgin birth, and inevitable deductions affecting the Trinity (q. v.) and the atonement (q. v.).

I. *Sources in the New Testament.*—(a) The gospels show how the disciples became convinced of the incarnation as a fact. The impression of the greatness of Christ's personality; his miracles, which showed his sovereign power over disease and nature; his sinlessness, proved not so much by express declaration and outward conduct as by a combination of the most penetrating ethical insight and moral power with an entire absence of any sense of sin or moral failure or need of forgiveness; the intimacy of his knowledge of God and communion with him; his claims that moral character and future salvation were decided by relation to himself; his assumption of authority to forgive sin, and his promises of rest to weary souls, who came to him; the experience of this forgiveness and rest in their own hearts — all predisposed the disciples to this belief. Yet the most powerful factor, taken in connection with the foregoing elements, was Jesus' claim to be the Messiah (q. v.), who had been prophesied in the Old Testament scriptures and was a familiar figure in the later current Jewish literature. This claim meant nothing less than that he would be the future judge of all men, the bringer of the supernatural kingdom of God, and king in that kingdom. This claim was acknowledged by Peter at Cæsarea Philippi with Christ's joyful approval, was constantly asserted by implications of more than human authority and by the use of the phrase, "Son of Man," which means nothing more nor less than Messiah, and was maintained, although Christ knew that it would cost him his life, in reply to the High Priest's question in the trial before the Sanhedrin. The resurrection, however, decisively and forever settled the matter in the mind of the disciples. After that event, they had no further doubts. John's gospel truly represents the growth of their faith to the climax, when Thomas calls the risen Jesus, "My Lord and my God."

(b) The early Church consequently proclaimed Jesus the Messiah, sitting not on David's throne, but at the right hand of God, and cited the resurrection as proof. They called Jesus Lord, using the very word used of Jehovah in the Septuagint, and in connections which exclude any other reference. The opening chapter of the earliest Pauline Epistle, 1 Thessalonians, associates God and Christ on terms of practical equality. 2 Cor. 4:4, 6, and Col. 1:15 assert that Christ is the image of the invisible God, cf. 2 Cor. 5:19. 1 Cor. 8:6, and Col. 1:16–18 make Christ the mediator of creation. 2 Cor. 3:17 identifies him with the divine Spirit, and, according to the best modern expositors, Paul in Rom. 9:5 calls him "God blessed forever." The earliest epistles already show that the pre-existence of Christ is no new idea to be explained and enforced, but the common property of Christians, cf. Rom. 8:3, 1 Cor. 15:47, 2 Cor. 8:9, Gal. 4:4. These thoughts are developed at length in Phil. 2:6–11 and Col. 1:15 20. The familiar and incidental reference to these teachings as matters of course in the belief of the Church dispose us to believe that they have their root in Christ's own declarations of pre-existence as recorded in John's gospel, John 17:5, 24, 8:58, 3:13, 6:62, 33, 38, 16:28, etc. The other New Testament writers shared these views of Christ's pre-existence, cf. Heb. 1:1–3, and 1 John 1:1–4. The Prologue of John 1:1–18, is the climax of the development of the teaching in the New Testament.

Historically viewed then, the early Christians believed without any doubts in the incarnation on the basis of a synthesis of proofs derived from Christ's personality, his moral spotlessness and force, his miracles, his Messianic claims, his resurrection and their own experience of his forgiving and renewing power, and not on the basis of the virgin birth, which is never mentioned outside the opening chapters of Luke and Matthew. This teaching however, was welcomed by men, who believed the fact of the incarnation, as an explanation of its method, and is accepted by most believers to-day in the same relation. It is therefore not essential to the teaching of the incarnation, which might have taken place in other ways, but is the gospel-given history of the method adopted by God to bring the incarnation about, and, logically considered, it is burdened by no more difficulties than any other possible method would probably be. It does not appear improbable to those who already believe in the incarnation. The historicity of the virgin birth has recently been keenly attacked on the most diverse grounds, principally by those who eliminate the supernatural. Its defenders are taking the position that though the reports of it were late in being disclosed, as shown by absence of mention of it in the rest of the New Testament, they are in fact the most archaic Christian documents. In support of this, they point to the Aramaic coloring of the narratives; their Hebrew background; their primitive Christian viewpoint; their simplicity, beauty, and delicacy; the reasons which immediately suggest themselves why such a story should be withheld till Jewish opposition had decreased, and the principal actors had passed from the stage; and their inexplicability on any other hypothesis than their truth.

II. *The Church Doctrine.*— The New Testament fails to give any answer to the questions of the exact relationship of Father, Son, and Holy Spirit, and of the manner in which the divine and the human in Christ were related to each other, and these matters formed the subject of the first great theological controversy, during which the teaching of the incarnation was defined and developed principally in opposition to misapprehensions of it by different parties and individuals within the Church.

(a) The earliest were the nearly opposite errors, Ebionitism (see EBIONITES) and Docetism (see DOCETÆ), both of which began in the 1st century and flourished during the second. The Ebionites were a sect of Jewish Christians who held that Jesus was naturally born, was merely a prophet, received an extraordinary enduement of the Spirit at his baptism, and was finally exalted to Lordship at his resurrection. It was merely Judaism in semi-Christian dress; against it the Fathers asserted the full teaching of the incarnation, and it soon passed away.

(b) Gnosticism (q. v.), which started with the assumption of the inherent evil of matter, almost necessarily drifted into Docetism, the doctrine that Christ could have no real relation to matter, that his body was merely apparent, a vision and delusion, or at least of a spiritual nature different from a human body, and not subject to suffering and death. This view was held in different forms and was shared also by Manichæism (see MANICHÆANS). It is a practical denial of the possibility of the union of the divine and the human. Docetism was very early. It seems to be opposed in 1 John 4:2, and 2 John 7. The apocryphal Gospel of Peter, discovered in 1886, is Docetic. It was attacked by Ignatius. The Fathers met it by an insistence on the real humanity of Christ. After large influence, it passed away with Gnosticism. Justin Martyr, Irenæus, Clement of Alexandria, Origen, and Tertullian were the principal theologians who defended and developed the teaching of the Church during this period.

(c) With Sabellianism (see MONARCHIANS, SABELLIUS), condemned in 262, began the real contest. Sabellius urged that the Trinity is not a trinity of persons in one substance, but merely three different or successive forms of the revelation of the one person. Christ was pre-existent because the one person persisted under the change of revelation-form. The Patripassians were Sabellians, who logically asserted that it was the Father who suffered on the cross. Sabellianism, variously modified, has constantly reappeared, and is now known as the doctrine of a modal Trinity. The controversy with Sabellianism did much to sharpen the definition of the Church.

(d) The greatest battle over the teaching of the incarnation was brought on by Arius (see ARIANISM; ARIUS), a presbyter of Alexandria, about 318. Arius held that Christ was a pre-existent divine being, but of a different essence from the Father (heteroousios), created by the Father out of nothing, but himself the creator of the world, and the incarnate Saviour. The Semi-Arians taught that Christ was not of a different essence from the Father, nor as the orthodox asserted, of the same essence (homoousios), but of a similar essence (homoiousios). This was a very elastic and ambiguous view. The great defenders of the coequality of the Son and the Father were Athanasius (q. v.), the father of orthodoxy, at one time called. "Athanasius versus mundum," Basil, Gregory of Nazianzen, and Gregory of Nyssa (q. v.). The whole Christian world rang with the contest, which culminated, but did not end, with the decision of the Council of Nicæa, the first œcumenical council, in 325 A.D., in these words, "We believe in one God, the Father Almighty, maker of all things visible and invisible. And in one Lord Jesus Christ, the Son of God, begotten of the Father (the only-begotten, that is, of the essence of the Father, God of God), Light of Light, very God of very God, begotten not made, being of one substance (homoousios) with the Father; by whom all things were made (both in heaven and in earth); who for us men, and for our salvation, came down and was incarnate and was made man; he suffered, and the third day he rose again, ascended into heaven; from thence he shall come and judge the quick and the dead." After a renewed struggle, this creed, slightly enlarged, was reasserted at the second œcumenical council at Constantinople, 381 A.D.

(e) Apollinarianism (see APOLLINARIANS), as well as Arianism, was condemned at this latter council. It was a reaction against Arianism, and taught that Christ had a human body and animal life, but that the pre-existent Logos took the place in Him of the human mind and spirit. Against this extreme, the Church protested that Christ had a real human soul as well as a real human body.

(f) Nestorius (q. v.), bishop of Constantinople, objected to calling Mary "the mother of God." This position led him, however, to join the human and divine in Christ so loosely that he was accused, probably unjustly, of giving Christ not only two natures but making Him two persons, at best a man inhabited by God. He was irregularly deposed at Ephesus in 431 A.D., but the verdict was generally accepted that the Church must insist on two natures vitally united in one person.

(g) The opposite extreme was attempted about 448 by Eutyches (q. v.), an abbot of Constantinople. He maintained that Christ had only one nature, a fusion of the human and divine, and something different from either. This period of controversy was closed by the celebrated formula of the council of Chalcedon (see CHALCEDON) 451 A.D. as follows: "We, then, following the Holy Fathers, all with one consent, teach men to confess one and the same Son, our Lord Jesus Christ, the same perfect in Godhead and also perfect in manhood: truly God and truly man, of a reasonable (rational) soul and body; consubstantial (coessential) with the Father according to the Godhead, and consubstantial with us according to the Manhood; in all things like unto us, without sin; begotten before all ages of the Father according to the Godhead, and in these latter days, for us and for our salvation, born of the Virgin Mary, the Mother of God, according to the Manhood; one and the same Christ, Son, Lord, Only-begotten, to be acknowledged in two natures, *inconfusedly, unchangeably, indivisibly, inseparably;* the distinction of natures being by no means taken away by the union but rather the property of each nature being preserved, and concurring in one Person and one Subsistence, not parted or divided into two persons, but one and the same Son, and only begotten, God the Word, the Lord Jesus Christ; as the prophets from the beginning (have declared) concerning him, and the Lord Jesus Christ himself has taught us, and the Creed of the Holy Fathers has handed down to us." This declaration has ever since been considered by the strictly orthodox the limit of human wisdom on this subject.

(h) Still it did not immediately end the controversy. Eutychianism revived in Monophysitism (see MONOPHYSITES), or the doctrine of one nature in Christ, which convulsed the Eastern Empire for more than a century; while its corollary, Monotheletism (see MONOTHELITES), the doctrine that Christ had one will, unfortunately induced the Church in the sixth œcumenical council at Constantinople in 689 A.D. to assert that will belongs to nature rather than to person, that consequently Christ had two wills, never at variance. This completed the orthodox statement.

III. *Modern Views.*—Since the Chalcedonian formula (see g above) followed the lines recommended by Pope Leo I., it was accepted by the Western Church, although it subsequently fell somewhat into the background before the development of the idea of the Church as the body of Christ. Briefly, though the incarnation was discussed in the Middle Ages, no progress was made, and the great Reformed Churches made, and still make, their Christological declarations on the basis of the Chalcedonian formula.

(a) While the great creeds and the great mass of the Christian Church still rest here, many modern Protestant scholars insist on reexamining this great central doctrine as they do all others, seeking a restatement more in accordance with modern points of view. There is an inclination, on the one hand, to magnify the incarnation as the great specifically Christian doctrine, and on the other, to object to the ancient definition of it as too fine-spun and metaphysical, going beyond what it is given men to know. These scholars insist on a revaluation of the scripture statements and the historical facts on which the doctrine is based, especially on giving to the fact of Christ's growth in knowledge and wisdom, and to his true humanity generally its proper weight, on proceeding on the lines of history and ethics, rather than on the lines of metaphysics. Many deem the ancient formulas full of bad psychology and impossible philosophy, and demand a restatement in line with the progress of human thought in other departments of knowledge. Many even of these, however, would agree that the general results of the earlier contest must be preserved as the expression of the universal faith of believers from the apostolic age to the present.

(b) The first of these attempts was made by the Socinians (see SOCINUS) in Poland in the 16th century. They rejected the Trinity, and held Christ to be not divine, but more than a mere man, in that he was conceived of a virgin, was absolutely holy, and was finally exalted to absolute power. The Socinians gave birth to the modern Unitarians (q. v.), who reject the deity of Christ, and in varying degrees look on him as the ideal of humanity, "the best we know," or, at least, as one of the prophets. This shades off into

(c) Pantheistic conceptions, to which Hegel gave a powerful impulse. There is an essential unity of the human and divine; humanity is itself divine. The pre-eminence of Jesus is seen in that he first awoke to the consciousness of this fact, and represents it in its purest and strongest form. The great body of Christian believers fail to find in the Unitarian or pantheistic statements a sufficient explanation of the Christ of history and experience.

(d) The Kenotic theories propounded by Thomasius, Gess, and Martensen, have a more orthodox origin and result. They are based on Phil. 2:6–8, especially the words "he emptied himself" (ekenosen), and are inspired by the desire to present the full human development of Christ. The Kenotists in varying degrees declare that the pre-existent Christ at the incarnation divested himself of the attributes of omnipotence, omniscience, and omnipresence, and *became* man, retaining, however, the essential attributes of truth, holiness, and love. By thus depotentiating the divine nature to the level of the capacity of the human, it was hoped to overcome the dualism of the ancient statement. These theories have had wide influence, but are severely criticized as metaphysically impossible.

(e) A theory of gradual or progressive incarnation was matured by Dorner (q. v.). There is no self-limitation of the pre-existent Logos, but a limitation of his self-communication to the human nature. Jesus Christ progressively became conscious of his divine nature and realized it fully only at the resurrection. Christ became conscious of his Godhood just as He became conscious of his manhood. Its opponents hold that this theory is Nestorianism in a more subtile form and does not really do away with dualism.

(f) The present dominant German theological school, the Ritschlian (see RITSCHL, ALBRECHT), follows a new method of procedure. Instead of beginning to discuss the incarnation with a consideration of the self-witness of Jesus or of the apostolic testimony, it begins with the Christian's experimental knowledge of Christ as Redeemer, and consequently asserts that none but the possessor of a Christian experience can have any real knowledge of his person. What the believer has learned of Christ in his experience leads him to call Jesus God, for none but God can do for the believer what Jesus has done. Christ is the full and perfect revelation of God in His grace and truth: Christ's will, too, is the will of God, namely, the establishment of the kingdom of God, and to found this was Christ's unique vocation in the world, a vocation to which he was absolutely true; in all his life and sufferings He was absolutely independent of and superior to the world, and so gained unlimited sovereignty over it. But if we meet God in Christ so as to *experience* the divine power and presence, God himself must be in Christ and in some true sense Christ must be God. How this can be is a matter of metaphysics which is insoluble and does not concern us. Ritschlianism thus attempts to prove the deity of Christ from experience, and to free Christianity from the entanglement of metaphysics on the one hand, and make it independent of the results of biblical criticism on the other. From such a viewpoint, it regards the doctrine of the two natures as a hindrance, and the virgin birth as a matter of indifference, something to be decided on the grounds of historical criticism. The tendency of the leading living theologians of the school is toward a personal pre-existence, and some form of the doctrine of the Trinity. Kaftan declares that "Christ's historical person stands in a connection of nature with God which is altogether unique and can never be repeated." (Consult Garvie, 'The Ritschlian Theology,' chap. IX.)

(g) The modern conceptions of the universe, and especially of evolution, have had their influence on the modern belief in the incarnation. (1) In many different schools of thought, the idea gains currency that the incarnation was an ethical, not a metaphysical, necessity of God's nature, a necessity of his love and grace, and would have occurred in some form, even if sin had never entered the world. The incarnation was no afterthought to repair an unforeseen calamity, but has its place in the eternal purpose of God alongside of and conditioning the plan of creation which made sinning possible. (2) Theistic evolution suggests not only that Christ is the consummate flower of the race, "the end and goal of the whole ascent of life, the perfect man beyond whom there can be none higher," but that this perfect man is raised to the throne of divinity. (3) It is also seen that the finality of the Christian religion can be guaranteed only on the ground of the deity of Jesus Christ; for if Christ was one like us, however superior to all who have yet existed, there is no certainty but that during the ages another may arise superior to Him. The incarnation is thus the central doctrine of Christianity, and its maintenance in some form or other is vital to its existence. See also CHRISTOLOGY.

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Inca or **Ynca**, the name of a tribe of Peruvian Indians — not exclusively that of a royal family or caste, as has been commonly asserted. The members of this tribe sometimes called their war-chief "Cuzco," meaning chief or lord of Cuzco, but probably more often "the royal Inca," or simly "*the* Inca" (compare 'Royal Commentaries of the Yncas,' by Garcilasso de la Vega: Lisbon, 1609: Part I, chapters viii and xv). The latter usage was in the end adopted by Spanish chroniclers; and Garcilasso, half Spaniard, half Indian, in the 15th chapter of his commentaries, which were written, he tells us, 71 years after the conquest, uses both the longer and the abbreviated forms — "Yncas Kings" and "Yncas" — though feeling that he must explain that he means by the latter the "native kings of Peru." Throughout the tribe mother-right prevailed, and marriages were contracted between members of different clans: therefore offices could not descend from father to son; and especially the office of war-chief, or Inca *par eminence*, must usually have been filled by selection. The tribal dialect was called Quichua. See also PERU and SOUTH AMERICA.

Inca Semi-Civilization, the state of advancement in arts and learning reached by the most progressive tribe of South American Indians, occupying a portion of the Andean Sierra, and exercising control, in the regions now known as Peru, Ecuador, and northwestern Bolivia, over many other tribes of the highlands and lowlands before the Spanish conquest.

In the articles INCA, CUZCO, and PERU, reference has been made to certain popular misconceptions touching Inca government, chronology, and the tribal name. It is necessary to add that the evidence at present available is entirely insufficient to warrant such assertions as the following, which occurs in one of the leading works of reference: "The Inca was the absolute but, in most cases, *kindly* ruler. . . . In many respects the Inca government will compare favorably with any which at that time existed in Europe"; or this, from a popular account published in December 1903: "The far-famed Inca race had developed in pre-Columbian times an astonishing and marvellous civilization." Far from lending itself to such conclusions, the evidence furnished by Spanish writers of the 16th and 17th centuries, when their works are tested and corrected by a comparison with the results of modern archæological research, points to social conditions which cannot be ranked above semi-civilization. Moreover the objects collected by archæologists to illustrate or represent industrial and artistic activity in ancient Peru (especially the important Bandelier collection which was put in order at the American Museum of Natural History in 1904) in point of fact illustrate and represent the activities of a race very slightly elevated above semi-barbarism. In the customary treatment of their dead a lack of higher symbolism made itself felt oppressively: the crouched position of the body, bound in a tawdry pack, and the commonplace offerings buried with it suggested nothing better than the petty comforts, or ignoble miseries, of a life forever limited to alternating phases of servile toil, crouching rest, sensual indulgence, and childish diversions. The various tribes of the Sierra, from Quito to Lake Titicaca, were bound together by roads which ran from one highland village to another; the lowland Indians were held in subjection through fear alone, the Inca supremacy signifying to them a prolonged reign of terror.

Some of the war-chiefs may have been "kindly rulers": we shall, in all probability, never know whether they were or not. Cristoval de Molina, who described the "Fables and Rites of the Yncas," and who, in order to gain the knowledge of those rites which he imparts, "assembled," as he says, "a number of aged persons who had seen and participated in them in the days of Huayna Ccapac," believed that some definite, if scanty, records existed. He says: "It is so that these people had no knowledge of writing. But in a house of the sun called Poquen Cancha, which is near Cuzco, they had the life of each one of the Yncas, with the lands they conquered, *painted with figures* on certain boards." Another chronicler, Juan de Santa Cruz, who wrote about 1620, says: "I affirm that I have heard, from a child, the most ancient traditions and histories, the fables and barbarism of the heathen times, which are as follows." Such as these are the sources of our knowledge of the story of the Inca rulers. Some of the events in the lives of the war-chiefs were depicted, as valuable records or as parts of an ornamental design, in a "house of the sun"; otherwise all rests upon the prattle of Indian dotards and of Indian nurses. Accounts written by the conquerors themselves (for example, Xeres) leave almost everything to the imagination. We may be certain, at least, that tradition retained most accurately the traits of the last two or three native chiefs, whom the "aged persons had seen"; and though we may not condemn the unknown by reason of the credibly reported misconduct of the known, we shall be obliged to suspend judgment, instead of accepting the easy platitudes now current with respect to the succession of war-chiefs from Manco down to Huayna. The shameless private life of Huayna Ccapac is set forth in the 'Antiquities of Peru' by Juan de Santa Cruz. As for that great war-chief's still more famous son, we read in Garcilasso de la Vega's 'Royal Commentaries of the Yncas' (Book 9, chapters 35–37) that Atahualpa summoned all Incas of the blood royal to assemble at Cuzco, and put them to death. "The cruelty of Atahuallpa," says this historian, himself half Inca, "was greater than that of the Turks, for, not content with the blood of his own 200 brothers, the sons of the great Huayna Ccapac, he passed on to drink that of his nephews, uncles, and other relations . . . so that none of the blood royal might escape, whether legitimate or bastard. They were all murdered in different ways." The same fate was meted out to all the loyal captains of his rival Huascar; furthermore "he ordered all the women and children [of royal blood] to be assembled, of whatever age and condition, reserving only those who were dedicated to the sun in the convent of Cuzco. He ordered that they should be killed outside the city, by little and little, and by various cruel tortures, so that they might be long in dying." The varieties of ingenious tortures mentioned by Garcilasso are similar to those inflicted by North American aborigines upon captive women and children; and "though the work could have been done in a shorter time, they prolonged it in order to enjoy their cruelties more fully."

It appears to be altogether improbable that the Inca semi-civilization, if it had not been interrupted by the coming of the Spaniards, would have reached the height of 16th or 17th century European civilization, or by native merit have kept abreast of the advancing nations of the Old World. That the tribe had neglected to provide itself with a written language, and failed to develop high ideals in art, we have already noticed. A third essential for progress was equally wanting: the Incas had no money, or any medium of exchange corresponding to the wampum of the Indians who lived near the North Atlantic coast. But it is impossible for any people deprived of trustworthy records of human experience to construct a convincing system of morality; and without some convenient medium of exchange an extensive and pacific commerce is equally impossible. Both deductive and inductive methods of reasoning must, therefore, lead an unbiased student of old Peruvian institutions to the conclusions that, at home, inveterate and fully sanctioned practices made for degeneration; while steady blackmail, varied by occasional slave-raids, took the place of mutually beneficial dealings with neighboring, subject or independent tribes.

Limitations of the race's genius or experience may be exemplified in the department of music. The Inca musicians used drums which "were made by stretching a skin over a hoop of wood or over one end of a short section of the trunk of a tree which had been hollowed out to a thin cylinder" (compare 'The Musical Instruments of the Incas,' by Charles W. Mead, assistant, Department of Archæology, American Museum of Natural History). Other musical instruments of percussion in common use were copper bells, in form resembling sleigh-bells; rattles, made of small shells, gourds, and nuts, often strung together and attached to the wrists, ankles, or other parts of the body, in dancing; also cymbals of rudimentary form. Wind instruments were the syrinx or pan-pipe, consisting of reeds of graduated lengths, held in position by a crosspiece of split cane lashed to the reeds with a cord made of llama wool — the reeds being sometimes closed at the lower end, sometimes open, and occasionally arranged in double rows, yielding octaves; flutes, made of cane or bone, "simply tubes, open throughout their length, and all belonging to the class known as 'end-blown'," not scientifically constructed and not attuned one to another; resonator whistles, emitting several different notes; trumpets, made either of terra cotta or of conch shells,— primitive instruments, producing only four or five distinct tones (as shown by actual test of specimens taken from the ancient tombs); a double musical water bottle, consisting of two pottery vessels connected near the bottom in such a way that water passes freely from one to the other, and in its passage (when the vessels are swung backward and forward) forces air through an opening near the top, producing a series of whistling sounds; and finally the "cornets" mentioned by Garcilasso ('Royal Commentaries') and Herrera — instruments formed like the oboe, rather than the cornet in the modern sense. With this enumeration the list is exhausted. Such evidence as we have at the present time disproves the existence in Peru of any form of stringed instrument before the coming of the Spaniards. In other words, the unaided genius of the Inca Indians, exerting itself in the field of music, stopped short of the more complex instruments: ancient Peruvians were satisfied, as their Quichu and Aymara descendants are to-day, with the wild discords evoked from pan-pipes, flutes (or fifes), drums or clashing shells, all of rude construction.

And, as in music a great volume of sound — not harmony — was the desideratum, so in architecture they neglected beauty and strove to attain resistant mass, with walls as solid and homogeneous as possible — the prime essentials in a country shaken by destructive earthquakes; and their solicitude in this respect, which was less justified in Cuzco valley, suggests that the tribe, before the migration to which old legends refer, may have dwelt in the volcanic western part of the Sierra (see PERU). Hence the so-called "cyclopean" walls of the temples and palaces, structures built to endure, for which the builders utilized enormous stones of irregular shapes, fitted together so skilfully that mortar was not required.

It is safe to say that nearly all features of the ancient industrial life of the tribes inhabiting the Andean Sierra and Peruvian coast strip are either intimated or plainly shown by specimens in the Bandelier collection. With the utmost care products which are not properly to be classified as Incan have been separated from those showing the activities of the dominant race; and such care is obviously indispensable, for the Incan objects, though they may be discriminated by a trained archæologist, do not stand out from the rest quite unmistakably. One finds practically nothing to support the theory that there was ever a nearly unrelated, or a wholly distinct and marvellously superior, Inca civilization. Especially instructive are the examples of the potter's art which have been secured in great numbers — representing such different social classes as the warrior, musician, and water-carrier. Costumes, weapons, occupations, etc., are depicted faithfully, though without artistic charm. Fabrics of cotton, or woven from the wool of the llama, vicuña, and alpaca; looms, spindles, and colored threads, bear witness to the wide extension of the industry of weaving so often mentioned by early writers. Offerings made to the dead in the graves which have been explored (and, in the sacred cause of science, discreetly rifled) recall the fact that agriculture shared with warfare the distinction of being the chief occupation of able-bodied men. Inca women are shown to have been, like their Quichua descendants at the present time, eminently domestic in their tastes and employments, ruling supreme in the house, taking no part in public affairs, and perhaps never developing the characteristics of the Amazons who dwelt beyond the montaña in the region of tropical forests. Gold and silver appear to have been not less abundant — perhaps they were even more abundant — in the lowlands than in the highlands: at any rate vessels formed from the precious metals are found more commonly in the burial places near the coast. It is not to be supposed that the natives failed to appreciate the beauty and utility of silver, gold, and copper. An ingrained preference for the clumsy methods of barter — which the Quichuas have not even yet forsaken — prevented them from adopting any medium of exchange or setting apart one or more of the metals to be used as "money."

MARRION WILCOX.

In'cense, aromatic substances burned in religious rites on account of the sweet odor they emit. The custom of burning incense is ancient and widely spread. Among the Jews the practice was enjoined as part of the worship of the sanctuary (Ex. xxx. 27), the ingredients of the incense also being laid down, and it was to be burned on a special altar called the altar of incense. This altar was made of acacia (shittim) wood, and was overlaid with gold, hence it was called the golden altar, as distinguished from the altar of burnt-offering, which was made of brass. The incense was burned daily — morning and evening. Both the Greek and the Latin churches use incense in worship. Among Catholics it is used at every high mass, at consecration of churches, in processions, funerals, etc.

Inch, a lineal measure, the 12th part of a lineal foot, anciently said to consist of three barley corns. A statute of Edward II. (1324) makes "three barley corns round and dry" the definition of an inch. It is subdivided into halves for mechanical work, and for a scientific purpose decimally into thousandths, as in gunnery, and into ten thousandths by the makers of gauges. The English inch is equal to 2.54 centimetres. The old Scotch inch was slightly larger than the English.

Inch-worm. See MEASURING-WORMS.

Inch'bald, Elizabeth Simpson, English actress, dramatist, and novelist: b. Stanningfield, Suffolk, 15 Oct. 1753; d. London 1 Aug. 1821. In 1772 she was married to an actor named Inchbald, and the same year went upon the stage. She retired from this profession in 1789 and devoted herself to literature. Some of her plays, which belong to the class of high comedy, still keep the stage, but her greatest success was the novel 'A Simple Story' (1791), which was translated into several languages. She also wrote 'Nature and Art,' and among her plays may be cited: 'Such Things Are'; 'The Married Man'; 'The Wedding Day'; 'The Midnight Hour'; 'Every One Has His Fault'; and 'Lovers' Vows.'

Inclina'tion, Magnetic, or Magnetic Dip. See DIPPING NEEDLE.

Inclined Plane, one of the mechanical powers. When a body lies on an inclined plane part of its weight is supported; so that if a cord be fastened to it and pulled, a force less than the weight of the body, acting in a direction parallel to the plane, will prevent it from sliding, or will move it up the plane. Thus a heavy wagon is raised on an inclined road by a horse which would be quite unable to exert a pull equal to a quarter of the weight of the wagon. A body lifted by means of an inclined plane is moved through a greater distance than if it had been raised vertically, so that although the force employed may be smaller, it is exerted through a greater space. When the plane is smooth, so that friction may be neglected, the force parallel to the plane necessary to raise the body is equal to the weight of the body, multiplied by the vertical height through which it is lifted, divided by the distance it is moved along the plane. For instance, when a train moves up an incline which rises 3 feet for every 100 feet of rail, the engine exerts a pull equal to 3/100 of the weight (neglecting friction). Inclined plane railroads are common in the United States, the best known being located in Pittsburg and Cincinnati.

Income Tax, a tax levied directly from income of every description, whether derived from land, capital, or industry; first imposed in Great Britain in January 1799, during the ministry of Pitt, after the failure of an attempt to raise a revenue adequate to the exigencies of the period by trebling the amount of the assessed taxes. In the Pitt act incomes under $200 were exempted; the tax rose by a series of gradations till it reached 10 per cent, at which rate it was charged on all higher incomes. This tax was repealed in 1802, but was again imposed in the following year, though with a change of name to property tax, and a difference of rate.

But one income tax has been imposed by the United States government, arising from the necessities incident to the Rebellion. In 1861 Congress authorized a tax of 3 per cent on all incomes over $800 per annum. In July 1862 an act was passed taxing all incomes under $5,000 5 per cent, with an exemption of $600 and house-rent actually paid. Incomes in excess of $5,000 and under $10,000 were taxed 2½ per cent additional, and incomes over $10,000 5 per cent additional with no exemptions. Further taxes of 5 per cent on incomes of Americans living abroad and of 1½ per cent on incomes from United States securities were laid, these expiring in 1865. In 1864 a special tax of 5 per cent was imposed on incomes above $600. A readjustment the same year imposed a 5 per cent tax on incomes between $600 and $5,000; 10 per cent on incomes above $5,000. During Cleveland's second administration a bill was passed imposing a tax upon all incomes above $4,000. The constitutionality of the law was tested before the Supreme Court, which after a protracted hearing decided adversely by a majority of one.

Inconnu, ĭn-kŏ-nū', Fr. ăn-kŏ-nü', the French-Canadian name of a fish of the rivers that enter the Arctic Ocean (*Stenodus mackenzii*), intermediate between a salmon and a whitefish in its characteristics, and of great value as food for the people of that region.

Inco-ordina'tion, a lack of control over muscular movements. In inco-ordination there may be (1) some interruption in the paths of the motor impulses as sent from the motor areas in the brain to the muscle-centres in the spinal cord; or inco-ordination may result from (2) deficiency in the incoming sensory paths, thus causing an interference with the sense of muscular localization. One of the most familiar illustrations of inco-ordination is seen in acute alcoholism. In this condition the lack of motor control is largely due to interference in the conduction-paths of motor impulses. The intoxicated person is unable to control the movements of his hands to make them perform in their wonted fashion ordinary acts. In locomotor ataxia, a disease in which inco-ordination of the movements is very striking, the inco-ordination seems to result from a loss of muscle and joint sense, whereby the patient's mind is rendered unable accurately to realize just where his limbs are. Inco-ordination is a symptom of a number of different forms of poisoning, and is extremely characteristic in diseases such as locomotor ataxia, multiple sclerosis, chorea, and paralysis agitans. It is also found in a number of infantile diseases.

Incubator, a machine employed for the artificial hatching of chickens from eggs. Such devices were known to mankind from early ages. Pliny says that the Egyptians thus hatched 100,000,000 chickens a year. While artificial incubation was introduced into France and England during the 18th century, the incubator was brought to greatest perfection in the United States in the 19th century. The first patented invention of the modern incubator was in 1847, but any practical success in such machines cannot be met with before 1877, when Rouillier and Arnoult exhibited their hydro-incubators at the Paris Exposition.

There are two general classes of incubators, those in which hot air is used for the maintenance of heat and the application of it to the eggs, the other in which hot water serves this purpose. An automatic incubator of first class make is equally efficient whichever of these two heating mediums is employed, but there are many different types of machine offered for sale, and the struggle between cheapness and efficiency sometimes leads to the sacrifice of the latter. There are certain essentials to an incubator which must be attained at any cost, and the machine that is deficient in anyone of these is a failure, which means that it cannot guarantee to yield of living chicks at least 80 per cent. The following may be enumerated as absolute requisites in a good incubator: (1) An egg chamber heated at a uniform temperature. It is best that the heat should come from above, when it is likely to be reverberated from the floor of the chamber, and to more evenly affect the eggs, and may at once strike the germinal vesicle which from its lightness always rises to the upper surface of the yolk. (2) A source of heat which is self-regulative. The thermo-regulator in general use is actuated by an arm thrust within the egg chamber, and must be sensitive to an atmosphere ½° or at most 1° above that which is desired. (3) Good ventilation within the egg chamber, with some provision by which a certain degree of moisture may be maintained in the air. (4) Added to this, is a good turning apparatus. There are very many devices for effecting this purpose; perhaps the best is that of a tray fitting exactly over the tray in which the eggs are laid, and by the turning of which the eggs may be replaced in a reversed position in the applied tray.

Of course the aim of a true incubator is to reproduce as accurately as possible by artificial means the conditions of natural hatching under a sitting hen. Thus the supply of heat and air must be conformable to a fixed standard. The temperature is to be kept unchanged at 100° F., or a little above that, by placing the incubator in a room not exposed to draughts. To make accident in this respect impossible, a cellar, or specially built chamber, should be used, where no access of colder air may cause a fall in temperature, and a sensitive thermo-regulator furnish automatic means of preventing excessive heat from destroying the vitality of the eggs. Moisture must be preserved in the air of the egg chamber that the eggs may not be shriveled by excessive evaporation. There must also be adequate ventilation, that no harmful gases sicken or kill the hatching chick. The turning of the eggs is considered necessary, because the sitting fowl has the habit of so doing, but the eggs should not be disturbed after the 18th day, nor the incubator be opened after that date, until the hatch is completed. With regard to the moisture of the air, it has been considered proper, after studying the progress of evaporation, as reckoned from the loss of weight in a fertile egg during the process of hatching, that a humidity of 45 per cent is the safest degree of saturation.

Various ways have been resorted to of taking care of the chickens after they leave the incubator. They must at first be kept in an atmosphere of from 90° to 100°, at least for the first week, and heated places of shelter, known as brooders, must be prepared for them. There are many patterns and kinds of brooders, which are manufactured by the same firms as those which make incubators. The requisites for brooders are: (1) The temperature of the first week, as given above should be gradually lowered. (2) The greatest diligence should be applied to secure and maintain cleanliness, dryness, and good ventilation. (3) Their construction should be such that newly-hatched chickens may always be in view. As the chicks grow toward fledging, facilities should be afforded them to leave the brooder for exercise. See also POULTRY. Consult: Watson, 'Farm Poultry' (1901); Stoddard, 'The New Egg Farm' (1900).

In'cubus (Lat. «one who lies upon»), a spirit to whom was ascribed the oppression known by the common name of nightmare, in Greek *ephialtes* (from *epi*, and *hallomai*, I leap upon). These demons play an important part in the superstitions of the Middle Ages, having been perhaps not unfrequently employed, like the older gods of Greece, to cloak the advances of earthly lovers. See NIGHTMARE.

Incunab'ula, is a term applied by bibliographers to editions of books printed during the early period of the art, and is generally limited to works which appeared previous to 1500. The incunabula are divided into xylographic and typographic, the former those printed from engraved blocks, the latter from movable types. Among the most highly esteemed of the incunabula are those which are first editions of the ancient classics. See BIBLIOGRAPHY.

In'daja Palm. See ATTALEA.

Indemnity Contract, a form of contract which, while not of recent origin, is becoming much more common than formerly. Such a contract is any form of written agreement between two parties whereby one party agrees to indemnify or save harmless the other party for loss or damage arising out of a particular transaction, or against some specified claim of a third party. It is an original contract and must be in writing in order to come within the statute of frauds. Such contracts are frequently made in the form of a mortgage. But the substance and not the form is important, and the courts have usually given them a liberal construction with the intent of furnishing the party to be indemnified with all of the protection that was manifestly in the minds of the contracting parties when the contract was signed. Indemnity contracts are not adverse to public policy; but they are not binding when they undertake to protect persons against the consequences of illegal acts. Like other contracts, they must be founded on a sufficient consideration, and furnish indemnity only to the party named as indemnitee, and do not extend to a person having only a contingent or collateral interest in the subject matter of the contract.

Indepen'dence, Iowa, city and county-seat of Buchanan County, on the Wapsipinicon River, 70 miles southwest of Dubuque, and on the Rock Island and the Illinois Central R.R.'s. It is the centre of an extensive horse-breeding, farming and dairying region. There is located here the well known Rush Park, with its kite-shaped race track, the State insane asylum for northern Iowa, public library and other buildings. The electric-light plant and waterworks are owned by the municipality. Pop. (1890) 3,163; (1900) 3,656.

Independence, Kan., city and county-seat of Montgomery County; on the Verdigris River, 85 miles southwest of Fort Scott, and on the Atchison, T. & S. Fe and the Missouri P. R.R.'s. It is the centre and distributing point for a large agricultural section, and has cotton-mills, paper-mills, window-glass factories, flour-mills, cracker factories, brick works, planing-mills, and creameries. It has a public library, court house and other large buildings. Natural gas and oil wells are numerous near the city. Pop. (1890) 3,127; (1900) 4,851.

Independence, Mo., city and county-seat of Jackson County, five miles from Kansas City, on the Kansas C. & I., Missouri P. and the Chicago & A. R.R.'s. The city is considered a residential suburb of Kansas City. The town was settled in 1827, and in 1838 the Mormons' rendezvous was located here, and from hence the Latter-day Saints pursued their journey to Utah. Under the charter of 1889 the city is governed by a mayor and city council elected every two years. The electric-light plant is owned by the municipality. Pop. (1890) 6,380; (1900) 6,974.

Independence, Declaration of. See DECLARATION OF INDEPENDENCE.

Independence Hall, Philadelphia, a low plain brick building on Chestnut Street, begun in 1732 and completed in 1741, as a state-house for the colony of Pennsylvania, as closely connected with great national events as Faneuil Hall or the Old South in Boston. The architect was J. Kearsley, the builder E. Wooley. It was occupied as a state-house while unfinished, in 1735; the tower was added in 1750. Here the Continental Congress held its sessions; here Washington was appointed commander-in-chief of the Continental armies, on John Adams' motion; here the Declaration of Independence was adopted, and was read from its steps to the assembled crowds in front. The Convention of 1787 (q.v.), which framed the Constitution, was also held here. It is now kept as a museum of historical relics, especially of the Revolution.

Independent Catholic Church of the United States, a Polish religious body organized in Chicago, among disaffected Roman Catholics. Its founder, Rev. Anthony Kozlowski, attended one of the conferences of the Old Catholic Church in Europe and was there consecrated a bishop. The church has acquired considerable property in Chicago and has established a hospital, dispensary, orphanage, home for the aged, primary, grammar, high, and industrial schools. The society had in 1902 over 45,000 members, and 33 ministers and 43 churches.

Independent Order of Odd Fellows. See Odd Fellow.

Independent Telephony. In 1901-2, the expiration of numerous fundamental telephone patents enabled individual and independent companies to extend the telephone service to small communities, rural districts and farms in the West and Northwest. Many co-operative telephone lines were established in 1902 by farmers in the Middle West, and in 1903 it was estimated that 500,000 farms were in close communication by telephone with neighboring cities and commercial centres. The farmer finds that with the telephone he can keep in touch with the market, selling his produce or live stock when quotations are the most favorable. It is a common practice for the country doctor to give directions by telephone for caring for the patient, both diagnosing and prescribing. In Illinois the speeches of a political convention in 1903 were listened to by the farmers on a rural system as they sat in their homes from 15 to 36 miles away. Being in speaking distance of his neighbor, not only does the farmer feel a new sense of personal security, but he knows that his belongings are safer from molestation than they ever were before. The telephone has been instrumental in causing the arrest of many horsethieves and outlaws, and in some districts the farmers have almost broken up chicken stealing and petty larceny by telephoning the police and commission merchants of their losses, and thus enabling prompt arrests to be made.

An innovation in the use of the telephone which promises to be the vogue is already very popular. The local grocer or butcher, realizing that time is money, pays for the monthly rent of the telephone of any of his customers who spend $25 at his store during the month, or makes a corresponding discount for a smaller expenditure. He finds that in the increased amount of business coming through the greater ease of transmitting orders, and the reduction in his staff of order men, he can well afford to throw in the telephone service, which furthermore becomes a splendid advertisement for his store.

In the early days of the rural telephone the farmers were content to utilize their fence wires for intercommunication, and in many districts, particularly in the Western States, this method so reduced the cost of installation as to enable many communities to have a tolerably effective service, which otherwise would have had to go without any. But the farmers becoming more fastidious, demanded a better service. The systems employed range from a single line, with from three or four to a dozen instruments connected, to comprehensive systems covering entire counties and having hundreds of patrons. For instance, in Geauga County, Ohio, near Cleveland, where there is a population of about 14,000, there are over 1,000 patrons, the number in each township ranging from 50 to nearly 400. Great attention is paid to toll service, and the best construction and apparatus are insisted upon, as being in the long run the most economical. An example of the village and rural exchange is New Augusta, Ind., with 75 subscribers, 50 of whom are farmers, the most distant being about seven miles. When a single neighborhood line with a few instruments attached is desired, a switchboard is not necessary. The subscribers signal each other direct by giving different combinations of rings.

So easy has the organization of rural telephone systems become that it is safe to predict that within a decade the majority of the 4,000,000 farmers said to be yet unprovided with telephone service will have followed the example of their more enterprising brethren and brought themselves within touch of civilization. If any community wishes to install a system, no matter how limited, it has only to communicate with a reputable installation firm to receive the fullest and the clearest instructions as to how to go about it. A favorite method of organizing is for the farmers to form partnerships or co-operative (mutual) companies for the furnishing of service only to the locality in which the subscribers live. Sometimes the service is furnished by nearby telephone exchanges running lines into the rural districts.

In some places service cannot be given by city companies. In such case, the farmers can form themselves into a company, subscribe for the stock on pro rata or other basis, and install the system, running a direct line from their switchboard to that of the nearest town or city exchange. This is called the community system, the heart of which is the small switchboard, from which radiate in different directions the lines to which the various telephones are attached. See also, Telephone System, Independent.

Independent Treasury, The United States. See Finance.

Independents. See Congregationalism.

In'dex Libro'rum Prohibito'rum ("list of prohibited books"), in the Roman Catholic Church, a title used to designate the catalogue or list of books prohibited by ecclesiastical authority, on account of heretical or immoral opinions supposed to be contained in them, or maintained by the authors or editors of them; when the list or catalogue is of books allowed to be read after correction or alteration, agreeably to the orders of the Papal authorities, it is termed *Index Expurgatorius*. Such prohibitory catalogues have been in use from a very early period in the history of the Church, commencing with a list of prohibited books drawn up by a council held at Rome in 494, or even earlier, with the proscription of the writings of Arius. These prohibitions, in fact, were often issued by other than the Papal authorities. In 1408 a synod at London prohibited the reading of the books of Wickliffe. In 1544 the Faculty of Theology in Paris published a catalogue of books censured by them, and in 1546 the University of Louvain published an index of books regarded as dangerous. The indexes of the Church were a subject of consideration at the Council of Trent, which referred the business of drawing up a complete index to a select committee under the Pope. Their Index was published in 1564, and besides the catalogue of prohibited books contains general rules relative to such books. In 1586 a special ecclesiastical board, the Congregation of the Index, was formed, with authority to judge of new works, to indicate those of which the reading is entirely prohibited, and those which are permitted after correction, etc. The most important editions are those of Alexander VII. in 1664, and of Benedict XIV. in 1744. An edition appeared in 1881, with a supplement in 1884. In 1607 the first volume of an 'Index Expurgatorius' was published at Rome. Pope Leo XIII. had a revision made of the Roman Index, and about 3,000 books were taken from the prohibited list.

India, also called **Hindustan** or **Indostan**, derived from the Persian form of the Sanskrit *sindhu*, a river, and signifying "the land beyond the Indus," is a name used both in ancient and modern times with great latitude of signification, and applied more or less comprehensively to the great central peninsula of southern Asia. The mainland of India proper is bounded north by the main range of the Himalaya Mountains; east by mountain ranges which divide it from Burma, southeast by the Bay of Bengal; south by the Gulf of Manaar, which separates it from Ceylon; west by the mountain chains enclosing the valley of the Indus, which separates it from Afghanistan and Baluchistan, and by the Indian Ocean. Its length north to south is nearly 2,000 miles; its greatest breadth east to west about 1,800 miles. It extends between lat. 8° 5′ and 35° 15′ N., and lon. 65° 45′ and 97° E.

Political Divisions.—Legally "British India" means all territory governed by the "King-Emperor" or "Kaisar-i-Hind," as the monarch of Great Britain is designated in Hindustan, together with any territories of native princes or rulers under the suzerainty of the King of England exercised through the Governor-General and Viceroy of India. They are as follows:

1 *Madras* (Area 141,726 sq. miles; pop. 38,209,436) was the most important of the three presidencies before Clive's conquest of Bengal. The people are chiefly Hindus, although there are at least a million native Christians. The languages spoken are principally Tamid and Telagu. It is ruled by a governor. The chief cities are Madras (509,346), Madura (105,984), and Trichinopoly (104,721).

2 *Bombay* (Area 125,144 sq. miles; pop. 18,584,496). The governor of Bombay administers Sind, and other districts. 77 percent of the people of the Presidency are Hindus, and 20 percent Moslems. The Parsis, the ancient fire worshippers from Persia, are very prominent in the City of Bombay. Marathi, Gujerati, Sindhi, and Kanarese are the principal languages. Chief cities, Bombay (977,822), Ahmadabad (185,889), Poona (153,320), Surat (119,306), Karachi (116,660).

3 *Bengal* (Area 115,819 sq. miles; pop. 50,722,067). Ruled by a lieutenant-governor. It comprises the districts of Bengal proper, Behar, Orissa, and Chota Nagpur; only 5 percent of the population live in towns. Nearly 78 percent are Hindus. Principal languages Bengali and Hindu. Chief cities, Calcutta (1,106,738), Patna (1,341,785).

4 *Eastern Bengal* and *Assam* (Area 106,130 sq. miles; pop. 30,961,459). Ruled by lieutenant-governors. Prinpal languages, Benga and Assamese. Chief city, Dacca (90,542).

5 *United Provinces* of *Agra* and *Oudh* (Area 107,164 sq. miles; pop. 47,691,782). Principal languages, Hindi and Behari. 85 percent of the population are Hindus and 14 percent Moslem. Chief cities, Allahabad (172,032), Agra (188,022), Benares (209,331), Lucknow (264,049), Cawnpur (197,170), Meerut (118,129).

6 *Punjab* (Area 97,209 sq. miles; pop. 20,330,339). Under the rule of a lieutenant-governor. More than half of the population are Moslems and one-third Hindus. Sikhism, the national religion of the province, numbers more than 2,000,000 adherents. The languages are Gurmuki or Punjabi and Handi. The chief cities, Lahore (202,964), Delhi (209,575), Amritsar, the sacred city of the Sikhs (162,429).

7 *Burma* (Area 236,738 sq. miles; pop. 10,490,624), the largest province in British India. Conquered and annexed, 1885. Ruled by a lieutenant-governor. The inhabitants are of Indu-Chinese stock. 90 percent are Buddhist. Principal language Burmese. Chief cities, Rangoon (234,881), Mandalay (183,816).

8 *Central Provinces* and *Berar* (Area 82,635 sq. miles; pop. 9,237,654). Ruled by a chief commissioner. The people are mostly Hindus, and speak Hindi and Marathi. Chief city, Nagpur (127,734).

9 *The North-West Frontier Province* (Area 16,466 sq. miles; pop. 2,125,480). Mainly Moslems, speaking Pushto, or the Afghan language. A chief commissioner administers the districts of Peshawar, Hazara, Kohat, Bannu, and Dera Ismail Khan, together with the political charges of Kurram, Malakand, Khiber, Tochi, Gomal, and Shirani. Chief city, Peshawar (95,147).

10 *Ajmer-Merawa* (Area 2,711 sq. miles; pop. 476,912). Administered by a chief commissioner. Chief city, Ajmer (pop. 73,839).

11 *Coorg* (Area 1,582 sq. miles; pop. 180,607). The resident of Mysore is ex-officio chief commissioner of Coorg.

12 *British Baluchistan* (Area 45,804 sq. miles; pop. 308,246). Under the governor-general's agent, who resides at Quetta.

13 *The Andemans* and *Nicobars* (Area 3,143 sq. miles; pop. 24,649). A chain of islands in the eastern part of the Bay of Bengal, administered by a chief commissioner and superintendent. Port Blair is a convict settlement of British India.

14 *The Laccadive Islands*, 14 in number, belong to the Madras presidency. Aden and Perim are protected chiefships and are legally part of the Bombay presidency.

There are a number of *Native States*, ruled by native princes who are responsible to the Viceroy of India for their good government. Attached to Bengal, with an area of 35,834 square miles, and a population in 1901 of 3,735,715, are the individual states of Orissa, Chota Nagpur, Kuch Behar, and Hill Tipperah; to the United Provinces of Agra and Oudh, with an area of 5,109 square miles, pop. 799,675, are Rampur and Garhwal; to the Panjab, with an area of 38,299 square miles, pop. 4,438,816—the chief states are Patiala, Bahawalpur, Kapurthala, Jind, and Nabha; to Madras, area 9,609 square miles, pop. 4,190,322—the chief states are Travancore and Cochin; to Bombay, area 69,045 square miles, pop. 6,891,691—the chief states are the Kathiawar group, Kolhapur, Rewa Kantha, Palanpur, Mahi Kantha, Cutch, and Khairpur (Sind); to Central Provinces, 29,435 square miles, pop. 1,983,496—the chief states are Patna, Kalchandi, Bastai, Bamra, and Raigarh.

The other native states and agencies are: the Rajputana Agency, including among others the states Jaipur, Jodhpur, Udaipur, Bikanir, Alwar, Bhartpur, and Jaisalmir, with a total area of 130,268 square miles and a pop. (1901) of 9,841,032; Central India Agency, including among others the states Gwalior, Rewa, Indore, and Bhopal, with a total area of 77,808 square miles and a pop. of 8,501,883; Baroda, area 8,226 square miles, pop. 1,950,927; Hyderabad, area 82,698 square miles, pop. 11,174,897; Mysore, area 27,936 square miles, pop. 5,538,482; and Kashmir, area 80,900 square miles, pop. 2,906,173. The total area of native states and agencies is thus 595,167 square miles, and their total population in 1891 66,050,479, in 1901 63,181,569.

The following native states, whilst they are independent of British rule, are treated as within the sphere of British influence: *Nepal*, of which a Maharajah is ruler; *Bhutan* and *Tibet*, whose relations to the British government are somewhat unsettled, having no British resident; and *Afghanistan*, governed by his Majesty Amir Abibullah Khan. (See AFGHANISTAN.)

Physical Features.—The natural boundaries of the peninsula of India, which forms a triangle washed on two sides by the sea, and having its base in the great mountain chain which separates it from Tibet on the north, are completed by its three great rivers, the Indus, the Ganges, and the Brahmaputra. These all rise in the Tibetan Mountains beyond the Himalayas, and the first flowing west, the two latter east, descend in a southern direction toward the sea; the Indus discharging itself into the Indian Ocean; the Ganges and the Brahmaputra, after watering in their separate course a large part of Northern India, uniting to pour their waters together by numerous mouths into the Bay of Bengal. The mountains enclosing the basins of these rivers form the east and west boundaries of the northern part of the peninsula. The Himalayas, the loftiest mountain range in the world, with heights of upward of five miles above the level of the sea, descend by successive slopes to the elevated plain of Northern India. (See INDUS, GANGES, BRAHMAPUTRA, HIMALAYA.) The entire peninsula is sometimes distinguished by three natural divisions. The Vindhya Mountains, a range of about 3,000 feet in height, which extends irregularly across the peninsula, from Gujarat to the basin of the Ganges, forms an anciently-recognized division into two parts under the names of Hindustan and the Deccan (Southern Land). The name Hindustan, given in this restricted sense to the northern part of the peninsula, is frequently applied to the whole. The ancient division of the Deccan is again subdivided into two, the name Deccan being restricted to the northern part, the southern from the river Krishna or Kistnah, which flows from west to east almost across the whole peninsula, being called Southern India or India south of the Krishna. The portion of India watered by the Ganges and its tributaries is by far the most fertile and populous of the whole. At no great distance from the opposite extremities of the Vindhya Mountains two great ranges proceed southward along the line of the coast. The Western Ghâts, which attain a height of 5,000 to 6,000 feet, though at some parts much lower, proceed along the west coast to Cape Comorin, the southernmost point of India. They do not generally recede more than 40 miles from the sea, and rarely more than 70. On the sea side their descent is generally precipitous, forming a regular sea-wall. On the land side they descend gradually, and sometimes almost imperceptibly, to the elevated plains of the interior. The Eastern Ghâts recede farther from the east coast, are less elevated and precipitous. Before reaching as far in their southern course as Madras, they trend inward, and unite with the transverse range of the Nilgiri Hills, which connects them with the Western Ghâts. This mountain-formed triangle encloses an elevated table-land with a gradual slope eastward from the Western Ghâts, and which is continued beyond the Eastern Ghâts to the sea. The elevation of the plain of Southern India also increases toward the south. In the Deccan it is about 3,000 feet above the level of the sea. In the neighborhood of the Nilgiri Hills, which rise 3,000 feet above it, it reaches 7,000 feet.

Hydrography.— The chief rivers of India besides the Indus, Ganges, and Brahmaputra, already named, are the Jamna, Ramganga, Gumti, Gogra, Gandak, Kusi, etc., tributaries of the Ganges; the five rivers of the Panjab, Satlej, Bias, Ravi, Chenab, and Jhilam, tributaries of the Indus; the Nerbudda, enclosed on its northern bank by the Vindhya Mountains, and the Tapti, which flow west into the Gulf of Cambay, the Mahánadi, the Godávari, the Kistna, North and South Pennar, Vellar, Kaveri, etc., all flowing eastward into the Bay of Bengal. The uniform direction of the great rivers south of the Tapti is explained by the inclination of the land already described. The coasts of India have very few indentations, and consequently very few good natural harbors. The western coast is known by the name of the Malabar, the eastern by that of the Coromandel coast. There are no lakes of any extent in India — Chilka and Kolair near the east coast being the largest.

Geology.— All the great mountain ranges are chiefly composed of granite and of granitic rocks, which form also the base of the plateau of the Deccan. Both in the peninsula and in the Himalayas gneiss predominates, associated with mica-schist, hornblende-schist, chlorite slate, and primitive limestone. Syenite prevails in the southeast of the peninsula. In the southern portion of the Western Ghâts the granitic rocks are overlaid by an iron clay, which is continuous to the end of the peninsula, and reappears in the island of Ceylon. In the upper portion of the Western Ghâts and adjoining ramifications of the Vindhya range, basaltic trap in various forms overlies the granite to an extent unparalleled elsewhere in the world. It entirely covers a large portion of the table-land of the Deccan. In this district trap and granite frequently pierce the surface in isolated masses, forming flat-topped hills nearly perpendicular, and which can only be ascended by steps, or winding, dangerous paths. These have been converted into strongholds from a remote antiquity. They are frequently crowned with forts, and form a peculiar feature of the landscape. On the lower sides of the Himalayas regular strata of the Secondary and Tertiary periods are largely developed. Many of the sandstones and shales of the Secondary period belong to the coal-measures. The Indian Tertiary formations attain their greatest breadth toward Sind and the Panjab, where fossil remains, including many of singular forms and gigantic dimensions, are abundant.

Mineral Resources.— The principal coal fields in India are found in the region bounded north by the Ganges, south by the Godávari, and stretching east and west from the neighborhood of Calcutta to the middle of the valley of the Narbada. Indian coal is distinguished by its excessive lamination. The annual production in India was 6,635,727 tons in 1901, from 427 collieries worked throughout Bengal, Hyderabad, Assam, Rewah, the Central Provinces, Panjab, Baluchistan, and Burma. The most important mines are those of the East Indian Railway Company near Giridhi (Bengal) and the Singareni mine in Hyderabad. Of the coal used on the railways 95 per cent is Indian coal. Iron ore is abundant in many parts of India, but the amount produced is still small. The only large iron-work in India is at Barrakur in Bengal, but iron is manufactured locally on a small scale in other parts of Bengal and in the central provinces. The chief obstacle to the successful development of the iron industry of India is the difficulty of finding the ore, fuel, and flux sufficiently near to one another to

INDIA
SCALE OF MILES.
Population of places is indicated by different lettering, thus:
200,000 and over ---------- CALCUTTA
100,000 to 200,000 ---------- Bangalore
50,000 to 100,000 ---------- Mirzapur
10,000 to 50,000 ---------- Chanda
Smaller Places ---------- Pondicherry
Railroads
AFGHANSTAN
BALUCHISTAN
KASHMIR
PUNJAB
RAJPUTANA
NORTH WESTERN PROVINCES
CENTRAL PROVINCES
CENTRAL INDIA
HAIDARABAD
MYSORE
BENGAL
NEPAL
BHUTAN
ASSAM
CHINESE EMPIRE
HIMALAYA MOUNTAINS
DELHI
LUCKNOW
Cawnpur
BENARES
Patna
Allahabad
Agra
Jaipur
Gwalior
Srinagar
Lahore
Amritsar
Meerut
Bareilly
Karachi
Ahmadabad
Baroda
Surat
BOMBAY
Poona
HAIDARABAD
Bangalore
MADRAS
Trichinopoli
Madura
Howrah
CALCUTTA
CEYLON
Colombo
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
TROPIC OF CANCER
Andaman Islands
Nicobar Islands
CALCUTTA and Vicinity.
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Longitude East from Greenwich

make it profitable, but it is believed that iron-works near Calcutta, using Madras ore and Bengal coal, would succeed. Gold is worked to some extent, more especially in Mysore, the total production in 1900 being 513,266 ounces. Copper, lead, antimony, and other metals are fairly abundant. Burma yields a large amount of petroleum annually, and smaller quantities are obtained from Assam and the Panjab. The total output for 1900 was over 37,500,000 gallons, but much is still imported. There are valuable ruby mines in Upper Burma, and a few diamonds are still obtained in Central India. Salt is an important manufacture and source of revenue: its production is treated under the head of *Finance*.

Soils.— The alluvial deposits along the mountain valleys and in the plains, and the soil composed of disintegrated rock masses on the plateaus, are especially rich and of great productivity. Their fertility is greatly enhanced and maintained by an elaborate system of irrigation. See paragraph in this article on *Canals and Irrigation*.

Climate.— India extends 15½° within north tropical latitudes, and 12½° within the temperate zone. Owing to modifying circumstances, the climates contained within this range are not only extremely various, but distributed with great irregularity. One of the chief modifying circumstances is the distribution of moisture, the great regulators of which are the monsoons. The northeast monsoon blows from October to March, the southwest from April to September. The latter surcharged with vapor from the Indian Ocean condenses in torrents on the heights of the western Ghâts, and forms the rivers which flow to the east. Before it reaches the Coromandel coast, it becomes a dry wind which scorches up vegetation. In Hindustan, on the contrary, this wind passes over the low plains in the lower valley of the Indus, is arrested by the Himalayas, and fills the tributaries of the Ganges. The northeast monsoon runs a similar course in the opposite direction, but deriving less moisture from the Bay of Bengal, which is of less extent than the Indian Ocean, it has less influence on the climate, and its season is in general the dry one. The great plain of Southern India being exposed to greater heat than that of Hindustan, and not being watered by the snow-fed streams of the Himalayas, is naturally much less fertile. The seasons in India are divided into rainy, cool, and hot. The periods of these different seasons vary according to latitude and modifying circumstances. On the Malabar coast the rain begins earliest to the south. At Calcutta rain falls from June to October: the cool season begins about November, the hot season in February, the heat increasing gradually till May. In Calcutta where the mean annual temperature is about 79°, the range is from 50° to 85° F. In Bombay the mean annual temperature is about 82°, the range about 10°; in Madras mean about 84°, range 7° to 8°. The annual rainfall in India is much greater than that of England; but it is distributed with great irregularity. The basin of the Indus, including all Sind and the half of the Panjab, is an arid region with an annual rainfall under 15 inches. The high plateau in the interior of South India has an annual rainfall generally under 30 inches. On the whole Malabar coast the rainfall is over 75 inches; at Kananor it reaches 128 inches. On the Coromandel coast it is very much lower, being 45 inches at Vizagapatam, 50 inches at Madras, while farther south it falls below 30 inches. Between the arid region of the Indus and the Ganges runs a dry zone of 100 to 200 miles wide, including Lahore, Delhi, and Agra, with a rainfall between 15 and 30 inches. The valleys of the Tapti, the Nerbudda, the lower part of the Jamna, the Ganges, and the Brahmaputra, are generally over 30. Along the slopes of the Himalayas from Cashmere east to the boundaries of India, and southeast to the mouths of the Mahánadi runs a belt of country with a rainfall over 60 inches, within which is included the lower course of the Ganges. Within this is another belt, including a lower slope of the Himalayas, and the lower course of the Brahmaputra before its junction with the Ganges, in which the rainfall rises above 75 inches.

Forests.— The three most valuable timber trees of India are the teak (*Tectona grandis*), the sál or saul (*Shorea robusta*), and the deodar (*Cedrus Deodara*). The teak grows most luxuriantly along the Bombay coast, in Travancore and Cochin, and in Burma, but it is also abundant throughout much of Central India and elsewhere. The sál is the chief forest tree of the Himalayan slopes, from the Satlej eastward to Assam, and it grows also in the forests of Central India and the Eastern Ghâts. The home of the deodar is the northwestern Himalayas. Among the most valuable trees of the densely forested Western Ghâts from Kanara to Travancore and Mysore are teak, blackwood, bamboos, sandal-wood, a kind of ebony, and *Calophyllum inophyllum*, whose wood is prized for the spars of ships. In the United Provinces and neighboring districts the leading species are sál and several varieties of pines, and in the extensive jungles of the Ganges delta the most useful wood is that of the sundari (*Heretiera littoralis*). The forests of Assam yield sál, *Pinus Kasya*, caoutchouc (*Ficus elastica*), and other useful species, and plantations of teak, tun or toon (*Cedrela toona*), and sissoo (*Dalbergia sissoo*) have been laid out. Beside teak the Burmese forests contain ironwood and the cutch-tree (catechu). Before the formation of the Indian Forest Department the forests were recklessly destroyed by timber-cutters, nomadic cultivators, and others, but large forest areas in all the provinces have now been marked off as reserved forests under the immediate care of the forest officers, and other forest areas have been brought under partial conservancy. Timber-cutting and grazing have been either prohibited or restricted; and plantations of the more useful trees have been formed in many parts of the country. In every province a few of the most valuable timber trees are declared to be reserved trees, and can only be felled under special license. Forest revenue is raised by royalties on, or by the sale of, timber or other produce, and by the issue at specified fees of permits to graze cattle, or to extract for sale timber, firewood, charcoal, bamboos, canes, and other minor forest produce. The reserved forests now cover an area of more than 80,000 square miles, and the protected or partially conserved forests occupy other 30,000 square miles. Some of the native states, such as Mysore, Travancore, Baroda, and Kashmir, have followed the example of the British government.

Flora.— Where moisture is plentiful, as in the valley of the Ganges, vegetation is superabundant. The delta of the Ganges, in particular, called the Sunderbunds, is covered with dense jungle full of the largest wild animals, and the excessive vegetation renders most of the mouths unnavigable. There are many other similar tracts of extensive forest and jungle. On the Coromandel coast, on the other hand, the heat, which reaches 100° or 120° F., destroys vegetation, and the delta of the Indus from the southeast of the Panjab to the Ran, or great salt marsh of Kach (Cutch), forms a great sandy desert, continuous across the river with the desert of Baluchistan, and with a wide band stretching across the whole continent of Asia to Central Africa. In the various altitudes of the Himalayas forms of vegetable and animal life belonging to all the various climates from tropical to polar are to be found. These as well as the Western Gháts are magnificently wooded. Orchids, rhododendrons, and other valuable flowers are common. Among the staple natural products of India are rice, maize, wheat, barley, cotton, flax, hemp, jute, rhea, indigo, tea, coffee, sugarcane, opium, tobacco, ginger, pepper, cardamoms, palms bearing nuts which are extensively consumed, anise, dye-woods, etc. European fruits abound, and among indigenous fruits may be mentioned the mango, plantain, pomegranate, citron, date, almond, grape, pineapple, and tamarind. Palms, including the date, cocoanut, palmyra, betel-nut, and other species, the banyan, and bamboo, are common features of the vegetation.

Fauna.— The elephant, the rhinoceros, the camel, the tiger, a few lions in the northwest, the leopard, bears, hyena, jackal, wolf, and numerous smaller carnivora, the boar, antelopes, deer, wild ox, ass, sheep, and goat, monkeys in great variety, and the greater number of European quadrupeds are found. There are several large species of ox, such as the gaur or "bison" and the arnee or wild buffalo. Crocodiles, snakes (including the dreaded cobra), and reptiles in all varieties are very numerous; of birds, the eagle, vulture, falcons, peacock, parrots, kingfishers, mina-bird, partridge, quail, heron, stork, are characteristic species, and other varieties, both indigenous and common to other regions, are numerous. Fish are plentiful and in great variety both on the coasts and in the rivers.

Land Tenure and Revenue.— In India the state, or the monarch, has always enjoyed a share in the rent or profits from the land. Before the advent of the Mohammedans and the establishment of the Mogul Empire the almost universal unit for the purposes of revenue collection was the village community. In a village community land was held, not by private owners, but by cultivators occupying it under the village corporation, and the land revenue was collected from the head-man as representing the community. With the Mohammedan conquest new methods of revenue collection were introduced. The state claimed one third of the gross produce of the soil as its share, and entrusted its collection to persons who each agreed to pay a definite amount from the district assigned to him. These revenue farmers, known as *zamindars*, were often local magnates under the old Hindu system. Under British rule the aim has been to substitute private property in the soil, wherever practicable, for the older communal systems, and in consequence the zamindars, who were in no sense proprietors, have become so in several parts of British India, while in others the cultivating *rayots* (or *ryots*) have been raised to the status of peasant proprietors. The village community, however, in some form still exists both in British and in native territory.

The term "settlement" is applied in Indian revenue affairs to the process of assessing the land revenue demand. Occasionally, in newly acquired or specially backward tracts, the land revenue is assessed for a short term of years on a general review of the circumstances and capabilities of the land and people concerned; such a process is called a summary settlement. But a regular settlement is a more complicated affair, and consists of many stages. In the first place, every separate estate or holding is demarkated by permanent marks on the ground; and disputes between neighboring right-holders are investigated and decided. Every estate or holding is then surveyed and mapped, all boundary-marks, wells, and buildings being shown on the field or cadastral maps. After the field maps are prepared, the next process is to classify or record each field according to its productive value, as evidenced by its soil, the amount of its produce, or by the rent it pays. A record is at the same time drawn up of all rents paid, and of all rights, whether landlord rights, or tenant rights, or rights of user, over all the ground, buildings, wells, and trees shown in the map. Then the assessing officer (or settlement officer, as he is often called) compiles the information obtained for all the lands in a circle of villages; and on a review of all these data, of the past fiscal history of the tract, of the range of prices, of the accessibility of markets, and of other general considerations, he proposes rent rates or revenue rates for the several classes of lands in the circle. The rent rates or revenue rates proposed by the settlement officer, and the grounds on which they were based, are then investigated by a superior officer, and are not adopted until they have been accepted or modified by the latter.

In provinces where the zamindari tenure prevails, that is, where single proprietors or proprietary brotherhoods possess large estates of several hundreds or thousands of acres, the state revenue is assessed at an aliquot part (usually about one-half) of the ascertained or assumed rental. The revenue, though it is fixed with reference to acreage rates on the land actually cultivated, is assessed on, and is payable by, each estate as a whole; the assessment remains unchanged for the 30 years, or other period of the settlement; the proprietor can bring as much as he likes of his waste and fallow land under the plough; and it is only on re-assessment at the end of the term of the settlement that the state obtains any increase of revenue on account of the extensions of cultivation during the settlement period. In provinces where the rayatwari tenure prevails, that is, where each petty proprietor holds directly from the state, generally cultivates his own land, and has no landlord between himself and the government, the revenue is separately assessed at an acreage rate on each petty holding, and land revenue becomes payable at once, or

FEASTING THE IDOLS.

after a short term of grace in the case of uncleared lands, on all extensions of cultivation. The rayatwari proprietor is at liberty to throw up his holding, or any portion of it, at the beginning of any year, after reasonable notice; the zamindar, or large proprietor, engages to pay the revenue assessed upon him for the term of the settlement.

The land revenue assessment was fixed permanently more than 100 years ago on the greater part of Bengal, about a third of Madras, and certain southern tracts of the Northwest now the United Provinces, paying in all about $14,250,000 a year. In the temporarily settled tracts, comprising the rest of India, it is fixed periodically for terms of 12 to 30 years. In the nine chief provinces (Bengal, Bombay and Sind, Madras, the United Provinces of Agra and Oudh, Central Provinces, Panjab, Burma, Assam, Berar) the number of rayatwari holders is about 273,000, of whom none belong to Bengal, Panjab, and the United Provinces and Oudh. The total number of zamindars and village communities is about 318,500, of which only Sind and Berar have none. The total number of holdings is thus about 591,500. In the greater part of Bengal land is held by zamindars under a permanent settlement, but the tenants are protected by recent legislation. The rayatwari system is the prevalent one in Madras, and in Bombay a similar system has been established. In the latter province the cultivators are now protected by law against the extortions of the money-lenders. The village community is still common in the United Provinces and the Panjab. In Oudh much of the land is held by talukdars, who have been granted certain privileges which are denied to the zamindars.

Agriculture.— The total area accounted for in the agricultural returns for 1901 is 546,000,000 acres, of which 66½ millions are under forest, 135½ million not available for cultivation, and 147½ million culturable waste and current fallows. The net crop-yielding area is thus 198½ million acres, or, taking account of land cropped several times in a year, 223½ million acres The three chief food-grains of India are rice, millet, and wheat. Rice is the staple food of about a third of the population, and is grown on 75 million acres, but it is nevertheless essentially a local crop, which can be cultivated with profit only under exceptional circumstances. Of the total rice area 40 million acres belong to Bengal, where it is the staple crop, and about 7 million each to Madras and Burma. Over 90 per cent of the cultivated area of Lower Burma is under rice, and it is grown on nearly three quarters of the area of Assam, about one third of that of the Central Provinces, a quarter of that of Oudh, while it is of importance also in the United Provinces and Sind. It is grown to a less extent in the Panjab and Bombay. Rice is also cultivated by hill tribes in all parts of India. In Bengal there are two chief rice harvests in the year, the *áus* or early crop, chiefly for local consumption, and the *áman* or winter crop, chiefly for export; but in Lower Burma, whence most of the exported Indian rice comes, there is but one harvest, corresponding to the Bengal winter crop. The total area under wheat is 24 million acres, mainly in the Panjab (7½ million), where it is the leading crop, the United Provinces of Agra and Oudh, the Central Provinces, Bombay, Central India, and Bengal. Taking India as a whole, it may be broadly affirmed that the staple food-grain is neither rice nor wheat, but millet. The area under the various kinds of millet and maize is 43 million acres, chiefly in Bombay (13½ million), where these are the chief food crops; Madras, where also, though to a less extent, millets are the chief food-grains; Panjab, United Provinces, Berar, in which millets are by far the most important food crops; Central Provinces, Sind, Oudh, Bengal, and Upper Burma. The chief varieties of millet grown in India are *joár*, or *jawári*, or *cholam*, great millet (*Sorghum vulgare*); *bájra*, or *kambu*, spiked millet (*Pennisetum typhoideum*); and *ragí*, or *náchani* (*Eleusine corocana*), grown chiefly in Southern India. About 8 million acres are sown with barley, chiefly in the upper Ganges valley, the Himalayan valleys, and the Panjab. Gram crops or pulses, especially chick-pea, green-gram, horse-gram, lentil, and pigeon-pea, occupy 10 million acres, mainly in the United Provinces of Agra and Oudh, the Panjab, and Bengal. The large native demand for oil has been reinforced in recent times by a rapidly-increasing foreign demand, and in consequence the cultivation of oil-seeds has greatly developed. They are grown in many parts as a second crop on ground from which rice or some other food crop has already been taken. The chief varieties cultivated are linseed, rape-seed, sesamum (*til* or gingelly), and castor-oil, and the total area occupied by them is 22 million acres, chiefly in Bengal, Bombay, and Sind, Madras, Central Provinces, and Panjab. The area under ground-nuts in Bombay and Madras is about 170,000 acres. The cultivation of vegetables for household use is general, and near some of the towns it is carried on more extensively. Potatoes thrive best in the more elevated tracts. Among cultivated fruits are the mango, guava, orange, melon, citron, lime, fig, plantain, pineapple, pomegranate, tamarind, shaddock, jack, papaw, and custard-apple. The area under sugar-cane is about 2,800,000 acres in Bengal (especially Orissa), United Provinces, Panjab, Oudh, Madras, and Bombay. Jaggery sugar is made from the bastard date-palm, which is grown for this purpose in the neighborhood of Calcutta and in northeastern Madras. The tea crop is one of great and increasing importance, and occupies about half a million acres, of which 330,000 are in Assam, the rest being in Bengal, Panjab, United Provinces, Madras, Burma, and native states. With the exception of a few hundred acres in Burma, Assam, etc., the whole of the coffee-growing area, amounting to about 280,000 acres, is in Southern India, in Mysore, Kurg, Madras, Travancore, and Cochin. The chief cinchona plantations are the government ones at Darjiling and in the Nilgiris. The tree was introduced by the Indian government.

Cotton is one of the most valuable vegetable productions of India. The total area under the cotton-plant is 14,000,000 acres, distributed thus: Bombay and Sind (3,900,000), Berar (2,500,000), Hyderabad (1,700,000), Madras (1,400,000), United Provinces of Agra and Oudh (1,250,000), Panjab (1,200,000), Central Provinces (1,000,000), and smaller areas in Central India, Rajputana, Burma, and Bengal. Next in importance to cotton among Indian fibres comes jute, which is cultivated in eastern Bengal along the valleys of the Ganges and the Brahmaputra, occupying fully two million acres. The cultivation of the mulberry, for the rearing of the silk-worm, is chiefly carried on in eastern and northern Bengal, with Murshidabad as a centre. The indigo industry is one of the oldest in India, but it is at present in a languishing condition. The area under the plant is about 964,000 acres, chiefly in Bengal (300,000), United Provinces of Agra and Oudh, Madras, and Panjab. The opium poppy is cultivated in certain parts of western Bengal and the United Provinces of Agra and Oudh, in the Panjab, and in the native states of Rajputana and Central India, occupying in all about 600,000 acres. (See below under *Finance*.) Tobacco is grown in every district for local consumption. Among the numerous minor cultivated vegetable products of India are turmeric, chillies, ginger, coriander, aniseed, black cummin, fenugreek, pepper, cardamoms, betel-pepper, areca or betel-nut palm, cocoanut palm, palmyra palm, and date-palm. Experimental cultivation of rhea, rubber, sisal-hemp, and other valuable economic plants has been carried out on the experimental farms maintained by government in various parts of the country.

Stockraising.— Horned cattle are used in agricultural operations throughout all India, except Sind and the Panjab, where camels generally take their place. The total number of cattle in India is over 100 millions, of sheep and goats 40 millions, of horses, ponies, mules, and donkeys, 2½ millions, and of camels about a quarter of a million. There are large numbers of buffaloes in all parts of the country. A public veterinary department has been organized to attend to the improvement of the breeds of horses, ponies, mules, and cattle, the prevention of disease among domestic animals, and the provision of veterinary instruction. Its operations are mainly confined to Northern India, where the conditions are most favorable for the breeding of horses for military purposes.

Commerce.— From a very early period down till comparatively recent times Western traders visited India in order to obtain the gold and silver, jewels, spices, and other costly products for which India was then celebrated, but the present foreign trade of India has developed under British rule and rests on an entirely different basis. In the year 1700 the total value of the exports from India was under $5,000,000, in 1834 the value had risen to $50,000,000, and now goods and treasure to the value of about $400,000,000 are exported every year. In 1899–1900 the total value of private imports by sea (excluding treasure) was $235,706,200, of government imports of stores, $15,308,725; total of all imports other than treasure, $251,014,925. The total value of private exports of Indian merchandise was $352,379,510, of foreign merchandise re-exported $10,975,525, of government exports of stores $357,115; total of all exports other than treasure, $363,712,150. Treasure was imported to the value of $69,912,285 and exported to the value of $26,521,295. Thus, including treasure, the total exports by sea amounted to $390,233,445, and the total imports to $320,027,210, the total sea-borne trade being $711,160,655. The exports by land in the same year were valued at $18,800,925, and the imports by land at $23,529,025. Thus, the total trade of India by land and sea amounted in 1899–1900 to $753,490,605. The chief articles of import were: cotton woven goods, metals and hardware, oils, chiefly petroleum, sugar, railway material, machinery and mill-work, cotton yarns, chemicals, medicines, dyes, woolen goods, silk, raw and manufactured, provisions, liquors, and apparel. The chief exports were: jute, raw and woven, husked rice, hides and skins, oil-seeds, raw cotton, tea, opium, cotton yarns, wheat, indigo, coffee, raw wool, and cotton woven goods. The proportion of trade directly with European countries is about 63½ per cent, omitting the trade with Egypt, much of which really goes to Europe. The trade with the United Kingdom is over 70 per cent of the trade with Europe and nearly 45 per cent of the total trade. Next to the United Kingdom, the chief countries trading with India are China, Germany, United States, Straits Settlements, France, Japan, Belgium, Ceylon, Austria-Hungary, Italy, and Russia. The figures for 1900–1 show that, while Indian imports of American goods were valued at only some $49,000, Indian exports to America amounted to $241,640. The chief articles of export appear to be gunny bags and cloth, of which latter America takes more than all other countries. The trade of India with America, however, is only of short standing, but, wisely organized, is capable of being greatly expanded. At present Germany supplies many things this country should furnish, particularly in the electrical and chemical lines, in which it at present holds the market. Other important articles of Indian export are tea, jute and jute manufactures, wheat, oil-seeds, rice, leather, wool, indigo, coffee, teak-wood, cotton, and lac. The share of the five chief seaports of India in the total foreign trade (excluding treasure and government stores) in 1899–1900 was as follows: Calcutta, $264,130,000; Bombay, $188,230,000; Rangoon, $40,590,000; Karáchi, $35,170,000; Madras, $32,180,000. India has many other seaports of minor importance. The value of merchandise and treasure carried in coasting vessels during 1899–1900 was $135,470,000. The trade across the land frontiers is steadily increasing, the chief item among imports being food grains, and among exports cotton goods. Much greater than her trade with foreign countries is the internal trade of India, but no returns of its amount are available. It is mostly in the hands of natives, and to a large extent in those of particular groups or castes. It is still carried on, as it has long been, at village markets, town bazaars, religious fairs, and similar gatherings, but the development of railway and canal communication and the transformation in the system of agriculture have greatly altered its character in many ways.

Manufactures.— The domestic industries of India, such as weaving and spinning, pottery, brass-work, iron-work, and art work of many kinds, continue to be practised after ancient methods all over the continent of India. But Indian fabrics and products, made on a small scale by workers at their homes, have for years past been giving way before the cheaper, less artistic, and often less durable cotton yarn and fabrics, and the iron or steel products of British factories. Meanwhile an important manufacturing industry has been growing up, and steam-power factories are at work, among which those for spinning and weaving cotton, for spinning and weaving jute, for making paper, for husking and cleaning rice, for sawing timber, and for brewing beer, are the most important. Steam power is also largely employed in factories, on tea gardens, and indigo estates. In 1900 the number of cotton-mills in British India and native states was 186, containing 38,420 looms and 4,728,000 spindles, and giving employment to 163,000 persons. Of these mills 136 were in Bombay Province (80 in Bombay City), the rest being in Madras, Bengal, Central Provinces, United Provinces, Burma, Panjab, and Berar, besides some of the native states. The number of jute-mills was 33 in 1899–1900, containing 14,021 looms and 293,218 spindles, and employing over 100,000 persons. All the jute-mills are in Bengal, except one in Cawnpore, which is the chief manufacturing centre of the United Provinces. Four woolen mills produce blankets, serges, and cloths worn by the army and the police. The largest brewery is at Murree, in the Panjab Himalayas. Among other industrial works of importance are silk-mills, soap-factories, tanneries, iron and brass foundries, sugar-factories, coffee-works, cotton-presses and ginning-factories, jute-presses, rope-factories, oil-mills, cutch and lac factories, flour-mills, ice-factories, pottery and tile factories, bone-crushing works, tobacco and cigar factories, silk filatures, glass-factories, dye-works, indigo-factories (over 5,000), printing-presses, and dairy farms. The total number of persons employed in all these manufacturing industries is about 700,000. The present Indian Factory Act came into force at the beginning of 1892. The daily wages of a man employed in a factory vary, according to locality, from 2 to 4 annas (4 to 8 cents).

Shipping and Navigation.— In 1897–8, 9,759 vessels of 7,784,630 tons burden entered and cleared the ports in British India, as against 8,613 vessels of 9,625,317 tons in 1901–2. Of these in the latter period 3,988 were of British nationality, 2,003 native, 1,289 British Indian, and 1,333 foreign; included in these numbers were 1,644 steam vessels of 4,299,948 tons entering and clearing via the Suez Canal. In 1901–2 115 vessels of 4,833 tonnage, were built in Indian ports, 81 in Bombay, 13 in Madras, and 10 in Sind.

Railways and Roads.—The first Indian railway, from Bombay to Thana, was opened in 1853. The main trunk lines constructed from that time till about 1875 were built and managed by private companies on whose capital the Indian government guaranteed a fixed rate of interest, generally 5 per cent. The government in return for this assistance, exercised a general control over the companies, and reserved the right of buying the undertakings at specified dates on stated terms. In 1870 Lord Mayo initiated the policy of railway construction by direct state agency, but in more recent times several lines have been constructed by «assisted companies.» Several of these latter lines have been taken over by government. There are also native state railways constructed from capital raised in native states, but generally worked by a staff employed by the government of India or by the trunk railway companies to whose lines they serve as feeders.

The importance of railroads in India is largely increased, in a governmental sense, by reason of their forming strategical links between the various military cantonments through which the vast Indian population is held in check by a comparatively small army of British soldiers. This, more than any other incentive, has hastened the development of railways in India.

The main lines are two in number, and are known as the Bombay-Calcutta and the Bombay-Madras lines. The former crosses the great northern plain, the latter the great southern plain of India, and are both connected by means of branch lines with all the large cities of the empire — the capitals of the rajahs, maharajahs and nabobs. These two great trunk lines have also been extended to the farthest limits of India, and even into adjoining territories, as where the line which crosses the Indus at Sukkur enters Afghanistan, the terminus being not more than 60 miles from Kandahar. There is also the Burman line, which passes up the valley of the Irawaddy in the direction of the Chinese frontier. These three main lines, with their several offshoots, may be roughly sketched as follows: In the north, a direct line from Bombay on the west coast to Calcutta on the east coast; a line to Benares from Bombay; a direct line from Calcutta to Peshawar, on the Afghanistan border, by way of Benares, Delhi and Lahore; a line from Lahore to Karachi, with the branch line between these two cities to Kandahar. In the south, the main line between Bombay and Madras through Hyderabad; the line from Bombay to Goa, and from Goa to Madras, with lines connecting with Calicut and with the line from Madras to Tuticorin in the south. In Indo-China, the main line from Rangoon to the Chinese frontier, by way of Mandalay, and with an extension to Bhamo and another to Meaday. (It is proposed to extend the Bhamo line to Bishi and the main line to Yun-nan in China with offshoots to Tching-tou and Hai-pong.)

The total mileage of railways in India on 31 December was distributed as follows: State lines worked by the state, 5,884; state lines worked by companies, 11,654; total state lines, 17,538. Lines owned by native states and worked by state railway agency or by the states themselves, 1,314; native state lines worked by companies, 1,560; total native state lines, 2,874. Total of lines owned by government and native state, 20,412. Lines worked by guaranteed companies, 2,663; lines worked by assisted companies, 1,518; total private lines, 4,181. The total capital outlay of these railways till the end of 1900 was slightly over $1,000,000,000; the total number of passengers carried in 1900 was 117,613,218; and the total weight of goods carried slightly over 43,000,000 tons. The chief highways are well metalled with a kind of limestone called *kankar*, but in Lower Bengal and similar districts, where there is no available stone, roughly-made bricks are used for road-metal. Many of the roads are planted with avenues of trees. The total length of roads in India maintained by public authorities is over 152,000 miles, of which over 36,000 miles are metalled.

Posts, Telegraphs, and Telephones.— The number of post-offices in India in 1899–1900 was 10,823, and the length of postal lines 91,534 miles. The total number of letters and post-cards carried was 448,868,998; of packets of every kind, 509,006,476. Adding the district post lines and the political and military lines administered by the Imperial post-office, the total length of the lines over which mails were carried was 127,934 miles. The Indian telegraph system now consists (1900) of 52,909 miles of line, 170,766 miles of wire, and 283 miles of cable. The number of telegraph offices is about 5.000, and the annual number of messages over 6.000,000. There are telephone companies at important towns, such as Bombay, Calcutta. Karáchi, Madras. Maulmain. Rangoon, and Ahmadabad. India is now in direct telegraphic communication with the Straits Settlements and the Australian colonies, with Europe via Suez, via Teheran, and via Turkey, with the East Coast of Africa, and with China via Bhamo.

Canals and Irrigation.— In some parts of India, such as Sind, cultivation is impossible without irrigation, while in others, such as much of Lower Bengal, irrigation may be regarded as quite unnecessary; but in the greater part of all the provinces the rainfall is either insufficient for the proper cultivation of the soil, or so uncertain as to expose the agriculturists to the constant risk of scarcity and even of actual famine. Hitherto irrigation has had only a secondary place in the governmental development of India, the attention of the administration having run more to railways. The profit on the railways is, on an average, 5 per cent, while on the expenditure on irrigation works on which only $125,000,000 have been spent, the profit has averaged 7⅓ per cent; on the Eastern Jumna canals the profits rise to 25 per cent. The annual irrigation expenditure under the present Indian budget comes to only $7,500,000 for major and minor works together.

In 1903 it was proposed by a special commission that the sum of $150.000.000 be devoted to irrigation works, the expenditure to be spread over 25 years. This period is regarded by some as too long, and they think it should be curtailed by one-half, as the question is urgent from both the political and economic point of view. While not considering the expenditure on railways excessive, seeing their military importance, it is felt that they have more than sufficient capacity for draining away all the produce of the country, to which it is time to cry a halt, and to devote more money and attention to works that will extend and stimulate production. The larger irrigation works have been found unprofitable in four districts only, and in those the loss has been very small.

Many of the irrigation works now administered by the Public Works Department are simply old native works restored, and in some cases extended or improved. The total irrigated area of India is about 37 million acres. Tank irrigation is common in some districts, especially in Southern India, and the tanks are mostly of native origin. Many old tanks, however, have been repaired or improved by the British government, and new ones have been constructed in Madras (where there are now 60.000 tanks), the Bombay Deccan, and Ajmir Merwara: In parts of Baluchistan, where the rainfall is scanty and capricious, water for irrigation purposes is drawn from underground springs by means of tunnels driven into the hill-sides. The most common method of irrigation in India, however, is that by wells, which prevails over large areas in all the provinces. Canal irrigation was practised to some extent by the native rulers, but all the important canals have been constructed since the British occupation. Irrigation canals are of two kinds, inundation and perennial. The latter are furnished with permanent headworks and weirs, and are capable of irrigating large areas throughout the year, independently of the local rainfall; while the latter, which are peculiar to Sind and the Panjab, are simply earthen channels supplied with water by the annual rise in May of the Indus and its affluents. Many of the perennial canals are, either in whole or in part, used for navigation, and there are, besides, a few canals used for navigation alone. The total length of irrigation canals in operation was 42.352 miles, of which 12.497 miles were main canals and the rest distributaries. The total mileage of navigable canals in Bengal, Panjab, United Provinces of Agra and Oudh, and Madras is fully 4.000 miles, of which about 1,600 miles are for navigation only.

The total area irrigated by canals in Bengal exceeds 720,000 acres, and the length of irrigation canals is 3.381 miles, of which 747 miles are main canals. Of these canals 495 miles are open to navigation, and there are besides 1.339 miles of canals used for navigation only, thus giving a total length of 1.834 miles of navigable canals. The area in the United Provinces of Agra and Oudh irrigated by canals exceeds 2.800,000 acres, over 1½ million acres being irrigated by the Upper and Lower Ganges Canals (q.v.), and the total length of irrigation canals is 12.534 miles, 1.554 miles being main canals. Of these canals 537 miles are open to navigation. Over 5.000.000 acres in the Panjab are irrigated by canals, the total length of these being 12.069 miles, of which 3.478 are main canals, 432 miles of the latter being utilized for navigation also. Three million acres are irrigated by canals in Madras, and rather more by tanks and in other ways. The total length of irrigation canals in the province is 10.522 miles, of which 3.474 are main canals. The total length of canals used for navigation is 1,252 miles, of which 262 miles are for navigation only. In Bombay proper the canals are generally small, and they are usually associated with storage reservoirs. Taking Bombay and Sind together, the total irrigated area is 1.700,000 acres; the length of irrigation canals 3.801 miles, of which 3.240 miles are main canals. There are no large irrigation works in Lower Burma, but a considerable amount has been expended on river embankment and drainage works, and on making navigable channels. The chief work in Upper Burma is the Mandalay Canal.

Money, Weights, and Measures.— By an act passed in 1835 a uniform monetary system was established throughout India, with the Madras silver rupee of 180 grains, 11/12 fine, as the monetary unit. The rupee was subdivided into 16 annas, and each anna into 12 pies (or four pice). Silver was made the universal standard of value, and the silver rupee and half-rupee were declared to be legal tender to any amount. The other smaller coins were made legal tender up to the value of one rupee; 100.000 rupees are called a lakh or lac, and 100 lakhs a crore. Under this system large sums are punctuated differently from the usual European method. For instance, the Indian Post-Office Savings banks' statistics show that in 1900–1 816.651 depositors had to their credit 100.432.569 rupees, or, according to the Indian method, crores 10, lakhs 04, rupees 32.569.

The coins under this system are: Silver — Rupee, half-rupee, quarter-rupee; Bronze or Copper — Three pies (or a pice), six pies, one pie. There are also gold coins called mohurs, but they are not a legal tender, and there is no fixed ratio between them and the silver coins. Small payments in the bazaars are made in cowries, of which from 2,500 to 5,000 are equivalent to one rupee. The rupee was formerly valued at 48 cents, but it has fluctuated greatly, mainly downwards. In January 1895 it was nearly as low as 24 cents; at present it is about 32 cents. In view of the steady depreciation of silver, and the consequent financial embarrassments and burdens to which the government of India was subjected in its dealings with gold-standard countries, an act was passed by the Governor-general's Legislative Council in 1893 under which the Indian mints were closed to the free coinage of silver. On 15 Sept. 1899 a further act was passed, by which gold coins issued from the Royal Mint in England, or any branch of the Royal Mint, were made legal tender at the rate of 15 rupees to the sovereign. Arrangements are being made for the coinage of gold in India. By an act of 1861 and some subsequent acts, promissory notes for amounts varying from 5 to 10,000 rupees have been emitted under the authority of a public issue department. Currency circles have been established from time to time, and these notes are legal tender only within the circle of issue. They are payable at the place of issue and also at the capital city of the presidency in which the place of issue is situated.

By the Measures of Length Act of 1889 the British imperial yard of 3 feet or 36 inches was made the standard of length for the whole of British India. The most important of the old native measures of length was the *guz* of Bengal, which was practically equal to a yard. An act was passed in 1871 to prepare the way for the adoption of a uniform system of weights and measures of capacity throughout British India. The unit and standard of weight established by the act is the *ser*, which is equal to a kilogram or 2 1-5 lbs. The unit of capacity was declared to be a measure containing one ser of water, at its maximum density, weighed in a vacuum, and is thus equal to a litre or 1¾ pint. Among native weights the most important are the tola (Bengal) of 180 grains, and the imperial or Indian maund of 40 seers, equal to 82 2-7 lbs.

Government.— The government of the Indian empire is regulated by an act passed in 1858, by which all the territories formerly possessed by the East India Company are transferred to the crown, and all the powers of the said Company exercised in name of the sovereign, all taxes being received and disposed of for the purposes of the government of India alone. His majesty's secretary of state for India is invested with the powers formerly exercised by the Company or the board of control, and he must countersign all orders and warrants under his majesty's sign-manual. He is assisted by a council of from 10 to 15 members, the greater number of whom must be persons who have resided 10 years in India, and have not left it more than 10 years previous to their appointment. The secretary for India fills up vacancies in the council. The members receive a salary of $6,000 a year payable out of the revenues of India, and they hold their office for 10 years. All orders sent to India must be signed by the secretary, and all dispatches from the Indian government must be addressed to him. The executive authority in India is vested in the governor-general or viceroy appointed by the crown, and acting under the direction of the secretary of state for India. He has a salary of 250,000 rupees, or about $83,500. The governor-general in council has power to make laws for all persons, whether British or native, within the dominions subject to the British crown, and for all British subjects residing in allied native states. His council consists of five ordinary members and one extraordinary member, namely, the commander-in-chief. The ordinary members preside over the departments of home affairs, foreign affairs, finances, revenue and agriculture, military administration, legislation, and public works, and together with a certain number (not less than 10 nor more than 16, by the act of 1892) of "additional members for making laws and regulations," appointed by the viceroy, form a legislative council. The meetings of the legislative council are open to the public, and the governor of the province in which a meeting is held is a member for the time being. The members may discuss the annual financial statement, and ask questions about it, but they are not allowed to propose resolutions or to divide the council. The whole of India is now divided into a number of separate provinces, each with a separate administration of its own, but all subordinate to the supreme government at Calcutta, the capital. These are not all on exactly the same footing nor ruled by officials having the same title. Two of them, Bombay and Madras, are each under the rule of a governor, appointed by the crown, and assisted by a separate executive council. Bengal, the United Provinces of Agra and Oudh, the Panjab, and Burma are each under a lieutenant-governor, appointed by the governor-general with the approval of the crown, and the lieutenant-governor of the United Provinces is also chief commissioner of Oudh. The head of the government in Assam and the Central Provinces is a chief commissioner, appointed by the governor-general in council. The two governors and the four lieutenant-governors are each assisted by a legislative council similar to that of the governor-general. Ajmir Merwara, Berar, and Kurg are under the more immediate control of the central government.

Finance.— The gross revenue of India in 1899–1900 was $343,185,820, and the gross expenditure charged against revenue $329,312,705. In addition, there is a capital outlay on railways and irrigation not charged against revenue, amounting in 1899–1900 to over $20,000,000. The total public debt of India on 31 March 1900, was $995,637,675, of which $374,915,670 represented the debt in India, and the rest the debt in England. The largest item in the revenue is that derived from land, which amounted in the year under review to $89,376,150. (See paragraph on *Land Tenure and Revenue.*) The revenue from forests was $6,177,125, and the total amount of tribute received from native states was $2,933,015. The revenue from opium amounted to $22,009,610, but the net revenue is less than that amount by about $8,500,000. The opium revenue is raised partly by a monopoly in Bengal, and partly by the levy of a duty on all opium exported from native states. The cultivation of the opium poppy is absolutely prohibited in British territory, except in certain parts of Bengal and the United Provinces of Agra and Oudh, but a few thousand acres in the Panjab grow it for local consumption. The opium grower in the monopoly districts receives advances from government to enable him to prepare the land for the crop, and he is required to deliver the whole of his produce to government agents at the fixed price of 6 rupees per seer. The manufacture for the foreign market is carried on only in the government factories at Patna and Ghazipur, and the chests of manufactured opium are sold by auction at monthly sales in Calcutta. Outside of British territory opium (known as Malwa opium) is cultivated in the native states of Rajputana and Central India, and some of these states have agreed to control the manufacture and sale of opium in much the same way as the Indian government does in British territory. They levy heavy duties on opium exported from their territories for the China market, and the Indian treasury imposes on all such opium a duty now fixed at $166.66 per chest. The revenue from taxation is $201,000,000, the chief item in it being the salt revenue, $29,252,315. The salt revenue is raised by a duty on all salt imported into, or manufactured in India, the duty being now 2½ rupees (80 cents) per maund, except in Burma, where it is 1 rupee (32 cents) per maund. The native sources of salt supply are the coast, especially the Rann of Cutch (Baragra salt) and Maurypur (Sind), the salt lakes and pits (especially Sambhar Lake) of Rajputana, and the salt mines (especially the Mayo mine) of the Panjab. Bengal and most of Burma import their salt by sea, much of it coming from England. Several native chiefs have entrusted the management of their salt sources to the British authorities in return for certain payments. The excise accounts for $19,299,710 of the revenue from taxation. The only excisable articles are intoxicating liquors (including toddy, palm-wines, and rice-beer), and certain drugs (opium, ganja, bhang, charas), and the aim of the government in taxing these has been as much to reduce consumption as to raise revenue. The government treats the right to manufacture and the right to sell spirits at state monopolies, which are granted to individuals on special terms. Throughout Bombay and the Panjab, the most populous tracts of Madras, the United Provinces, Oudh, and Burma, and in some parts of Bengal and the Central Provinces, the central distillery system in some form prevails, and a still-head duty is levied on all spirits manufactured at the recognized distilleries. Except in Madras and some other parts, these central distilleries are government establishments at which private persons distil spirits. In other districts the spirit revenue is raised by farming out the spirit monopoly to the highest bidder, or by licensing the establishment of private stills, the latter method being called the out-still system. The Indian government is replacing the farming and out-still systems as far as possible by the central distillery system. The customs revenue amounted in 1899–1900 to $15,353,140. Import duties were abolished in India in 1882, but in 1894 they were reimposed, and now all goods, with the exception of railway material and industrial machinery, food grains, coal, jute, wool, and other raw materials, gold and unset precious stones, and some other commodities, are subject to import duty. The amount of the duty is generally 5 per cent, but petroleum is charged at the rate of 1 anna per gallon, and iron and steel are subject to a duty of only 1 per cent. Since 1896 all cotton yarns imported into or manufactured in India have been duty-free, while all woven cotton goods imported from abroad, or manufactured at power-mills in India, pay an *ad valorem* duty of 3½ per cent. There is an export duty on rice and rice-flour of 3 annas per maund of unhusked rice. A countervailing duty on bounty-fed sugar came into force in March 1899. The revenue from stamps was $16,327,385. The provincial rates, amounting to $12,493,925, are levied mostly on the land to meet local charges for roads, schools, etc., and are generally collected with the land revenue. The income tax, which yielded $6,501,425 in 1899–1900, is levied at the rate of four or five pie per rupee, certain incomes being exempted. Other important heads of revenue are: Post-office, telegraphs, and mint, $11,680,890; civil departments, $5,876,500; railways, $82,939,225; irrigation, $13,087,880; buildings and roads, $2,209,000. The chief elements in the expenditure are: Railways, $82,555,430; army, $74,250,000; civil salaries, etc., $47,987,720; charges of collection, $22,244,195; buildings and roads, civil and military, $20,673,260; miscellaneous civil charges (furlough and superannuation allowances, pensions paid in England, etc.), $17,565,690; irrigation, $12,208,825; famine relief and insurance, $10,494,240; post-office, telegraphs, and mint, $8,427,935; interest on public debt, etc., $6,711,415; refundings, compensations, drawbacks, etc., $7,295,000.

Army and Navy.— The army in India is under a commander-in-chief, who is under the control of the Indian government, and has directly under him four lieutenant-generals commanding respectively the forces in Bengal, the Panjab, Madras, and Bombay. The Indian army numbers usually from 215,000 to 220,000 in all, the native soldiers being twice as many as the Europeans. The native troops are officered by Englishmen. Wherever European troops are stationed there is always a larger native force, and in many of the smaller and less important posts there is a native force only. Much money has been spent in recent years on defensive works and military establishments, strategic roads, etc. India has also a certain number of vessels for coast defense.

Ethnology— India is inhabited by numerous peoples belonging to several distinct groups or families. Previous to the Mohammedan ascendency the dominant race were the Hindus, who, however, were not the aboriginal inhabitants nor even the first invaders. From the northwest of India, through Kashmir and down the valley of the Indus, and from Tibet through the passes of the Himalayas, the inhabitants of Northern Asia from a very early period migrated southward to the milder and more fertile plains of India. Two great successions of these invasions are recognized as having taken place before the period of authentic history. The first immigrants, of dubious ethnological connections, but commonly known as the Tamil races, appear to have overspread the entire peninsula. Following them the Sanskrit-speaking peoples, called the Hindus, of Aryan speech, dispossessed the Tamil races, and superseded their language in the whole of India north of the Nerbudda. The Hindus subsequently descended into the peninsula and penetrated as far as Cape Comorin; but though their influence on the languages of Southern India was considerable in the way of introducing

YOUNG BRAHMIN AND WIFE.

new terms, the grammar and construction of the Tamil languages maintained their place in the districts south of the Nerbudda. The native tribes were not exterminated by these invasions, but are still to be found under various names, as Bhils, Catties, Coolies, Gonds, etc., inhabiting the fastnesses of the mountain-ranges in Bengal, the Vindhya and Satpura Mountains, the Ghâts, etc. The hill tribes and other aborigines in all India are estimated at 70,000,000.

Population.— The first census of all India was taken in 1871–2, but it was not till that of 1891 was taken that a really reliable and comprehensive statistical account of the people of India was available. In 1871–2 the total population of India was returned at 240,931,521, in 1881 at 253,793,514, in 1891 at 287,223,431, in 1901 at 294,266,701, of which, as shown under *Political Divisions,* 231,085,132 were under immediate British authority. The total number of Europeans was only 168,000.

France still possesses in India Pondicherry, Karikal, and Yanaon, on the east coast of Madras; Mahé, on the west coast of Madras, and Chandarnagar on the Hugli, north of Calcutta. To Portugal belong Goa, Damão, and the small island of Diu, on the coast of Bombay. These French and Portuguese possessions have a total area of 1,754 square miles and a population of 852,752.

Education.— A system of education for India was inaugurated in 1854 in conformity with the instructions of the home government, and the despatch of Sir Charles Wood (afterward Lord Halifax) of 19 July 1854 is the basis on which the educational system still rests. The fundamental principle of the despatch was that the native languages should be made the medium of communicating European knowledge. Examining universities with affiliated colleges were to be founded, and English and vernacular elementary schools were to be established. The despatch enumerated five government colleges in Bengal; the Sanskrit College and Mohammedan Madrasa at Calcutta; five colleges in the United Provinces; the Elphinstone Institution, Puna College, and Grant Medical College in Bombay; the High School at Madras, and several missionary schools, as proper to be at once affiliated to the universities. In 1857 the three universities of Calcutta, Madras, and Bombay were formally incorporated by law as examining bodies based on the model of the University of London as then constituted. A somewhat different university, with teaching powers, was established in 1882 at Lahore in the Panjab, and in 1887 a fifth university was founded at Allahabad for the Northwest Provinces. The Education Commission of 1882–3 extended the system of Wood's despatch by placing education on a more popular basis and giving greater recognition to indigenous schools, and the first proposals for extending education to Indian women were made by this commission. Educational institutions in India are officially divided into two classes: (1) Public Schools, in which the course of study conforms to the standards prescribed by the Department of Public Instruction or by the University, and which either undergo inspection by the Department, or else regularly present pupils at the public examinations held by the Department or by the University. These institutions may be under either public or private management, and among them are many schools receiving grants-in-aid. (2) Private Schools, comprising all which do not fulfil the above conditions. The three main grades of institutions through which the system of education operates are: (1) Primary schools, which aim at the teaching of reading, writing, and such elementary knowledge as will enable a peasant to look after his own interests; (2) Secondary Schools, either English or vernacular; and (3) Colleges, the students in which, having passed the matriculation examination of a university, are reading for the further examinations required for a degree. There are also many other colleges teaching special branches of knowledge, such as medicine, law, and engineering, and special colleges for sons of native chiefs and noblemen. In Burma primary education is still very largely in the hands of Buddhist monks. Outside of a few exceptional districts female education is exceedingly backward in India, but slow progress is being made. There are schools of art in Madras, Calcutta, and Bombay, and many of the chief towns have good museums. Many normal schools have been established for the training of teachers.

The total number of colleges in India in 1899 was 169, of which only 5 were for females. The number of pupils in these colleges was 21,006. Secondary schools numbered 5,396, with 569,271 pupils, 43,403 of the latter being females. The number of primary schools was 100,858, with 2,824,257 male and 313,289 female pupils, or 3,137,546 in all. The total number of training and other special schools was 720, with 28,158 pupils, 2,371 of them being females. Beside all these, there were 42,805 private institutions, with 558,914 male and 42,926 female scholars, in all, 601,840. The total number of educational institutions of all kinds was thus 149,948, of which 7,454 were for females, and the total number of persons under instruction, 4,357,821, of whom 402,153 were females. Of these institutions 22,804 are under public management, 61,494 are state-aided, and 65,650 are unaided private schools. It has been estimated that 22.2 per cent of the boys of school-going age attend school, but for girls the percentage is only 2.3. In nearly all branches of education in India the missionaries have been the pioneers, and their work is still important.

Languages, Literature, and the Press.— All the Hindu languages are cognate dialects founded upon the Sanskrit, a language of the Aryan or Indo-European family, which has been extinct as a spoken language for more than 2,000 years, and bears a similar relation to the spoken languages of India with that of Latin to the modern European tongues. See Sanskrit Language and Literature, and Vedas. In the time of Alexander the Great, Sanskrit had already been superseded by a vulgar tongue, the Prakrit, founded on it. In ancient Hindu dramas persons of rank are represented as speaking Sanskrit, common people Prakrit. Pali, a dialect of Prakrit, became the sacred language of the Buddhists, their scriptures being compiled in it. It was spread by them into Ceylon and India-beyond-the-Ganges. It is still used for works, chiefly religious, for which a wider circulation is desired. Hindi, the prevailing literary language of the non-Mohammedan population, is a modernized form of an older dialect, Hindui, which flourished during the middle ages, having grown out of the Prakrit dialects about the 10th century. Both Hindui and Hindi are rich in poetical chronicles. Hindustani or Urdu, a kind of Hindi mixed with Persian and Arabic, is the language of the Mohammedan conquerors, and grew up after the conquest of Delhi at the close of the 12th century. It is also rich in literature, particularly in translations from the Persian, Arabic, and Sanskrit. It is the language which has been favored by the British government for purposes of administration and diplomacy. The Dakhni, a mixture of similar elements, grew up from the same cause in the Deccan. Among the numerous other descendants of the Sanskrit the most important are the Bengâli, the Orissa, Uriya, or Utkala, the Marâthi, the Gujarâti, the Sindhi, and the Panjabi. The languages of Southern India form a distinct group called the Dravidian, differing in structure from those of the north. The most important of them are Tamil, or Malabarese, spoken on the Coromandel and Malabar coasts, Telugu or Telinga, in the middle of the Deccan, Kanarese in the Carnatic and neighborhood of Mysore, Malayâlam on the Malabar coast from Mount Dilli to Cape Comorin. From all these Burmese stands apart.

The chief vernacular languages in which books are published are: Urdu (Bengal, N. W. Provinces, Panjab, Bombay), Bengali (Bengal), Hindi (Bengal, N. W. Provinces, Panjab, Bombay, and Central Provinces), Panjabi (Panjab), Marathi (Bombay and Central Provinces), Gujarathi (Bombay), Tamil and Telugu (Madras), and Burmese (Burma), and the bilingual works are mostly either in English and another language, or in a classical and a vernacular language. Many works are also published in English alone, or in one of the three classical languages, Arabic, Sanskrit, and Persian. The greater number of these publications belong to the departments of poetry, religion, philosophy, and philology, but Urdu and Hindi fiction has developed greatly in recent years. Till about 1850 newspapers were prevailingly religious, but since then the native press has become more and more a medium for the discussion of social and political questions.

Religions.— The religions of India like the races are numerous. The most important is the Hindu or Brahmanical, which is very ancient. The earliest period of the Hindu religion is called the Vedic, from the Vedas (q.v.) or sacred books in which its records are preserved. These exhibit several marked phases of transition. The earliest date of the Vedic literature cannot be satisfactorily determined, either from philological or internal evidence. Its latest writings are not more recent than the 2d century B.C. Each Veda consists of two parts, the Sanhitâ, a collection of mantras or hymns, and the Brâhmana, which contains the doctrinal and ceremonial development of the religion. The worship represented in the greater number of the hymns is that of natural objects: Indra, the cloudless firmament; the Maruts, the winds; Ushas, the dawn; Vishnu, Surya, Agni, and other deities, to whom various attributes of the sun were attributed. These deities were invoked for assistance in the common affairs of life, and were reminded by the suppliants of their former glorious deeds. In the earlier Vedas no attempt is made to classify the gods and assign them particular ranks. In the Upanishads, a species of commentary on the Vedas, a systematic attempt is made to solve the problems of creation, of the nature of the supreme being, and of his relations with the human soul. Some of the Upanishads are legendary in form, others doctrinal or exegetical. These commentaries, though not in form philosophical, being professedly founded on the Vedas, contain the germs of the great systems of Hindu philosophy which were afterwards developed.

A new era in the history of Hinduism begins about the time of the Christian era with the composition of the two great epics, the Râmâyana and the Mahâbhârata, the latter of which was the product of successive ages. The vulgar creed had by this time experienced the influence of the theological and metaphysical speculations of the Upanishads, and had assumed a mystical unity. Brahmâ, Vishnu, and Siva, the three emanations of the great soul Brahma, representing respectively the creative, preserving, and destroying principles, had become the leading objects of worship.

The third or Purânic period of Hinduism corresponds with the period of the Middle Ages in Europe. The Purânas are discussions upon religion and philosophy, in the form of dialogues conducted by sages. They are designed for popular instruction, and mark a rapid and extensive corruption of the Hindu religion. The epic legends are amplified and distorted. The Vedânta philosophy, which had become the basis of the educated creed, still exercises a favorable influence on the popular worship. The creed of the Purânas is that of the masses in India.

Buddhism arose in India in the 6th century B.C. It prevailed there extensively, and spread itself through the adjoining regions of Asia. It became extinct in India before the 12th century, but still flourishes in China, Japan, and in the southeastern regions of Asia, as well as in Nepal and Ceylon. (See BUDDHA.) The Jainas or Jains, whose religion is a mixture of the Buddhist and the Brahmanical creeds, are still numerous in Hindustan, and particularly in Gujerat. There are two sects of this creed, called Digambaras and Swetâmbaras. Sikhism is another heretical form of Brahamanism prevalent in the Panjab. There are numerous other minor sects of Hinduism and worshippers of particular gods in the Hindu mythology. The Brahmo-Somaj (q.v.) is a modern Hindu theistic sect. The Hindu Fakirs are devotees, who give themselves up to penance, filth, and self-torture. The Parsees or fire-worshippers are descendants of the Persian followers of that religion, who took refuge from Mohammedan persecution on the western coast of India. Their principal emigration was to Surat, and is supposed to have taken place about the end of the 8th century. They were well received in Gujarat. They are now to be found mostly in the mercantile towns in India, and are most numerous in Bombay. The Mohammedans of India are chiefly descendants of its Asiatic conquerors from Afghanistan, Persia, Baluchistan, and Arabia. They are said to be more liberal-minded than the Mohammedans of Western Asia. There is among them a sect of Fakirs like those of the Hindus. There are also numerous Jews in India. On Christianity in India see below under *Christian Missions*. Hinduism recognizes four castes — the Brahmans, or sacerdotal class; the Kshatriyas, or military class;

HALL IN TEMPLE, MADURA.

the Vaisyas, or mercantile and agricultural class; and the Sûdras, or servile class. These casts are hereditary (see CASTE). Closely connected with the Hindu religion is the collection of laws commonly known as the Institutes of Manu. (See MANU.) In the Indian census table of religions (1901) 8,584,349 people are returned as heathens or aboriginals, that is, devotees of some form of animism. Practically, for the purposes of the Indian census, all are classed as animistic who are not locally acknowledged to be Hindu, Mohammedan, Christian, Buddhist, Jew, Parsee, etc., but every stratum of Indian society is in reality more or less saturated with animistic conceptions. Of the total population of British and Native India in 1901, 207,146,422 were registered as Hindus, the greater number of these being in Bengal, the United Provinces of Agra and Oudh, Madras, Bombay, Hyderabad and Rajputana. There were 62,458,061 Mohammedans chiefly in Bengal and the Panjab, 9,476,750 Buddhists almost all in Burma; 2,923,241 Christians of whom two thirds are in Madras and in the Madras States; 2,195,268 Sikhs, chiefly in the Panjab; 1,334,148 Jains, chiefly in Rajputana and in Bombay; 94,190 Parsees, and 18,228 Jews mostly in Bombay.

Christianity and Christian Missions in India. — The introduction of Christianity into India is variously ascribed by tradition to St. Thomas the Apostle, Thomas the Manichæan of the 3d century, and Thomas, an Armenian merchant of the 8th century. The earliest Christian church in India of which we have any definite knowledge was Nestorian, but after the Portuguese occupation these Nestorians came into the Roman obedience. In 1663, after the arrival of the Dutch, some of these renounced their allegiance to Rome. In 1665 these latter received from the Patriarch of Antioch a Jacobite bishop known as Mar Gregory, and to this day they have remained faithful to his Jacobite tenets. Thus, the ancient Nestorian Church of southwest India is represented now by two bodies, namely: (1) Catholics of the Syrian Rite, owning the supremacy of the pope, but retaining the Syrian language and ritual in their services; and (2) the Jacobite Catholics, rejecting the errors of Arius and Nestorius, and following the Nicene creed, though not acknowledging papal supremacy. The spread of the Roman Catholic faith in India was mainly the work of Jesuits from the 16th century onwards, the first of these being the celebrated St. Francis Xavier, who reached India in 1542. The Jesuits were suppressed in the 18th century, but since the re-establishment of the order in 1814 they have made great progress. The Roman Catholics of India are at present organized in seven archbishoprics (Goa, Agra, Bombay, Calcutta, Madras, Pondicherry, and Verapoly), and 16 bishoprics (Daman, Cochin, Mailapur, Allahabad, Lahore, Poona, Dacca, Krishnagar, Hyderbad, Nagpur, Vizagapatam, Coimbatore, Mangalore, Mysore, Trichinopoly, and Quilon), and there are also several vicars and prefectures apostolic. The earliest Protestant missionaries in India were the Lutherans Ziegenbalg and Plutschau, who arrived in the country in 1705 and began work at the Danish settlement of Tranquebar. The Lutheran missions were supported from the first by the Society for Promoting Christian Knowledge, and from 1719 till 1844 they were entirely maintained by that body. The celebrated Christian Friedrich Schwarz worked under the auspices of this society from 1750 till his death in 1798. Kiernander, a Dane, was the pioneer of Protestant missionary enterprise in Bengal. He was allowed by the East India Company to settle at Calcutta in 1758, but soon afterwards the Company changed its policy, and began to prevent missionaries from landing in the country controlled by it. When William Carey, the great Baptist missionary, arrived in 1793, he had to settle on Danish territory at Serampore, 15 miles from Calcutta, and it was not till 20 years later that the Company's opposition to missions was withdrawn. Carey was followed at Serampore by Marshman and Ward, whose names will always be associated with his and with the wonderful literary activity begun by him. Other celebrated Indian Protestant missionaries are Henry Martyn and Bishop Heber of the Anglican Church, and Dr. Alexander Duff, at first of the Church of Scotland, afterwards of the Free Church of Scotland. The head of the Anglican Church in India is the bishop of Calcutta, and under him are the seven bishops of Madras Bombay, Lahore, Rangoon, Lucknow, Chutia Nagpur, and Travancore. Many American missionaries also work in India.

Judiciary.— The law administered by the courts of India is chiefly based on the enactments of the Indian legislative councils, the statutes of the British parliament relating to India, the Hindu and Mohammedan laws of inheritance and their domestic law in cases affecting Hindus and Mohammedans, and the customary law affecting particular castes and races. Bengal, Bombay, Madras, and the United Provinces have each a High Court supreme in civil and criminal cases (but with an ultimate appeal to the Privy Council in England), and somewhat similar tribunals exist in the other provinces. There are numerous courts of different grades throughout the country, and many of the judges are natives of India. Various enactments have been passed for the establishment of local government, and there are now upwards of 760 cities and towns with municipal government in the different provinces under these acts, and local taxation for police and local improvements has been enforced.

Local Government.— All the provinces, except Madras, are divided into divisions, each under an official called a commissioner, and all, including Madras, are divided into sections distinctively designated districts, the district forming the unit of administration. At the head of each district is an officer called a collector-magistrate or deputy commissioner, the former name implying the twofold nature of his duties, since he is not only a fiscal officer charged with the collection of the revenue from the land and other sources, but is also a revenue and criminal judge, both of first instance and of appeal. Police, jails, education, municipalities, roads, sanitation, etc., all come under his supervision; and he is expected to be familiar with the social life of the natives in all its phases. The districts are sub-divided into lesser tracts, known in Bengal as sub-divisions, in Madras and Bombay as *taluks*, in northern India generally as *tahsils*. The unit of police administration is the *thana* or police circle. An important portion of the administrative staff consists of persons who have received appointments in the Indian civil service, after being successful in competitive examinations held in England: these form what is called the *covenanted* civil service. A certain section of the civil service, known as "the statutory civil service," consists of natives specially selected. The native states are generally governed by hereditary princes, who exercise sovereign power within their own dominions. They are more or less controlled, however, by British influence, a British resident, agent, or commissioner being stationed at their courts. They have no power to make war or peace, to send ambassadors to each other or to non-Indian states; they can only keep up a certain specified military force, and they may be dethroned for misgovernment.

History.— Little is known of the political history of India previous to the expedition of Alexander to the Indus, 326 B.C. The 20th satrapy of the Persians comprehended, as Herodotus states, part of the northwest of India. Alexander did not penetrate beyond the tributaries of the Indus, and between his invasion and the Mohammedan conquest there is no authentic political history of India, although the territory was divided among a number of rulers of whom Asoka (q.v.), the founder of Buddhism, was one of the chief. At the time of the Mohammedan invasion a Hindu monarchy was the dominant power in India. The conquest of Persia (632–651) brought the successors of Mohammed to the Indus, and they subsequently acquired a temporary hold of some parts of India, as Sind, which they conquered in 710 and lost in 750. The foundation of a more durable Mohammedan empire in India was laid some centuries later. The Kingdom of Ghazna, in Afghanistan, founded, according to Ferishta, by Alpetegin, an ex-governor of Khorassan, in 962, was declared independent by Mahmud in 999. This monarch, of whom as many as 12 expeditions into India are recorded, penetrated in one direction beyond the Jamna; in another he occupied Gujarat and captured Somnauth. He annexed the territory of Lahore to his kingdom, and nominally extended his dominion to the Ganges on the west, and to Gujarat on the south. His last expedition was to Gujarat in 1024. About the middle of the 12th century the Kingdom of Ghazna was divided, and Lahore became the capital of the Indian portion. The Ghaznavid Kingdom of India was overthrown in 1186 by Mohammed Ghori. On his assassination in 1206 Kutb-u-din, his governor in India, established the Afghan or Pathan dynasty at Delhi, and conquered Behar and Bengal. His successor Altamsh conquered Sind (1225), and completed the subjugation of Hindustan. About this time Genghis Khan overthrew the western empire of Ghazna, and founded a great Mongolian empire, which began to extend eastward, and came into collision with the monarchs of Delhi while these were still pushing their conquests to the south and east of India. The Delhi kingdom was, moreover, exposed to frequent commotions, both from the revolts of its own rajahs and from the predatory excursions of the hill tribes. A revolt of the rajahs was suppressed in 1250, and in 1265, after an extensive slaughter of the predatory tribes, a line of forts was constructed to check their incursions. But though frequently defeated the Mongols continued their incursions into all parts of India. In 1240 they reached Lahore, in 1244 they invaded Bengal; Gujarat, the Deccan, and the Carnatic were assailed in turn; the Panjab was subject to frequent invasions; in 1298 they were defeated at Delhi. A new dynasty, the Khilgi dynasty, arose under the usurper Jelal-u-din in 1288, which was succeeded by a fresh dynasty in 1321, the house of Toghlak. The invasions of the Mongols still continued with greater or less success. During the reign of the last Toghlak king the celebrated Tamerlane invaded India at the head of a great host, took and sacked Delhi in 1398, leaving behind him his deputy Khizr Khan, who now assumed the government. A period of anarchy ensued, which terminated in the conquest of India by the Mogul emperors. Ibrahim, the last of the dynasty of Lodi, the third in order from that of Toghlak, was defeated in 1526 by Baber, who established the Mogul dynasty in Hindustan. His grandson Akbar succeeded his father at the age of 14 (1556), and during a long reign of about 50 years, terminating in 1605, subdued nearly the whole of India, which, by introducing religious toleration, he succeeded in consolidating into an empire. At the death of Akbar his empire was divided into 15 subahs or vice-royalties, which indicate its extent, namely, Allahabad, Agra, Oudh, Ajmir, Gujarat, Behar, Bengal, Delhi, Cabul, Lahore, Multan, Malwa, Berar, Khandesh, Ahmadnagar. His son Selim succeeded him under the title of Jehanghir. The Portuguese, as will be seen in another section, had already established their territorial dominion in India. In 1615 an English ambassador appeared for the first time at the court of the Mogul emperor in Hindustan. He died in 1623, and was succeeded by his son Shah Jehan, who had disturbed his father's reign by rebellions, and during his own reign the country was filled with civil wars. He quarreled with the Portuguese, and expelled them from their settlement at Hugli. During his reign the Mahrattas or Marathas, under their chief Sivaji, began to be an important power in the Deccan. He was deposed in 1658 by his youngest son Aurengzebe, who also murdered his brothers. His reign was passed amid continual contests, both for extending his dominion, and subduing the revolts of the numerous peoples under his sway, both within the limits of India and beyond the Indus. He made war successfully with the Afghans, the Rajputana tribes, and the rising power of the Mahrattas. The Sikhs, a Hindu sect which had been persecuted by the Mohammedans, formed a religious and military commonwealth in the Panjab in 1675. Aurengzebe died at Ahmadnagar, in the Deccan, in 1707. On his death the Mogul empire began to decline. The succession was disputed by his four sons. Bahadur Shah, who succeeded, died in 1712, and was succeeded by his son Jehundar Shah, who, in the following year, was put to death by Farokshir, a great-grandson of Aurengzebe, who usurped the crown. He was deposed and put to death in 1718 by Hosen Ali. Mohammed Shah, grandson of Bahadur, was raised to the throne in 1718. His reign was disturbed by the insubordinate spirit of his viceroys, and through the defection of one of them the Mahrattas succeeded in subduing the Deccan. In revenge for an insult Nadir Shah of Persia invaded Hindustan in 1738, took possession of

THE GREAT HALL IN THE HINDU TEMPLE ON THE ISLAND OF RAMESWARAM.

Delhi, and gave it up to be sacked and plundered by his soldiers. The country west of the Indus was ceded to Nadir Shah in 1739. Mohammed died in 1748, and was succeeded by his son Nadir Shah. The empire was now tending to dissolution. The new emperor called in the Mahrattas in 1751 to aid him against the Rohillas, who, in 1749, had defeated the last imperial army ever called into existence. The various states were seized by the former viceroys or by independent chiefs. The Mahrattas, now the most powerful people of India, possessed, besides the Deccan, part of Malwa, and the greater part of Gujarat, Berar, and Orissa. The whole empire was at this time in extreme agitation and disorder, every government fearing the attacks and intrigues of its neighbors. Ahmed Shah was deposed in 1754 by Ghazi-u-din, a former vizier of the empire, who set up Alamgir II. In 1757 Delhi was captured by the Afghans, against whom Ghazi-u-din called in the Mahrattas. In 1759 the vizier assassinated the emperor. His successor, Shah Alum, without the shadow of power, escaped from Delhi, and finally took refuge with the British. The rival powers of the Afghans and the Mahrattas, which had been brought into collision by the feebleness of the empire, now engaged in a fierce struggle for the mastery over its ruins. This terminated at the decisive battle of Paniput, fought 6 Jan. 1761, in the complete overthrow of the Mahrattas. The victor, Ahmed Shah, recognized the grandson of Alamgir as emperor by the title of Shah Alum II.; but the empire was now only a shadow, and the native states, which had divided its power, were destined soon to give way to the superior European commercial organizations which the pursuit of gain had brought to their shores. See Colonies and East India Companies. Henceforth the history of India follows the course of these European colonies, until it is merged in the Indian empire of Great Britain.

The doubling of the Cape of Good Hope opened up the way by sea to India, and led the Portuguese to the possession of a kingdom in Asia. A few years after Vasco da Gama had landed on the coast of India they were already the most favored merchants upon the whole coast, and in spite of the active jealousy of the Mohammedans, who had hitherto monopolized the lucrative commerce of India, they formed settlements, and made commercial treaties with some Indian princes, in which the latter acknowledged the King of Portugal for their lord. By 1542 the Portuguese ruled from the Arabian to the Persian Gulf; nearly all the ports and islands on the coasts of Persia and India fell into their power; they possessed the whole coast of Malabar to Cape Comorin, and had settlements on the coast of Coromandel and the Bay of Bengal; Ceylon was tributary to them; they had factories in China; and the ports of Japan, to which a tempest had shown them the way, were open to their merchant ships. For 60 years they carried on their lucrative commerce without any considerable rivals. Portugal owed this power to a few able men, among others Francis of Almeida, and Alfonso de Albuquerque (qq.v.). But the successors of the men were not endowed with the same talents, and a revolting abuse of power excited the resistance of the natives, who became united by the sight of their common danger. The union of Portugal with Spain, under Philip II., in 1580, decided the fall of their commercial power in India. The Portuguese, satisfied with bringing the commerce of India to Lisbon, had allowed the Dutch to become the carriers between that port and the markets of Europe. But Philip II. closed the harbor of the Portuguese capital to the Dutch ships on account of the revolt of the United Provinces, and thus obliged that enterprising people to go to the sources of this commerce. Cornelius Houtmann in 1595 was sent with four ships to India to explore the coasts and gain information concerning the inhabitants and the commercial relations in that region. He returned with favorable accounts, for in this very first voyage treaties of commerce were made with the princes of the island of Java. The hatred of the natives against the Portuguese, who had at times landed here, assisted in the accomplishment of the enterprise. After the Dutch East India Company had formed settlements at Java and upon other points, and had made commercial treaties with several princes of Bengal, there began the long struggle with the rival Portuguese. The stronger and better-served navy of the Dutch enabled them to take one place after another from the Portuguese. In 1607 the latter were stripped by their victorious rivals of the Moluccas; in 1641 of Malacca; in 1658 of Ceylon; in 1660 of Celebes, where the Portuguese had settled after the loss of the Moluccas, to retain by smuggling some part of the spice trade; and after 1663 the most important places on the coast of Malabar, where they had longest maintained themselves, fell into the power of the Dutch. The Dutch made Batavia the capital of their eastern dominions. Their power in India began to decline from the time of their wars with Louis XIV. The English began to form commercial settlements in India about the same time as the Dutch. A settlement was formed at Surat in 1613, which became the chief station of the Company on the west coast in 1615, and in 1657 the seat of a presidency. A grant of a small territory around Madras was received from the Rajah of Bijnagar in 1639, on which was erected the fort of St. George. Madras became a presidency in 1654, and till the rise of Calcutta commanded the Company's possessions in Bengal. Calcutta, the third presidency, and ultimately the seat of government in India, was settled in 1690, and became a presidency in 1707. The English had to defend themselves against the Mahrattas in Surat in 1664, and early came into collision with the Portuguese and Dutch in the Indian seas. It was, however, the struggle with the French, who followed them, and who had acquired considerable territorial possessions in India, and the alliances of both parties with the native princes, coinciding with the decay of the Mogul empire, which brought about that long succession of almost unbroken successes by which this great empire was established. The claims of rival candidates for the governments of the Deccan and the Carnatic brought the two parties into collision at various points, and after a succession of maneuvers Dupleix, the French commander, succeeded in compelling the English to take refuge in Trichinopoly. Here Clive, who had already distinguished himself in an unsuccessful attack upon Pondicherry, proposed to carry the war into the enemy's country. In 1751 he besieged and took Arcot, Tinnevelly, Conjeveram, and Arani. On his return to Fort St. David he was despatched by Major Lawrence on another expedition, which he again conducted successfully. Lawrence at the same time gained other successes against the French and their allies. These successes led to the Treaty of Pondicherry in December, 1754, in which the French and English agreed to divide their territorial possessions on a footing of equality, and abstain from interference in native affairs. This treaty procured for the English the cession from the French of the Four Circars; nevertheless, they treated it as a dead letter, and immediately began to reduce Madura and Tinnevelly. The French, after vainly remonstrating, followed their example in disregarding the treaty. About this time important events took place in Bengal. Suraj-ud-Dowla, nabob of Bengal, in 1756 besieged Calcutta with a large army, when it was evacuated so suddenly by the English that a considerable part of the garrison was left behind. These had no alternative but to surrender (20 June 1756). To secure the prisoners taken in the capitulation, 146 of them were thrust, apparently more from mere recklessness than intentional cruelty, into the common prison of the garrison, a room 18 feet square, with two small windows barred with iron, since famous as the Black Hole of Calcutta. After a night of unparalleled suffering only 23 were found alive in the morning. Clive, who was sent from Madras with an armament to Bengal, recovered Calcutta on 2 Jan. 1757. War had again broken out between France and England, but the French refused the alliance of Suraj-ud-Dowla, and maintained their neutrality. Suraj again invested Calcutta, but Clive, though he failed in a night attack, inspired him with so much respect for his means of resistance that he restored the English factories and made peace. Regardless of the benefit he had received from the neutrality of the French, Clive, in spite of the opposition of the nabob, determined to attack their settlement at Chandernagor, which he succeeded in taking. The nabob supported the French till he was attacked by the Afghans, when he became desirous of peace with the English. Clive, however, had determined to dethrone him and replace him by Mir Jaffier, his aunt's husband. In the battle of Plassey, 23 June 1757, the nabob was overthrown, and afterward assassinated by the son of his rival. Mir Jaffier bound himself to pay for his elevation a sum of over £2,500,000 sterling. This plunder was partitioned among the Company and the Company's servants, with the exception of a small share assigned to the native allies.

While the English in the Carnatic were engaged as collectors for Mohammed Ali in reducing the districts of Madura and Tinnevelly, the French recommenced hostilities. An attack upon Trichinopoly failed (May 1757), but Bussy reduced Vizagapatam, and established the French superiority throughout the Deccan. Count Lally, who had arrived with a formidable armament in April 1757, besieged and took Fort St. David, 1 June 1758. He afterward besieged Tanjore and Arcot, the latter of which he took. The want of funds, which crippled his operations, compelled him to engage with inadequate forces in the siege of Madras, which, after lasting two months, entirely failed in February 1759. The English took Conjeveram, to which the French retired, by assault. In the following campaign the French, after some successes, were totally defeated by Col. Coote near Wandewash on 22 Jan. 1760. Their power was now completely broken, their fortresses one after another fell into the hands of the English, and the English fleet, which had the command of the seas, co-operated in the reduction of those on the coast. Pondicherry, their last stronghold, surrendered on 15 Jan. 1765. The English had now established themselves, as a formidable if not altogether a ruling power, both in West and South India; but in both they committed the mistake of greatly over-estimating the resources of the country, and their rapacity and extortion, though they ultimately led to the extension of their power, were the cause of serious and protracted troubles. Mir Jaffier was deposed in favor of his son-in-law, Mir Cossim, who rebelled against English extortions, but, notwithstanding his skilful and vigorous preparations for a war he had anticipated, was worsted in successive engagements, particularly at Gheriah, 2 Aug. 1763, and forced to flee. In revenge he massacred his English prisoners. Sujah Dowlah, the nabob of Oudh, who received him, was defeated and deprived of his dominions, with the exception of Corah and Allahabad, which were given to the Mogul Emperor, who formally invested the Company in the dewanee or collectorship of revenues and virtual sovereignty of Bengal, Bahar, and Orissa, by a firman dated 12 Aug. 1765. The English came to terms with Nizam Ali, subahdar of the Deccan, who opposed their occupation of them, by agreeing to pay him a rent for the territory, and assist him with their forces, but this agreement brought them in 1766 into collision with Hyder Ali, the powerful sovereign of Mysore. Nizam Ali afterward joined Hyder against the English, and both invaded the Carnatic, and, in spite of several defeats, laid waste the country to the gates of Madras. Finally, Nizam Ali deserted Hyder, and the latter concluded a treaty with the English, April 1769, by which their conquests were mutually to be restored.

Notwithstanding the protests and prohibitions of the directors, the administration of the Company's affairs left much to be desired even during Clive's governorship, and during the administration of Verelst, who succeeded Clive in 1767, the Company's affairs were in extreme embarrassment. Parliament took advantage of the discontent and clamor raised against the Company's servants, and in 1773 remodeled the constitution of the Company, and appointed Warren Hastings (q.v.) governor-general of India, with a salary of $125,000, and a council of four members, each of whom had $50,000.

His administration was marked by firmness and resourcefulness in upholding British interests, and also by his unscrupulous methods in raising money to carry out his projects. In 1778 war again broke out between France and England. The English captured Pondicherry and Mahé, the last port of the French on the Malabar coast. This place was considered by Hyder Ali as one of his dependencies. In revenge for its capture he seized the passes of the Eastern Ghâts, invaded the Carnatic with an army of 120,000 men and laid waste the country. Sir Eyre Coote was sent into the Carnatic to conduct the war against him. Hyder Ali died in 1782, but the war was continued with his son Tippoo Saib, till 11 March 1784, when it was concluded by a treaty of mutual restitution. In 1784 Pitt's India Bill was passed. In 1786 Lord Cornwallis succeeded Hastings as governor-general. Cornwallis made various administrative reforms for the relief of the people from former exactions, but Tippoo Saib diverted his attention from these peaceful measures by attacking the Rajah of Travancor, now an ally of the British. Having made an alliance with the Mahrattas and the Nizam, Cornwallis invaded Mysore, besieged Tippoo in his capital, compelled him on 9 March 1792 to conclude a treaty, by which he ceded half his territory and undertook to pay the expenses of the war. On the death of Mohammed Ali in 1795, Lord Hobart, governor of Madras, determined to assume the government of the Carnatic, but the plan was opposed by the supreme government and was not carried out. In 1798 Lord Mornington arrived in India as governor-general, when Tippoo Saib was making arrangements to renew his enterprises against the British and soliciting the alliance of France and of Cabul. Early in 1799 Lord Mornington invaded Mysore. On 4 May he stormed Seringapatam. Tippoo was killed in defending his capital, and Mysore was divided among the British, the Mahrattas, and the Nizam. Some time before this (1775) Oudh had agreed to receive and subsidize auxiliary troops for the defense of their territory, and the fortress of Allahabad was ceded to the British, who undertook to defend Oudh against all enemies. Subsequently in 1801 the subsidy was commuted for the cession of Southern Doab, Allahabad, and other territories. During the war with Tippoo, Lord Mornington, whose policy was to induce the native powers to accept British protection and mediation in their disputes, endeavored to induce his allies the Mahrattas and Nizam Ali to come under similar arrangements. The Nizam in 1798 agreed to dismiss his French troops and receive British auxiliaries. The Peshwa, the nominal head of the Mahratta Confederacy, forced by the contentions of the chiefs Holkar and Scindia, accepted the policy of the governor-general. Under the Treaty of Bassein, signed 31 Dec. 1802, Sir Arthur Wellesley restored the Peshwa, driven from his capital by Holkar. Scindia and the Rajah of Berar now entered into an alliance against the British. After a campaign in 1803 distinguished by the successes of Generals Wellesley and Lake, the former defeating the allies at Assaye, 23 September, the latter at Laswaree, 1 November, Scindia was compelled to make peace. He ceded to the British Baroach, Ahmadnagar, and the forts in the Doab (29 December) ; the Rajah of Berar ceded Cuttack (17 December). Scindia, thus weakened, accepted the British alliance, and received an auxiliary force to defend him against Holkar, 27 Feb. 1804. A war with Holkar immediately followed, which the skill of that chief in predatory warfare enabled him to sustain with some dexterity, and in 1805 he was joined by Scindia, but the British arms finally prevailed and he was forced to flee. The Marquis of Cornwallis succeeded Wellesley on 30 July 1805. He disapproved of the ensnaring alliances into which the former statesmen had drawn the native powers, and although he died before being able to carry out his views (5 Oct. 1805), Sir George Barlow, who succeeded him, adopted his policy. New treaties were made with Scindia, 23 November, and Holkar, 24 December, restoring their territories and their independence. The new policy was even carried so far as to abandon the petty princes who had trusted to the British alliance. Lord Minto succeeded to the governor-generalship in 1807. During his administration the chief enterprises of the English were directed against the insular possessions of the French and Dutch in the Indian seas. The Moluccas, Java, and other islands were taken; many of which were restored at the peace. Some disturbances took place during this period at Travancore, and among the British troops at Madras and elsewhere, which threatened at one time serious consequences. Travancore and Cochin were placed under British management. The Earl of Moira (Marquis of Hastings) succeeded to the governor-generalship in 1813. In 1814 a war broke out with Nepal, which was at first attended with some serious repulses, but was brought to a successful close by Sir D. Ochterlony in 1815, and resulted in the cession of Kumaon. Hastings was also called upon to suppress the Pindaris predatory bands of the former troops of Holkar and Scindia; and the Peshwa of Indore rebelling against a treaty his capital was seized, he himself deposed, and the Mahratta Confederacy dissolved. His ally the Rajah of Nágpur, Scindia, who submitted, and Holkar, who was defeated, were compelled to accept alliances virtually placing them under British protection. This pacification was completed in 1818, and greatly improved the revenues of the districts effected by it. The Marquis of Hastings was succeeded in 1823 by Lord Amherst, under whom the first Burmese war was concluded in 1826 by a treaty ceding to the British the Aracan and Tenasserim provinces together with a large pecuniary indemnity. During the governor-generalship of Lord William Bentinck (1828-35) various administrative reforms were effected, but no great political events took place. Lord Auckland assumed the governor-generalship in 1836. The Afghan war broke out in 1838, in consequence of long and complicated intrigues arising from the advance of Russia in the East, and the mutual jealousy of that power and Great Britain. War was declared on 1 October, the object of the British was to dethrone Dost Mohammed and restore Shah Sujah, a former ruler. It was at first attended by great disasters, particularly the famous massacre of the Khoord Cabul Pass. It was terminated in 1842, under the governor-generalship of Lord Ellenborough, by the evacuation of Afghanistan by the British, after they had relieved their captives and vindicated the superiority of their arms by the capture of Cabul. Sind was annexed to British India after a war conducted by Sir Charles Napier in 1843. After a brief war, arising out of a disputed succession, the dominions of Scindia lay at the mercy of the British, and were disposed of by a treaty dictated by the governor-general at Gwalior in January 1844. While he was thus engaged Lord Ellenborough was recalled and superseded by Sir Henry Hardinge (May 1844), who was soon engaged in one of the most formidable wars the British had yet had to encounter in India. The Sikhs, a politico-religious sect already mentioned, had, under their leader, Runjeet Singh, conquered the Panjab about the beginning of the century. Runjeet Singh, who had always maintained friendly relations with the British, died in 1839, and the government fell into a chaotic state: the army, being without a head, began to commit disorders and threaten encroachments on the British territory. In December 1845 the Sikh army crossed the Sutlej in great force, and in the short war which followed the Sikhs were defeated by Sir Hugh Gough and Sir Henry Hardinge at Moodkee, Ferozeshah, Aliwal, and Sobraon. Peace was made at Lahore, by the surrender of the Sikh territories on the left of the Sutlej, and between the Sutlej and the Bias (Jalindar Doab), and the payment of an indemnity. During the governor-generalship of the Marquis Dalhousie, 1848–56, a new war broke out with the Sikhs, and after their final defeat by General Gough at Gujerat, 21 Feb. 1849, the Panjab was annexed to the British dominions. This was immediately followed by the second Burmese war, ending in the annexation of Pegu, 20 June 1853. Sattari, Jhansi, Nágpur, and Oudh were, on the failure of the native succession, also annexed to the British possessions, 1852–6. During Lord Dalhousie's administration the extensive scheme of Indian railways and telegraphs was planned and inaugurated, the Ganges Canal opened, and the Panjab Canal begun. His last important act as governor-general was the annexation of Oudh, 7 Feb. 1856. The annexation of Oudh, and other provinces, combined with a general feeling of unrest brought about the mutiny of the native army. (See INDIAN MUTINY.) He was succeeded by his friend Lord Canning; in less than a year after the arrival of the new Governor General, a mutiny of the native troops took place at Meerut, on Sunday afternoon, 10 May 1857. The main incidents of the Indian mutiny are the massacre at Cawnpur; the defence of Lucknow, under Sir Henry Lawrence; the taking of Lucknow, by General Havelock; and the siege of Delhi, 14 Sept. 1858. The mutiny sealed the fate of the East India Company, after a rule of more than 250 years, and brought about the transfer of the country to the direct authority of the Queen of England. The Royal Proclamation was read at a grand durbar at Allahabad, 1 Nov. 1858.

1 LORD CANNING became the first viceroy of India. He left India in March 1862, and died shortly after his arrival in England.

2 THE EARL OF ELGIN, became viceroy in 1862, and died in India November 1863.

3 SIR JOHN LAWRENCE, afterward created Baron Lawrence, 1864–69. Reformed the finances. Bhutan war. Orissa Famine, 1866.

4 VISCOUNT MAYO, 1869–72. Received Amir Sher Ali Kehan of Kabul in great state at Umballa 1869. Assassinated by a convict in the Penal Settlement at Port Blair.

5 EARL OF NORTHBROOK, 1872–76. The Prince of Wales, now King Edward VII., visited India. A famine in Bengal. The Guikwar of Baroda deposed.

6 EARL OF LYTTON, 1876–80. Famine in South India. The invasion of Afghanistan. The proclamation of the Queen of England, as Kaisar-i-Hind, or Empress of India, 1 January 1877.

7 MARQUESS OF RIPON, 1880–84. Extension of municipal government. Various reforms in favor of the natives.

8 MARQUESS OF DUFFERIN, 1884–88. Third Burmese War. The annexation of Upper Burma with the Shan States. The "Scientific Frontier" of India defined and strengthened.

9 MARQUESS OF LANSDOWNE, 1888–93. The strengthening of the army and the defences of India. Reform in currency, closing the free coinage of silver. Reconstruction of the provinces of India.

10 EARL OF ELGIN, 1894–98, son of a former viceroy. British control of the northwest frontier of India strengthened. Earthquake in Anam 1897. Cholera, plague, and famine 1896. Frontier War. Celebration of the Queen-Empress. Diamond Jubilee.

11 VISCOUNT CURZON, 1899–1905. Dispatched 8,000 British troops to S. Africa 1899. About 20,000 sent to China 1900. One of the worst Indian famines on record. A period of reform and reconstruction. King Edward proclaimed Emperor at Delhi 1 January 1903. Political Minister to Tibet 1904. Seven earthquakes April 1905. Resigned August 1905.

12 EARL OF MINTO, arrived in India November 1905. A descendant of a former Governor-General of India. Partition of Bengal Province 1905. Visit of Amir Habib Ullah Khan of Afghanistan January 1907.

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India, Farther, or Further. See INDO-CHINA.

India, French. See EAST INDIA COMPANIES, and INDIA under *History*.

India Ink. The usual basis of India ink is a finely divided solid carbon, mixed with a size to hold it in suspension when the ink is prepared for use by mixing it with water, the depth of the shade being regulated by the quantity of water used in the mixing. This ink was originally made in China and Japan, where the ink is applied with a brush both for writing and drawing. In Europe and America it is now used chiefly for black-and-white drawings.

India, Native States of. See INDIA under *Political Divisions, Local Government*, and *History*.

India, Portuguese. See EAST INDIA COMPANIES, and INDIA under *History*.

India Rubber, the manufactured products of caoutchouc, or gum-elastic. Some of the properties of india rubber must have been known in America at a very early period, because balls made by the Haytians of the gum of a tree, bouncing better than the wind-balls of Castile, are mentioned by Herrera in his account of Columbus' second voyage. In a book published in 1615 Juan de Torquemada mentions the tree which yields it in Mexico, describes the mode of collecting the gum, and states that it is made into shoes; also that the Spaniards use it for waxing their canvas cloaks to make them resist water. More exact information was furnished by M. de la Condamine in 1735. India rubber was at first known as Elastic Gum, and received its present name from the discovery (about 1770) of its use for rubbing out black-lead pencil marks, for which purpose it began to be imported into Britain in small quantities about the end of the 18th century. Its application to the manufacture of waterproof cloth first gave it commercial importance. About the same time a method was discovered of fabricating articles of various kinds by casting india rubber in molds. The india rubber of commerce is obtained most largely from South America, but considerable quantities are also procured from British India, the Indian Archipelago, the west coast of Africa, and the Mauritius.

Pure India rubber is now used only to a limited extent in the arts, but it is applied in the vulcanized state to a very large extent. In the process of vulcanizing, the rubber, as a preliminary step, is either torn into shreds or crushed into thin pieces by machinery, and afterward washed. There are two principal kinds of vulcanized rubber, one hard and horny in its texture, the other soft and elastic. In the case of the former the caoutchouc is mixed with about one third of its weight of sulphur, and heated for several hours, the temperature finally rising to fully 300° F. For the soft kind of vulcanized rubber, on the other hand, a much smaller proportion of sulphur is required — viz. from 2½ to 10 per cent, and the heat to which it is subjected in the vulcanizing chamber is considerably less. Usually, too, with this latter kind, the articles are made before the rubber is heated. The sulphur is commonly added in the ground state, but sometimes the rubber is treated with some solution containing this element, such as the bisulphide of carbon.

Hard vulcanized rubber, termed vulcanite, and sometimes ebonite, is made into a great many small articles, such as combs, chains, bracelets, boxes, penholders, paper-knives, knife-handles, buttons, etc., as a substitute for materials like horn, bone, ivory, and jet. Like these substances themselves, it is formed into various objects by molding, cutting, carving, polishing, and other processes. Vast numbers of these articles are now sold. The black color of vulcanite ornaments has still a tendency to turn gray, but the brittleness which was a fault of combs made of it a few years ago seems to be overcome.

More than 50,000,000 pounds of india rubber, valued at more than $30,000,000, was imported into the United States in 1902. In 1890 the quantity was only 33,000,000 pounds; in 1880, 16,000,000; in 1870, 9,000,000, and in 1862, the earliest date at which it was separately shown in the import statements, was only 2,125,561 pounds.

Over $100,000,000 worth of manufactures from india rubber are now turned out from the factories of the country every year, and about half of this total is in the form of boots and shoes. So great is the demand for india rubber for use in manufacturing that not only has the importation grown from 2,000,000 pounds in 1862 to over 50,000,000 annually at the present period, but in addition to this the forests of the East Indies are called upon for several million pounds annually of a new substitute for gutta-percha, known as "gutta-joolatong," while at the same time the highways and byways of Europe and other countries are ransacked for cast-off rubber manufactures from which the rubber is "reclaimed" and re-used in conjunction with the new rubber from the forests of Brazil, Africa, and the East Indies.

The industry of importing and "reclaiming" india rubber for re-use in manufacturing is a comparatively new one, and while it utilizes large quantities of worn-out rubber boots and shoes and other articles of this character from the scrap heaps of the United States, it has only extended to other parts of the world in recent years.

Gutta-joolatong is another comparatively new material which may be used as a substitute for or in conjunction with India rubber. It is a product of the East Indies, chiefly the island of Borneo, located not far from our Philippines.

The tables which follow show the quantity and value of crude India rubber imported into the United States from 1893 to 1903, also the scrap and old India rubber for use in remanufacturing, also for gutta-joolatong from 1899, the date at which it was first separately stated, to 1903:

IMPORTATION OF CRUDE INDIA RUBBER, 1893 TO 1903.

Year Ending June 30	Pounds	Value
1893	41,547,680	$17,809,239
1894	33,757,783	15,077,993
1895	39,741,607	18,353,121
1896	36,774,460	16,603,020
1897	35,574,449	17,457,976
1898	46,055,497	25,386,010
1899	51,063,066	31,707,680
1900	49,377,138	31,376,867
1901	55,275,529	28,455,383
1902	50,413,481	24,899,230
1903	55,010,571	30,436,710

IMPORTATION OF OLD AND SCRAP RUBBER, FIT ONLY FOR REMANUFACTURE, 1893 TO 1903.

Year Ending June 30	Pounds	Value
1893	910,543	$25,633
1894	1,774,008	55,803
1895	2,032,563	63,112
1896	3,874,677	123,068
1897	3,653,945	113,722
1898	9,488,327	339,374
1899	10,513,604	462,044
1900	19,093,547	1,249,231
1901	15,235,236	988,316
1902	22,804,900	1,437,960
1903	24,659,394	1,516,137

IMPORTATION OF GUTTA-JOOLATONG, 1899 TO 1903.

Year Ending June 30	Pounds	Value
1809	6,473,882	$166,419
1900	8,701,753	237,214
1901	9,371,087	248,838
1902	16,850,821	501,418
1903	13,984,817	345,431

IMPORTATION OF GUTTA-PERCHA, 1893 TO 1903.

Year Ending June 30	Pounds	Value
1893	582,378	$155,428
1894	498,763	84,340
1895	1,326,794	122,261
1896	3,843,854	178,513
1897	1,117,665	100,187
1898	636,477	159,381
1899	518,939	167,577
1900	427,678	178,616
1901	280,560	130,957
1902	525,767	252,329
1903	316,290	22,400

See also CAOUTCHOUC; RUBBER MANUFACTURES, AMERICAN.

Indian. See INDIANS, AMERICAN.

Indian, Catholic Education of the. Upon the discovery of America in 1492. the various religious orders of the Roman Catholic Church hastened to send missionaries to the new field. A small school for the education of the natives was an accompanying feature of each mission station. and after Cortes had conquered Mexico. Franciscans. Dominicans. and Jesuits. in course of time educated and converted the natives to Christianity. and founded missions and schools which exist there to-day, and in California, now an integral portion of the United States. but formerly part of Mexico. North and south the missions and schools were established and as germs of diocesan organizations bore fruit in the foundation of the see of Caracas in Venezuela in 1531; that of Lima. Peru. in 1539; of Chiquisaca. Bolivia. in 1551; and of Santiago, Chile, in 1501. Brazil was entered in 1500 by Franciscans who were followed half-a-century later by Jesuits. The first Brazilian see was founded at Bahai in 1561; in La Plata. now the Argentine Republic. the see of Cordova was founded in 1570. and there in course of time the Jesuits built up a magnificent college. In Central America. Franciscans began their work of education and conversion in Costa Rica in 1560. and during the last 30 years of the century friars labored successfully in Guatemala. teaching the arts of civilized life along with the doctrines of salvation. Early in the 17th century. Jesuit fathers entered Acadia (Nova Scotia). and Canada. and in 1659 the first episcopal diocese in the region was organized at Montreal. Torture and martyrdom did not deter these brave champions and pioneers of Christianity and civilization, and the development of the United States followed the pioneer growth of Catholic congregations and schools among the native Indians. In the first half of the 19th century. the Indian nations of the Rocky Mountains and Northwest Territories (American and Canadian) were pagan. The Jesuit father De Smet made the long and dangerous journey from St. Louis. Mo., to the headquarters of the Flathead nation in Montana. inaugurated the introduction of Christianity. and prepared the way for the advent of younger members of the order. See CATHOLIC INDIAN MISSIONS IN THE UNITED STATES.

Indian, Education of the. Indian education as at present conducted in the United States is in no way the outcome of any deliberate plan on the part of the Federal government. but is directly descended from the first attempts to teach the Indians of Virginia. and particularly from like beginnings in Massachusetts. where the remarkable results of John Eliot (q.v.) were achieved.

Eliot's Work.— Eliot was actuated by high motives. and his simple measures were chosen with consummate wisdom. Having familiarized himself with the language. disposition. and character of his Indians. he secured their confidence and respect. Those who would follow him he gathered in towns. where he taught them the liberties and responsibilities of township government and the devices and institutions of civilized life. among which the Church and the school naturally occupied places of honor. A number of "choice Indian youths" he induced to attend English schools that they might prepare themselves for missionary work among their own people. He was warmly supported by 'the corporation for the propagation of the Gospel in foreign parts.' by the General Court of Massachusetts. and particularly by Daniel Gookins, the official superintendent of the Indians in Massachusetts. Eliot began his work in 1646. In 1674 there were 14 towns of "praying Indians," whose schools and churches. in the majority of instances, were administered by educated natives. and an Indian college had been founded at Cambridge. Yet in due time this success was swept away by the fears and prejudices which developed under the baneful influences of the Indian wars. Similar successful work under the direction of John Cotton and Richard Bourne in Plymouth colony shared the same fate.

Other Endeavors.— Followers of Eliot in the 18th century were John Sergeant at Stockbridge. Mass., and Eleazer Wheelock in Connecticut and New Hampshire. The work of Sergeant. which involved the establishment of day schools. of a boarding-school. and an experimental "outing system," was almost ideal in conception. but ended with the deportation of his Indians to the West. Dr. Wheelock's labors led to the establishment of an effective training school and. indirectly, to the creation of Dartmouth College 'for the education and instruction of youths of the Indian tribes in this land in reading. writing. and all parts of learning which shall appear necessary and expedient for civilizing and christianizing the children of pagans. as well as in all liberal arts and sciences. and also of English youths and any others.' Only the last purpose was destined to achievement.

Surviving Influences.— But in spite of external failure. the spirit and much of the form of these early enterprises persisted. Their impress is observable to-day in almost every prominent feature of the Indian-school organization of the United States. notably in the establishment of day schools in or near Indian villages as a means of domestic and industrial uplifting of Indian family and village life; of industrial boarding-schools in territory occupied by Indians. to introduce among the young a taste for the refinements. duties. and responsibilities of civilization; of advanced training-schools in civilized English-speaking communities for the fuller equipment of 'choice Indian youths" for full citizenship in such communities. or for missionary work in the ideals. institutions. and arts of civilization among their own people. It is seen in the universal stress in all schools upon instruction in husbandry. certain trades and domestic arts; in the 'outing system,' which places partially educated Indian girls and boys as paid helpers in suitable English-speaking families. and affords them instruction in the ordinary public schools; and in the importance attached to religious and ethical training.

Wrong Departures.— On the other hand. it is to be deplored that a number of valuable features of the early schools have been abandoned. and even supplanted by opposite tendencies — the unintelligent warfare against the Indian idiom; the introduction of certain brutalities of military discipline; an equally mistaken effort to wean Indian youth from Indian association by throwing contempt upon the Indian and by stimulating a feeling akin to hatred of Indian family ties; and in general a policy of compulsion and repression, rather than a spirit of development and benevolent helpfulness. Serious harm came to government schools because patronage entered as a factor in the appointment of officers and employees. Thanks to the Indian Rights Association, the Mohonk Conference, and a number of other societies, in 1893 civil-service rules were applied to employees of the Indian schools.

History of Organization.— The successive steps in the organization of Indian schools have been as follows: After the Revolution little heed was paid to Indian education for 30 years. Only minor appropriations are recorded on the basis of treaties with a few tribes. But in the first quarter of the 19th century a religious revival directed attention to Indian education as a Christian and national duty. Congress responded in 1819 with an appropriation of $10,000 in addition to certain treaty obligations. In 1820 the President was authorized to apply this sum annually in aid of societies and individuals engaged in the education of Indians. In 1823 $80,000 was expended in 21 schools maintained by missionary bodies, $12,000 having been granted by the government. In 1825 the number of such schools had risen to 38, their entire expenditure to $202,000, of which the government, directly and indirectly, had contributed $25,000. In 1848 there were reported in operation 16 manual-training schools, 87 boarding-schools and other schools. These schools continued to increase in number and efficiency up to 1873, under the control of missionary bodies, with scanty aid from the government, which had established only a few small day schools directly under treaty provisions. After 1873, however, the government entered upon an era of great activity in the establishment of strictly government schools. In 1877 Congress appropriated for schools outside of treaty provisions, $20,000; in 1880, $75,000; in 1885, $992,800; in 1890, $1,364,568; in 1895, $2,060,695; in 1899, $2,638,390; in 1900, $2,936,080; 1901, $3,083,403.65; 1902, $3,251,254; 1903, $3,531,220. The expenditures have doubled within the decade, and trebled within 15 years. During the quarter century the average attendance rose in more than like ratio. Increased appropriations naturally stimulated a desire on the part of the government to control expenditures. Moreover, the Constitution, by implication, at least, forbids the appropriation of public funds for denominational purposes. Conclusions unfavorable to government support of missionary schools were further strengthened by the fact that the Roman Catholic Church had gradually outstripped the Protestant missionary bodies and was absorbing the lion's share of government support. In 1893 the Methodist Episcopal Church withdrew from participation in government aid, but without abandoning its schools. In 1895 this example was followed by the Presbyterians and Congregationalists; in 1896 by the Friends; and in 1897 by the remaining Protestant denominations. This left only the Catholics in the field with an appropriation, and in 1901 it was withdrawn from them also. In 1804 Congress had declared its policy of abandoning all support of denominational schools, and this policy has gradually been followed out.

The Schools of To-day.— The present Indian schools under government control are day schools, reservation boarding-schools, non-reservation boarding-schools, and industrial and normal training-schools. These in 1902 numbered 249, with an enrollment of 24,434 pupils; 323 other pupils were maintained by contract at Hampton and in white public schools.

Day Schools.—Day schools in Indian villages, or near Indian camps or settlements, are, as a rule in charge of a male teacher and his wife, or, as in the pueblos of New Mexico and in the Indian villages of southern California, of a white woman teacher and an Indian housekeeper. These teachers are employed for 10 months in the year; the male teacher's wife acts as housekeeper. The children spend 5 to 8 hours during the 5 days of the week under the care of these employees, and return to their homes in the evening. The instruction is of the simplest character. The children are taught to speak, read, and write English within narrow limits, to cipher, to draw, and to sing. They get some rudimentary notions of geography, of natural history, and of United States history. The methods are borrowed largely from the kindergarten and from object-teaching, and much stress is laid upon habits of cleanliness and order, mutual kindliness, and prompt obedience. The boys receive some instruction in the use of tools, in gardening, and in some instances in the care of cows. The girls are taught sewing, cooking, and other arts of housekeeping. In the poorer Indian communities a noon-day lunch of a few simple articles is furnished. While these day schools accomplish comparatively little in conventional school-room work, they serve as concrete illustrations of a civilized Christian home which the Indians learn to respect and, in an appreciable degree, to emulate. Moreover, they reconcile the Indian with the idea of sending his children to school, and render him more willing in due time to entrust them to the care of boarding-schools, as well as more ready to appreciate and to accept the lessons of civilization. The most successful of 134 such schools in 1902, were located in Wisconsin, North Dakota, and South Dakota; the least successful, probably, among the pueblos of New Mexico, where the Indians live in a state of half-civilization which they owe to their Mexican and Spanish antecedents, and which fully satisfies their ideals.

Reservation Boarding-Schools.—There were 90 of these in 1902, averaging 125 pupils. They are in charge of a superintendent, assisted by a matron and such teachers, industrial and domestice helpers as the capacity and character of the school may require. In addition to regular teachers, the school is provided with a cook, a seamstress, and a laundress, whose office it is not only to supervise their respective departments, but also to instruct the girls in these arts. For instruction of the boys there is a farmer, an industrial teacher, and, at larger schools, a tailor, a shoe and harness maker, a carpenter, and a blacksmith. An experiment to provide for more methodical instruction in the use of tools, by expert manual-training teachers, failed because the Indian office would not afford a salary for this position sufficient to attract competent men. In 1894 the experiment of connecting kindergartens with these schools was tried, and proved eminently successful. At the present time there are 40 kindergartens connected with boarding-schools, and the use of kindergarten methods and material has entered the primary classes in practically all these schools with similar good results. In the kindergarten the children spend from 1½ to 2 hours each half-day. In most of the other schools children spend half a day in the school-room, and the other half-day in domestic or industrial work of a character suited to their age. Experience has proved that half-day instruction, at first forced upon the schools as an expedient, is commended by its good results.

The aim of the school-room work is to teach reading and writing within the usual limits of primary work; arithmetic for the needs of ordinary daily life; rudimentary geography and United States history; drawing and singing; the laws of hygienic living; garden and orchard work; and familiarity with the simpler requirements of agricultural and domestic industries suited to the locality. Moreover, in a few of the larger schools, the older boys have much opportunity to acquire skill in carpentry, blacksmithing, tailoring, and shoemaking. These institutions are to the children not only school, but home and community. The institution gives them shelter, food and clothing; it accustoms them to habits of cleanliness and decency; it cultivates their æsthetic tastes; it labors to secure right moral attitude, and in its Sunday-school seeks to stimulate the religious life of the children. The superintendent of the reservation boarding-school is subject in his work to the control of the Indian agent, who as representative of the government, administers the reservation's affairs. Inasmuch as these agents are selected on partisan grounds, usually at the suggestion of local politicians, this arrangement is fraught with danger to these schools.

In 1893, under civil-service regulations, there came some improvement. Still with reference to minor employees the superintendents, and even the Indian office, were powerless, and frequently good superintendents were forced out of service by combinations against them among the appointees of the agent, or through the aid and influence of unscrupulous partisan inspectors or supervisors. But in 1896 all employees of the school service were placed under civil-service protection, and since that time there has been marked improvement in the conditions and work of these schools. To a certain degree these evils still persisted, however, because of the power and political bias of the agents; but of late the government has adopted the policy of replacing the agents with bonded school superintendents, 22 agencies now being under such control. There has been decided gain in the equipment, in the sanitary condition, in the general character of employees, and in the conduct of the schools. For the Indian office, relieved of attention to office-seekers and their patrons, has been enabled to pay increased attention to the schools themselves. In the reservation boarding-schools instruction continues through 40 weeks; but often some children are kept at the school throughout the year.

Non-Reservation Boarding-Schools. — Of these there are 25. Seven of them are industrial training-schools, and three others are industrial and normal training-schools. The remaining 15, in their original scope of work, differed little from the reservation boarding-schools. But the superintendents of these schools are bonded and directly responsible to the Indian office. There is no intervening Indian agency, and the consequent sense of responsibility and self-respect in the head of the school finds its reflection in the attitude of his subordinates, as well as in that of the pupils. These schools are, as a rule, located at a distance from the Indian country, and in the vicinity of American towns which afford contact with the amenities of civilized life. Members of many different tribes are also brought together, and tribal antagonisms are broken down. The pupils are older than those at reservation schools, and some have had previous training in day schools or reservation boarding-schools. Because far away from their Indian homes, and near to English-speaking communities, they gain a better control of English; class-room work reaches far into the advanced grammar-school courses of study, with special stress upon language practice, arithmetic, geometry, geography, history, nature study, drawing, and civil government. Instruction in domestic and industrial arts is made effective by frequent opportunities directly to observe their practical applicability and value. The superintendents are paid from $1,200 to $1,500 per annum. Other employees are paid on the same scale as in reservation schools. The most noted and successful of these schools are located at Flandreau, S. D.; Pipestone, Minn.; Mount Pleasant, Mich.; Fort Mojave, Ariz.; Carson, Nev.; Perris, Cal.; Tomah, Wis.; Wittenberg, Wis.; Fort Lewis, Colo.; and Pierre, S. D.

Industrial Training-Schools. — There are schools of this class at Carlisle, Pa.; Chemawa, near Salem, Ore.; Chilocco, Okla.; Genoa, Neb.; Albuquerque, N. M.; Lawrence, Kan.; (the Haskell Institute), Grand Junction, Colo.; Sante Fe, N. M.; Phœnix, Ariz.; Fort Shaw, Mont. The most strenuous effort is now carried on at Chilocco; organized 1884; a large plant with a capacity of over 500 pupils, and a fine farm of about 9,000 acres. In organization these schools are similar to the schools just described, but in the scope of their work and in equipment they excel in a high degree. The government in 1894 added normal departments at Carlisle, at the Haskell Institute, and at Santa Fé. The experiment proved fairly successful with Carlisle and the Haskell Institute, at Santa Fé slightly so for a time, but of late it has shown better results there.

Contract Schools.— In addition to maintaining these strictly government schools, the Indian office up to 1901, as before said, paid by contract for the education of many hundreds of Indian pupils distributed in Catholic mission boarding-schools, in Catholic day schools; at Lincoln Institute, Philadelphia, and at Hampton Institute, Hampton, Va. In the appropriation for that year, the aid was withdrawn from all but the last-named, where 120 pupils were contracted for. Besides these, the government since 1891 has endeavored to place Indians in white public schools where there are many whites and few Indians, as the most rapid means of civilization. The antagonism of local or State authorities to this coeducation has made this plan a failure in some places; in others there has been some success. Rising from 8 to 45 between 1891 and 1896, the number of such schools has gradually sunk to 16 in 1902, with 110 pupils contracted for out of 189 enrolled, and average attendance of 98.

Supervision.— Direction of the Indian schools rests with the Indian office, which is under the supervision of the secretary of the interior. In the Indian office the details of the work are entrusted to the education division, to which all reports are made, and by which all directions and orders are drafted and issued. The education division is aided in its work by the superintendent of Indian schools and by 5 supervisors, assigned in their work to 5 districts respectively. These officials constitute a branch of the Indian-school service which occupies a very uncertain position. They have duties, but no rights. A similarly anomalous relation exists between the commissioner and the secretary of the interior with regard to all matters which the latter may wish to control directly. For this purpose the secretary has established under his direct control an Indian division, independent of the Indian office, to which all orders and directions the secretary may designate must be referred by the Indian office for approval. The power of this Indian division is further reinforced by a corps of inspectors in the field, appointed on partisan grounds, and responsible to him alone. Technically the superintendent of Indian schools may appeal from the commissioner to the secretary of the interior, and the commissioner from the decision of the secretary to the President. In view, however, of the hopelessly autocratic relation that runs through the chain, that is practically out of the question. Under these conditions, the fact that Indian education has prospered reflects credit upon all concerned.

Schools of Indian Territory.— The schools of the so-called "five civilized tribes" of Indian Territory are not included in the above sketch. The 5 tribes in 1900 included 25,639 Cherokees, 10,321 Choctaws, 7,963 Creeks, 5,872 Chickasaws, and 1,662 Seminoles. In addition there were in the Territory 36,853 freedmen and 302,680 whites. Missionary zeal availed itself promptly of this field for its efforts. Substantial boarding-schools were erected, more particularly by the Presbyterians, Methodists, and Baptists. In due time, however, the Indian authorities began to make appropriations for these schools. Ultimately they took entire charge of them. Unfortunately, administrative affairs were largely in the hands of whites, who, by intermarriage or bribery, had been adopted into the tribes, and there came over the schools, as well as over all other public interests, the blight of extreme partisanship and nepotism, which rapidly degraded them in character and efficiency. In 1898 the government at Washington assumed supervisory control over the affairs of all these tribes except the Seminoles. The conduct of the schools and orphan asylums in the 4 tribes involved was placed under the direction of a superintendent of schools in Indian Territory, appointed by the secretary of the interior. Under him there is for each of the tribes or nations a supervisor of schools, whose duty it is to inspect the educational institutions in his district, and to assist in their organization and conduct. The superintendent reports to the commissioner of Indian affairs at Washington through the United States inspector for the Indian Territory, who is his immediate superior. The initial report of this superintendent showed in the 4 tribes 24 boarding-schools, with an enrollment of 1,758 pupils, and an average attendance of 1,480, taught and cared for by 234 employees at an annual expense of $236,824. This does not include 363 neighborhood schools, in which more than 10,000 children are taught at an annual expense of $113,380, which, in character and equipment, show great inferiority.

William N. Hailmann,
Ex-Supt. Indian Schools.

Indian Affairs. The prevalent idea that the national government has always striven to dispossess the Indians from the lands they occupied, or has sympathized with such efforts, is the exact reverse of the truth. From its foundation until now, its history presents an unbroken record of quarrels between Indians and bordering or interdwelling white settlers, in which the government has been slowly and reluctantly pushed on to interfere; sympathizing with and justifying the Indians against its own citizens, its commissioners usually reporting in their favor, and even its generals in later days blaming the whites for the troubles; its courts deciding in their favor; attempting pacification amid local outcries against them, rebuffing appeals for aid, and only using its armies to reduce the Indians and its administrative power to remove them when it was no longer politically possible to leave them in possession. Even then, it has meant to deal righteously by them; but the complexity of the problem — one may say its insolubility till the country was very strong and the Indians very weak — along with the universal curse of "spoils" in the administration — has hindered success. While until 1887 there was no consistently formulated plan, there has been a sequence of government panaceas in a steadily descending line. First, there was to be one vast Indian reservation, large enough to give them all the hunting-room they needed, and so far from the United States that our growth would never reach to them and create more troubles; then three great reservations, to prevent so formidable an Indian district and internecine Indian wars; then a number of small ones, to segregate hopelessly hostile tribes, enable better training into civilized existence, and protect them from depredations; lastly, no reservations, but severalty ownership and individual citizenship. These changes of policy have been due not to fickleness or visionary causes, but to broadening experience and varying conditions.

The policy of removing the Indians west of the Mississippi was first formulated by Jefferson, who in a proposed constitutional amendment (1803) set off the Louisiana Purchase north of the Arkansas as a pure Indian country, in which no land was to be sold to whites. This was carried out, on a much reduced scale, in the formation of Indian Territory (q.v.) by act of 30 June 1834; by another act of same date a superintendent of Indian affairs was appointed, no one to trade or settle in the Indian country without permission from him or his agents. Previous to this the Indian matters had been under the War Department; in 1849 they were transferred to the new Department of the Interior, of which they still form a bureau. Under the commissioner of Indian affairs are eight inspectors and a large variety of subordinate officials and employees. The Indian agents, though under his control, are appointed by the President, for four years, with bonds; on their action depends often peace or war to great white populations, but in too many cases they have been the football of politics, and sometimes scandalously unfit for their places.

The legal theory, until a recent date, was that each tribe was a nation, but not a foreign nor independent one; a "domestic dependent nation," but with which, nevertheless, all intercourse was to be conducted through special commissioners appointed by the President. In 1871 Congress abolished this method of procedure, and substituted immediate Congressional control, but the fiction of Indian nations remained; nor, indeed, could any other system well be applied so long as the Indians were recognized as national wards, and could not be made a part of the regular republican system or thrown into the current of unrestricted competition. It was the general plan to let the larger and better advanced ones, as the five "nations" of the Indian Territory, govern themselves and thus develop political life, including a full judiciary system. But the smaller ones could not be thus left, even in leading-strings; and in all, the government has recognized its duty to watch over their ignorance, improvidence, and savage instability of will and emotion from either violence or cunning on the part of the whites. Traders with them must have certificates of good character and be licensed by the Indian commissioner, and the goods they sell are subject to regulation; no one can hunt, cut timber, or pasture cattle on Indian lands without the agent's permission; intoxicating liquors may not be sold to them. Still more important and beneficial is the educational work, which has not only been carried on by churches, missionary societies, and private individuals from early times, but has been actively forwarded by the government. The five civilized nations of Indian Territory had their own school system, of considerable extent; but for others, and even for those where needed, the President was empowered in 1865 to appoint instructors of Indian children in reading, writing, arithmetic, and agriculture, and in 1882 to appoint an inspector of Indian schools. (See INDIAN, EDUCATION OF THE.)

From 1877, when a $20,000 appropriation was made for Indian schooling, to 1900, when over $3,000,000 was appropriated, over $35,000,000 had been thus expended by the government. It has spent since its foundation nearly $400,000,000 on the Indians, outside of the cost of wars against them; and the present expenditure is about $10,000,000 a year. In 1900 it was maintaining over 45,000 wholly by rations, and 12,500 partly, at a cost of about $1,250,000 per annum; and paying annuitants (partly from trust funds derived from sales of their lands) over $1,500,000.

On 8 Feb. 1887, however, an act was passed, amended in 1890, to sweep away as soon as feasible all this system of tutelage and pauperization, in the belief that abolition was best for Indians and whites alike. All reservations were to be surveyed; all Indians who wished to take up lands in severalty to a certain amount might do so — and by the act become citizens, as well as all who had previously done so under treaties and Congressional enactments, over 10,000 in number. Up to 30 Oct. 1900 6,736,514 acres had been so allotted, to 56,996 Indians; about 2,000 a year comply with the permission; and a few years will see an end of Indian tribes except as historical reminiscences. Many of these new citizens are made voters by their States: there are over 20,000 such in the United States at present. See CHEROKEE; CHEROKEE NATION V. GEORGIA.

Indian Art. In none of the fine arts except architecture have the Hindus attained much eminence. Their paintings are of very little merit, though the walls of temples, of palaces, and of the better class of private dwellings are often ornamented at great cost with pictures illustrating the characters and events of their mythology. More attention has been paid to sculpture than to painting, and in the temples cut from the living rock great numbers of statues are contained, some single figures and others large groups. Many of these are bold and spirited in design, though the human form is not exhibited in good proportion nor with its parts well developed.

Indian Architecture, however, comprehends a great variety of styles, among which we may distinguish, as the most important, the Buddhist, the Jaina, the Dravidian or Southern Indian, the Chalukyan, and the Modern Hindu or Indian-Saracenic styles. The history of Indian architecture commences in the 3d century B.C. with the religious buildings and monuments of the Buddhists. Among the principal forms of Buddhist architecture are first, the *topes, stupas,* or towers built to mark some sacred spot, and the *dagobas,* constructions of a similar nature, containing relics of Buddha or Buddhist saints. These buildings generally consist of a circular stone basement, varying from 10 or 12 to 40 feet in height, and from 40 to 120 feet in diameter, on which rose a rounded domical structure, generally of brick or small stones laid in mud, the whole edifice rising sometimes 50, sometimes 100 feet high. Second, the rock-cut *chaitya* halls or churches, and the *viharas* or monasteries. Most of these are found in Bombay; some also in Bengal and Behar. In rock-cut buildings architectural skill is confined to the façade and the interior. Among the most notable for beauty of design are those at Ajanta, and, finest and largest of all, the great Chaitya cave at Karli, near Bombay, the date of which is probably about 80 B.C. Another interesting example is at Ellora. The Jaina style is a development or corruption of the pure Buddhist. It is characterized by the square or polygonal court, the twelve-pillared dome, the slenderness and elegance of the columns, the horizontal arch, the *sikras* or towers surmounting the cells containing the images, and, lastly, by the peculiar grouping of many temples together on hill-tops. Prominent examples of Jaina architecture are found at Girnar in Gujerat, and at Mount Abu. The most flourishing epoch of the Dravidian style comprises the 16th, 17th, and even 18th centuries of our era. To this late period belong the great temples at Tanjore, Tiruvalur, etc. The distinctive parts of a Dravidian temple are the *vimana* or temple proper, with storied pyramidal roof; the *mantapas* or porches, covering the door which leads to the cell; the *gopuras* or gate-pyramids, in the quadrangular enclosures surrounding the vimanas; and the *choultries* or pillared halls, used for various purposes. The general characteristics of a Dravidian temple of the first class are the storied pyramidal towers, the hall of 1,000 columns, the bold cornice with double flexure, the detached shafts, the richly carved stylobate, and the large tanks with flights of stone steps. The Chalukyan style, so named from a dynasty which rose in the 6th century in what is now Mysore and the Nizam's Territory, reached its perfection in Mysore from the 11th to the 14th century. The characteristic features are the open porch, the straight-lined, conical-shaped tower, the star-shaped temple, and the basement terrace of stone.

The Indian-Saracenic style is a general name for a number of somewhat varying styles, the result of the mixture of Saracenic principles of architecture, brought with them by the Mohammedan conquerors of India, and the distinctive architectural features of the different localities where they settled. Under the Mogul emperors in the 16th century were erected some most magnificent buildings, such as the tomb of Humayun Shah at Old Delhi; that of Akbar at Secundra; the palaces of Shah Jehan at Agra and Delhi; and the Taj Mahal, built by the same monarch at Agra. (See AGRA.) The Moslem architecture of India contrasts with the native Indian styles in its use of the radiating arch, in the superior simplicity and grandeur of its style — its flat ornamentation not interfering with the lines of true architectural construction. A characteristic feature also is its fine conventionalism of vegetable forms for decoration and tracery. See *Moslem Architecture* under ARCHITECTURE.

Indian Bean, a catalpa (q.v.); specifically the large southern tree (*Catalpa catalpa*), now planted as a shade or ornamental tree all over the country on account of the beauty of its masses of spring flowers and the quaint appearance in autumn of its long, bean-pod-like fruit.

Indian Bible, the first Indian translation of the Bible in the New England colonies. This translation was made in 1663 by John Eliot, «The Apostle to the North American Indians.» It was in the dialect of the Naticks, a Massachusetts tribe of the Algonquins. A second revised and corrected edition was printed in 1685, only 12 copies of which are known to exist. An edition with notes by P. S. Du Poneau, and an introduction by J. Pickering, was published in Boston in 1822. When the original edition was issued, 20 copies were ordered to be sent to England. A copy of the edition of 1663, with the Epistle Dedicatory, was sold in 1882 for $2,900.

Indian Bread-root, a plant of the genus *Psoralea;* the «large» was *P. esculenta;* the «small» *P. hypogæa.* See BREAD-ROOT.

Indian Corn. See CORN, INDIAN.

Indian Fig. See PRICKLY PEAR.

Indian Head, (1) the highest point of the Palisades, 550 feet; so called because it resembles somewhat the head of an Indian. It is in the northeastern part of New Jersey, on the Hudson and opposite Hastings. (2) The name of a village in Fayette County, Pa. (3) A small town in Maryland, on the Potomac River, below Washington, the seat of a naval station.

Indian Hemp. Sometimes called Canada hemp. See APOCYANACEÆ.

Indian Hippo, an American plant. See BOWMAN'S ROOT.

Indian Humped Cattle, a species of East Indian oxen (*Bos indicus*), now known only in the domesticated state, distinguished by a high fatty hump on the withers, by the prevalent ashy gray color, large drooping ears, enormous dewlap and several structural peculiarities. They vary in size from those as large as a European ox to the smallness of a half-grown calf. They form the working cattle and draft animals all over India and eastward more or less locally to China. They are venerated by the more pious sects of Hindus, especially in the persons of certain privileged bulls, called Brahma or Brahminy bulls, which wander about the bazaars of cities unharmed and unchecked in their depredations upon market produce.

Humped cattle are known in Madagascar, and in Abyssinia, and it has been suggested that the species was originally African. The Abyssinian form is a large animal with huge horns called «galla ox» or sunga. These animals seem to thrive only in hot countries, and have never been found profitable outside of their present range.

Indian Language and Literature. See INDIA.

Indian Mutiny. The British occupation of India had been largely aided by native troops called Sepoys, who were enrolled under British officers in the service of the East India Company. At the close of Lord Dalhousie's sway in 1856, when the whole of India seemed to have been either reduced directly under British rule, or if retaining its native princes to have placed itself under British protection, the Sepoy mutiny, a contingency for which the government ought not to have been altogether unprepared, occurred. Previous symptoms of disaffection had not been wanting. Mutiny had on several occasions broken out in the native army, in a way to indicate how easily through causes which Europeans, from their defective sympathy with native thought and feeling, could not anticipate, these troops might be alienated; but, on the other hand, the general fidelity of the Sepoys merited confidence, and this feeling prevailed over any grounds of suspicion which might have been formed from isolated occurrences. The Sepoys in Bengal were mostly either Mohammedans, or Hindus of the Brahmanical or military castes. The recent annexations had alarmed the native chiefs, while the fanatical Hindus had been deeply offended by reforms, including the successive abolition of various rites of their worship. Two European regiments had been drafted off for the Crimean war, and had not been replaced. Others had been sent to Burma, and in the beginning of 1857 fresh regiments were despatched to Persia, so that only eighteen regiments were left in all Northern India, of which nine were in the Panjab. In Oudh, where, from its recent annexation, disaffection was rife, there was only one British regiment, and Delhi and Allahabad, the two chief arsenals, were guarded by native troops. To add to these favorable circumstances a Hindu devotee had prophesied the termination of British rule at 100 years after the battle of Plassey. A slight incident sufficed to give point and direction to a spirit of disaffection which so many circumstances tended to favor. At this time the Enfield rifle was introduced into the Bengal army. This rifle was loaded with a greased cartridge, the end of which required to be bitten off at the time of loading. By a natural inadvertence the authorities had neglected to consider how this seemingly trifling requirement might affect the easily excited sensitiveness of the Hindus in regard to caste, and this insignificant circumstance removed the last security against a united movement of disloyalty among the native troops, by establishing a bond of sympathy between the Mohammedans and Hindus. A report got abroad that the cartridges were to be soaked in cow and pork fat. The prejudices of Hindus and Mohammedans were thus equally involved, and as this rumor rapidly spread, the excited imagination of the Sepoys conceived a conspiracy on the part of the government to convert them forcibly to Christianity, by compelling them to violate the laws of their own religion. When this grievance was explained it was at once removed, the manufacture of greased cartridges at Dumdum was stopped, and the men were instructed to grease them themselves with materials procured at the bazaars. Suspicion once aroused, however, was not to be allayed, and easily found a new object of contention. The paper of the new cartridges was glazed, and it was again alleged that grease was used in its manufacture. The spirit of disaffection became too deep-rooted for any measures of conciliation. Conferences among the disaffected gave rise to ambitious schemes, and the original grievances became a pretext in the hands of unscrupulous leaders, whose excesses debarred them even from the plea of patriotism, to extirpate the British power in India. On 26 February the first overt act of mutiny took place at Berhampur, when a regiment refused to receive their cartridges. Another dangerous outbreak took place at Barrackpur on 29 March. The arrival of a British regiment from Burma and the disbandment of the disaffected regiments was thought to have ended the trouble, but it soon became evident that disaffection, which had only wanted an occasion, was spreading rapidly not only among the Sepoys, but among the Hindus generally. Another outbreak took place on 2 May, near Lucknow, when a regiment of cavalry were, by some oversight of the government's instructions, ordered to bite their cartridges. Sir Henry Lawrence succeeded by a show of force in disarming it. A more formidable outbreak occurred about the same time at Meerut, 35 miles northeast of Delhi, when the mutineers, with the assistance of the native inhabitants, indiscriminately massacred the Europeans and escaped to Delhi. The advance-guard of the mutineers reached Delhi on 11 May, and at once entered the city, where they were assisted by the king's servants in massacring the Europeans. The native troops cantoned outside the city in the meantime joined the main body of the mutineers, and assisted in massacring their European officers. About 50 Europeans sought refuge in the palace, and placed themselves under the protection of the king, who had placed himself on the throne of the Moguls. These after some days were coolly murdered in an open court in presence of a general concourse of spectators, conspicuous among whom was Mirza Mogul, the king's eldest son, who had assumed the title of commander-in-chief. The magazine at Delhi had been blown up by its defenders; but the explosion was only partial, and most of its contents fell into the hands of the mutineers. European troops were now summoned from all quarters. Several regiments were detached from an expedition which was proceeding under Lord Elgin to China, and the Persian war having been concluded, the troops engaged there were immediately recalled. When intelligence of these events reached the Panjab the mutinous spirit which prevailed among the large body of Hindustani troops there was promptly subdued by disarmament. The Sikhs, though the Panjab had been so recently annexed, continued faithful. But the revolt had spread rapidly elsewhere, and British authority was almost extinct throughout the Bengal Presidency. Everywhere the mutiny was attended with savage excesses — women were outraged, and Europeans, without distinction of age or sex, barbarously murdered. Sir Hugh Wheeler, at Cawnpore, was betrayed by Nana Sahib, maharajah of Bithur, who, after offering aid, took the mutineers into his pay, and raising the Mahratta standard, besieged Cawnpore. The siege, or rather bombardment, lasted from 7–24 June, when a capitulation was agreed to, on a sworn promise of Nana Sahib to allow the garrison to retire to Allahabad. But as the embarkation was proceeding the boats were attacked by the Nana's troops, and the men indiscriminately massacred. The women and children were for the meantime made prisoners. Sir Henry Lawrence was besieged in Lucknow, where he died on 4 July from a wound received in a sortie.

Meanwhile mutineers had been converging on Delhi, and British reinforcements were hastening to the besieging camp on the ridge above the city. After protracted operations and repeated reinforcements on both sides Delhi was taken by assault, 14–20 September. Sir Henry Havelock, who had been engaged in the Persian campaign, had arrived in Calcutta, and immediately set out for Allahabad, to commence operations for the relief of Lucknow and Cawnpore. While his force was victoriously advancing on Cawnpore Nana Sahib, on 15 July barbarously massacred his prisoners, consisting of 210 women and children. Havelock was succeeded in the command at Lucknow by Sir James Outram, who held it till relieved by Sir Colin Campbell, on 17 November. At first it was feared that the mutiny might extend to the Bombay and Madras presidencies, and from this cause and the occupation of the troops in Bengal the mutineers had been left unchecked in Central India. At length columns organized in these presidencies entered Central India, and were united under Sir Hugh Rose. By the operations of these commanders the brave Rani of Jhansi, who died fighting at the head of her troops, was defeated, and Tantia Topi whose military capacity had prolonged Nana Sahib's resistance, was captured and the mutiny was finally suppressed. The war was substantially closed by June 1858, although the complete pacification of Oudh was not effected till the end of the year. See INDIA, EAST INDIA COMPANIES. Consult: Malleson, 'History of the Indian Mutiny' (1897).

Indian Ocean, that body of water which has Asia on the north, the East Indian Islands, Nicobar and the Andaman Islands, Australia and Tasmania on the east, Africa on the west, and the Antarctic continent on the south. The Cape of Good Hope, and the southern extremity of Tasmania may be considered its extreme limits from east to west. Its length from north to south somewhat exceeds 6,500 miles, its breadth varies from 6,000 to 4,000 miles. Its gulfs are the Red Sea, the Gulf of Aden, the Persian Gulf, the Gulf of Oman, the Arabian Sea, the Bay of Bengal, and the Great Australian Bight. Its islands are Ceylon, Madagascar, the Laccadives, Maldives, Socotra, Andamans, Nicobar, Mauritius, Bourbon, Kerguelen's Land, etc. Rocks and coral reefs render navigation dangerous. The Ganges, Brahmaputra, Irrawaddy, Indus, Euphrates, Gadavari, empty into the Indian Ocean. The southeast trade-wind blows between the 10th and 28th parallels of south latitude from April to October, after which date its limits are contracted; south of these are the northwest winds, which prevail almost in the same latitude, in the Atlantic and Pacific. The monsoons are mainly to be found in the north, from the continent of Asia to about lat. 8° S., and from the Mozambique Channel on the west to the western shores of Australia and the sea of China. They blow for six months, changing about the equinoxes. North of the equator the northeast monsoon prevails from October to April, the southwest from April to October; while south of that the northwest monsoon blows while the northeast is blowing on the north side, and the southeast prevails during the time of the southwest monsoon north of the equator. In the hot season, likewise, when the southeast trade-wind recedes south, the northwest monsoon flows between the equator and the 12th south parallel. The hurricanes of this ocean usually range between lat. 9° and 35° S., extending from Madagascar to the Island of Timor. They usually come from the northeast, and travel southwest and south, returning again east. Their season is from December to April.

According to the most recent soundings the mean depth of the Indian Ocean is 2,300 fathoms, or somewhat greater than that of the Atlantic. The greatest depths are in the eastern part to the south of the equator, where it is estimated that there are fully 50,000 square miles with a depth of over 3,000 fathoms. Over 13,000,000 square miles lie between the depths of 2,000 and 3,000 fathoms.

The area of land draining into the Indian Ocean is estimated at 6,813,600 square miles, and the rainfall on this land amounts to 4,379 cubic miles of water annually. The rivers flowing from the Asiatic continent are by far the most important, and they carry a vast amount of detritus into the Bay of Bengal and Arabian Sea, these forming immense deposits of blue mud. Along the African coasts, in depths from 100 to 1,000 fathoms, there are glauconitic sands and muds, and on these as well as other coasts, coral muds and sands, and blue and green muds in the shallower depths. In the deeper parts of the ocean, far from land, there are deposits of red clay, radiolarian-ooze, and globigerina-ooze. Toward the Antarctic continent the ocean bed is covered with a diatom-ooze.

The temperature of the surface waters varies much in different parts of the ocean, at different seasons, and under the influence of different winds. In tropical regions the temperature usually varies from 70° to 80° F., and the yearly range is 7° or 8° F. Off the Cape of Good Hope and Cape Guardafui, the annual range may be from 20° to 30° F. Sudden changes of temperature are often noticed off Cape Guardafui when the wind blows off shore. The cold and deep water is thus drawn up along the coast to take the place of the warm surface water which is driven east by the wind.

The temperature of the water at the bottom is very uniform and subject to little, if any, annual variation. In the Bay of Bengal and Arabian Sea temperatures of 33.7° F. and 34.2° F. have been recorded; these are only very slightly higher than those recorded by the Challenger in lat. 50° S. It is certain, therefore, that this deep cold water is slowly drawn into the Indian Ocean from the Antarctic to supply the place of the warm surface currents that are driven south by the winds.

The currents of the Indian Ocean are less constant than in the other oceans, being largely controlled by the monsoons. Some characteristic coral atolls and islands are found toward the central part, such as the great Maldive group, the Chagos, Diego Garcia, and the Cocos Islands. The tropical shores are generally skirted by fringing and barrier reefs. Christmas Island is coral formation, while St. Paul's, Mauritius, Rodriguez, and others are of volcanic origin, and Madagascar, Ceylon, and Socotra, continental islands.

The Indian Ocean was little known to the ancients. The first Europeans who explored it seem to have been the Phœnicians, who in the 7th century B.C., held the thalassocracy, or marine domination of the Mediterranean. Necho, an Egyptian monarch who flourished about 610 B.C., is reported by Herodotus to have sent some of his vessels, manned by Phœnicians, into the Indian Ocean, then known as the Erythræan Sea, to circumnavigate Africa. This they did, starting from the Arabian Gulf and regaining Europe by the Columns of Hercules. In the 6th century B.C. this sea was traversed by Hanno, a Phœnician admiral of Carthage. There is still extant his account of the voyage which is translated into Greek under the title 'Hanno's Voyage of Circumnavigation.' The Greek historian Arrian has given us an account of the coasting voyage of Nearchus, one of Alexander's generals, from the Indus to the mouth of the Tigris and Euphrates.

Hippalus, an Egyptian navigator who flourished about the beginning of the Christian era, was the first to observe the regular monsoons of the Indian Ocean, and to profit by them. In the 9th century the Arabs made frequent voyages across the Indian Ocean. In 1486 the Portuguese rounded the Cape of Good Hope, and in 1498 Vasco da Gama reached the coasts of India by the same route. In 1521 a ship of Magellan's squadron crossed the Indian Ocean in completing the first circumnavigation of the world, and has since been habitually traversed in a direct line between Arabia and Hindustan.

Indian Paint, the name of two American plants: (1) the golden seal (q.v.) or orange-root, which furnishes a yellow color; and (2) the bloodroot. (See SANGUINARIA.)

Indian Physic, an American plant. See BOWMAN'S ROOT.

Indian Pipe, or **Corpse-plant**, a smooth, waxy-looking, fleshy herb (*Monotropa uniflora*), of the order *Ericaceæ*, widely distributed in dark, rich woods almost throughout North America. It is said to derive some of its food from the roots of other plants, but much is obtained from decaying vegetable matter. From a matted mass of fibrous rootlets the white scaly, but not leafy, stems rise to a height of perhaps eight inches, and bear solitary, nodding, white, inodorous flowers during summer, followed by erect many-seeded fruits.

Indian Races. The numerous peoples of India belong to several distinct groups or families, speaking numerous dialects founded on two or three distinct stocks which are much blended by the intercourse of the different peoples with each other. Previous to the Mohammedan ascendency the dominant race were the Hindus, whose language is spread in various dialects over a great part of India, but who were not the aboriginal inhabitants nor even the first invaders. From the northwest of India, through Kashmir and down the valley of the Indus, and from Tibet through the passes of the Himalayas, the inhabitants of northern Asia have from a very early period migrated southward to the milder and more fertile plains of India. Two great successions of these invasions are recognized as having taken place before the period of authentic history. The first immigrants, of dubious ethnological connections, but commonly known as the Tamil races, appear to have overspread the entire peninsula. Following them the Sanskrit-speaking peoples, called the Hindus, of Aryan speech, dispossessed the Tamil races, and superseded their language in the whole of India north of the Narbada. The Hindus subsequently descended into the peninsula and penetrated as far as Cape Comorin; but though their influence on the languages of Southern India was considerable in the way of introducing new terms, the grammar and construction of the Tamil languages maintained their place in the districts south of the Narbada. Two great groups of languages were thus spread over India, which were further modified by the Mohammedan invasion. The native tribes were not exterminated by these invasions, but are still to be found under various names, as Bhils, Catties, Coolies, Gonds, etc., inhabiting the fastnesses of the mountain ranges in Bengal, the Vindhya and Satpura Mountains, the Ghâts, etc. The hill tribes and other aborigines in all India are estimated at 70,000,000. The leading religion is Brahmanism, the professed creed of the majority of the Hindus and the religion most distinctive of India. It reckoned 207,000,000 adherents in 1901. Large numbers in the north and northwest are Mohammedans (about 62,500,000). Buddhists number about 9,500,000; Parsees or Fire-worshippers 95,000; Sikhs 2,200,000. Among the Hindus the caste system still prevails. European missionaries have long been active, but only a mere fraction of the people are as yet Christians (2,284,380). Education is now making good progress, schools and colleges of all kinds having been established throughout the country. The pupils, however, only number about 4,000,000 in all. There are universities at Calcutta, Bombay, and Madras, besides other two at Lahore and Allahabad.

Indian Red, an impure oxid of iron, used as a pigment by painters. It was originally imported from India, but is now chiefly prepared by roasting ferrous sulphate. The sulphuric acid is expelled by the heat, and the red oxid of iron remains behind. It is very permanent, and the color varies from purplish to a yellowish red.

Indian River, an important stream in the eastern part of Florida, in Brevard and Volusia counties. It connects with the Halifax River at Titusville and extends 100 miles southeast to the ocean at Indian Inlet. Its width varies from 300 feet to 3 miles and it is navigable for vessels drawing five feet. The Indian River is famous for the excellent oranges grown along its banks.

Indian Schools, in the United States, are schools specially established either by private or denominational means or by the national government, for the education of children and youth of the Indian population of this country. For particulars concerning these schools see INDIAN AFFAIRS; INDIAN, EDUCATION OF THE.

Indian Shot. See CANNA.

Indian Summer, the name given to a period of mild summer weather which generally occurs toward the end of autumn. The term first made its appearance in the last decade of the 18th century. During the next decade the phrase was "second summer." This indicates that the spell of weather known by this name was not generally noticed much before 1800. The term Indian summer became established about 20 years after its first appearance, which was in western Pennsylvania, and spread to New England by 1798, to New York by 1799, to Canada by 1821, and to England by 1830. The term is, then, not an Americanism; to write in praise of Indian summer is now a literary convention of three continents.

It is by no means easy to account for the origin of the term. The principal characteristics of the season which it describes are haziness, smokiness, and high temperature. Some explanations of the origin of the term are (1) that the Indians predicted such spells of weather; (2) that the smokiness was produced by Indian fires; (3) that this was the last season of Indian attacks on the settlements of the whites; (4) that the season partook of the Indian character of deceptiveness; (5) that the name was given because one of the seasons of East India was similar in character. Horace Walpole used the term in 1778, not in reference to America, but in relation to weather in the tropics. "Squaw winter" was a name for the spell of cold weather preceding the Indian summer, and perhaps the key to the nomenclature is to be sought in this latter term.

Indian Territory, an organized body of land in the southwest centre of the United States, occupied by Indian allotments and reservations; not a "Territory" in the official sense, as it has no common local government, head, or capital, and sends no delegates to Congress. It lies between Kansas north and Texas south, Arkansas and a corner of Missouri east, and Oklahoma (till recently its own western half) west. It is about 250 miles north to south, and from 75 to 200 east and west. Area, 31,400 square miles, of which 400 are water.

The topography of the district is not yet fully studied, as Indians do not make surveys, and till less than a decade ago the government had no motive but a scientific one for undertaking them. Hence the interior was nearly as little known as central Africa, and as much misunderstood. Even yet, nearly every reference book describes the entire surface as "flat" or "gently rolling," and mostly prairie. But the government survey authorized in 1894, when the reduction to civilized conditions was undertaken, found it to be one fourth mountainous plateau, and two thirds woodland well distributed, mainly through the east and southwest portions. The prairie section is a continuation of the Kansas plains, and occupies most of the Cherokee district north of the Arkansas, and the Creek triangle between the Arkansas and Canadian, with about a fourth of the western half below the Canadian, the rest being timber land. In the extreme northeast is a rugged plateau cut by streams with a southward trend, west of which is a rolling plain with some hills. South of this the Ozark mountain chain, entering from Arkansas, stretches from northeast to southwest across the Territory, with a gradual declension; from about 2,500 feet high near the Arkansas line, they sink to about 1,000 feet in the centre. Their more pronounced elevations are termed the Boston, Poteau, Kiamichi, Sans Bois (treeless), Shawnee, etc. In the Chickasaw territory at the southwest, a set of low elevations from Tishomingo northwest, rising in the sharp spur called the Arbuckle Mountains, and again farther on in the Wichita Mountains of Oklahoma, connect the Ozarks with the outliers of the Rockies. The highest elevation in the Territory is about 3,000 feet above sea-level, the lowest 350. The timber north of the Canadian is mainly confined to a belt in the west, save for cottonwoods, elms, pecans, and a few other sorts along the streams; south of it the timber occupies much the greater portion, even in the west. The eastern half of the Territory is nearly all well wooded, the mountainous parts most heavily so; the woods besides the above are oak, largely in a belt from the Arkansas to the Red called the Cross Timbers (used only for fuel and railroad ties, not for construction), with valuable yellow pine and red cedar on the elevated grounds, and walnut in the bottoms.

The drainage belongs entirely to the Arkansas and Red River systems. The former, flowing across and cutting off a northern cantle, is joined east of the centre at Webber's Falls by the long Canadian, its main affluent, which forms nearly the median line of the Territory and its northern boundary with Oklahoma; and is further fed from the north by the Neosho and the Verdigris joining close together, and by the Illinois near the Canadian. The latter has hardly any water-shed on the south. Nearly the whole southern half of the Territory is drained by the affluents of the Red, forming the entire boundary with Texas; the chief are the Washita in the southwest and the Kiamichi in the southeast.

Geology and Minerals.— Geologically, the Territory may be divided into four sections: (1) The Arbuckle-Wichita region, with an outlying granite field at Tishomingo. This contains coal measures on the north and asphalt on the south; the former is the chief mineral product of the Territory. For the year ending 30 June 1903, there were employed in coal mining 6,091 men and boys; there were in operation for the same year 280 coke ovens, producing 52,625 tons of coke; the coal tonnage for the same year was 3,243,692 tons. Large bituminous asphalt deposits occur in the Choctaw and Chickasaw Nations; these have been worked some, but owing to the want of railroad facilities, and the asphalt trust, the operators have not been encouraged with very great success. There are also sandstone and limestone as well as granite. (2) The Ozark system, Carboniferous and Silurian, containing zinc and lead. (3) The northern prairie, Carboniferous, with coal and large quantities of petroleum. (4) The southern plains cropping over from Texas, underlaid by the Cretaceous, with artesian strata, and sand and marl above. There are valuable gold and silver deposits from which Indians have long made all their trinkets, but they have kept the places secret, to prevent an influx of miners.

Fauna.— The characteristic species are the timber and prairie wolves, panthers and foxes, black bear, deer, prairie dogs, and some smaller game. The wild turkey is the most important bird.

Climate and Rainfall.—The Territory belongs to the southern division by temperature and to the middle one by precipitation. It has a mean winter temperature of 35° to 48°, and a summer one of 77° to 82°; while the rainfall, light in the north like western Kansas, is heavy in the southeast (52 inches), and steadily decreases to the west (about 35 inches at Fort Gibson and 30 in the southwest). But hardly anywhere is it too scant for favorable agricultural conditions.

Agriculture.— Scarcely any region of the United States has greater natural advantages in fertile soil and plentiful water supply. With the opening of the Territory to white settlement and ownership, a vast increase in production will be effected. Until within the present year (1904) the word "ownership," as applied to tenures in the Indian Territory, had a peculiar meaning. To protect Indian interests, white men (except licensed traders and those made citizens by marriage to Indian wives in accordance with the laws of the tribe, or adopted into the tribe by tribal legislature) could not hold land, except as tenants of Indian landlords. The fee to the land in all cases was in the Indian tribes, and even the Indian citizen had only in a sense an occupancy right, owning the improvements absolutely, and cultivating the land practically as a fee simple owner, but always subject to future allotment among all the members of the tribe.

Within the past few years, agreements have been made between the United States and each of the five civilized tribes by which the lands of such tribes are being allotted in severalty to the citizens thereof, with the power of alienation in most of the nations, under certain restrictions, of all, except a certain amount reserved as a homestead, which, in some cases, is inalienable during the life of the allottee, and in others for 21 years, if the allottee lives so long.

In the Creek Nation, 120 acres of an allotment can at present be alienated with the consent of the secretary of the interior, which is being rapidly accomplished, under the rules and regulations prescribed by him, and the allotments are being bought by whites, who are either occupying them themselves or leasing them to other whites. The real Indian, as a rule, is not much of a farmer, and, as the amount granted to an Indian family is generally greater than the head can utilize or cares to utilize, the remainder is leased to some white farmer or cattleman. The whites farm a large proportion of the farms at present. In the year 1890, of the 35,451 farms cultivated by whites only 3,475 were owned by them.

These allotments to the Indians vary in the different tribes. A Choctaw and Chickasaw allotment is 320 acres of average allotable land, and of this the homestead consists of 160 acres of average allotable land, the latter inalienable during the lifetime of the allottee, not exceeding 21 years from the date of the certificate of allotment; the remainder of the land is alienable after issuance of patent, as follows: one fourth in acreage in one year, one fourth in acreage in three years, and the balance in five years; in each case from date of patent.

The Creek allotment is 160 acres, 120 of which is inalienable before the expiration of five years from the 8th day of August 1903, except with the approval of the secretary of the interior; the balance of 40 acres constitutes a homestead, which is inalienable for 21 years, unless the allottee sooner die, in which event the homestead remains for the use and benefit of children born too late to receive an allotment; but, if there be no such issue, then the allottee may dispose of his homestead by will free from restrictions, and, if this be not done, it descends to his heirs free from any limitations.

In all the above cases, as well as in the Seminole Nation, where the land was divided equally between all the members of the tribe, the allottee had the right to select his allotment so as to include any improvements owned by him at the time. At present the allottees can rent their allotments for one year for grazing purposes, and five years for agricultural purposes, and longer in some cases with the consent of the secretary of the interior. Mineral leases may also be made up to 15 years with the consent of the secretary of the interior.

The productions might easily be of the greatest variety in this warm moist region, but the conditions of tenure hitherto did not encourage tenants to diversify crops or improve the condition of farms to revert to Indian owners. The great crop at present is corn, of which in 1900, 30,700,470 bushels were raised; 1,486,820 of wheat, and 1,102,200 of oats were reported. The territory is well within the cotton belt, and 154,850 bales were shipped in 1900. The other products of note were about $1,000,000 of vegetables and fruits. Stock-raising is largely carried on; the value of domestic animals in 1900 exceeded $40,000,000, and included 110,687 dairy cows, 275,000 horses, mules and asses, 17,000 sheep, 10,500 goats and 650,000 swine. It has been known to many that there was a large quantity of oil and gas in this country, but owing to the lack of laws permitting leases and development in the Indian lands, nothing was done until within the last 18 months. The change in the laws, however, has permitted a great deal of development work in some of the towns as well as on outside allotments, and the production is proving very satisfactory to the lessees, as well as the lessors. The field thus far developed is in the northern portion of the Cherokee Nation and the border of the Creek Nation.

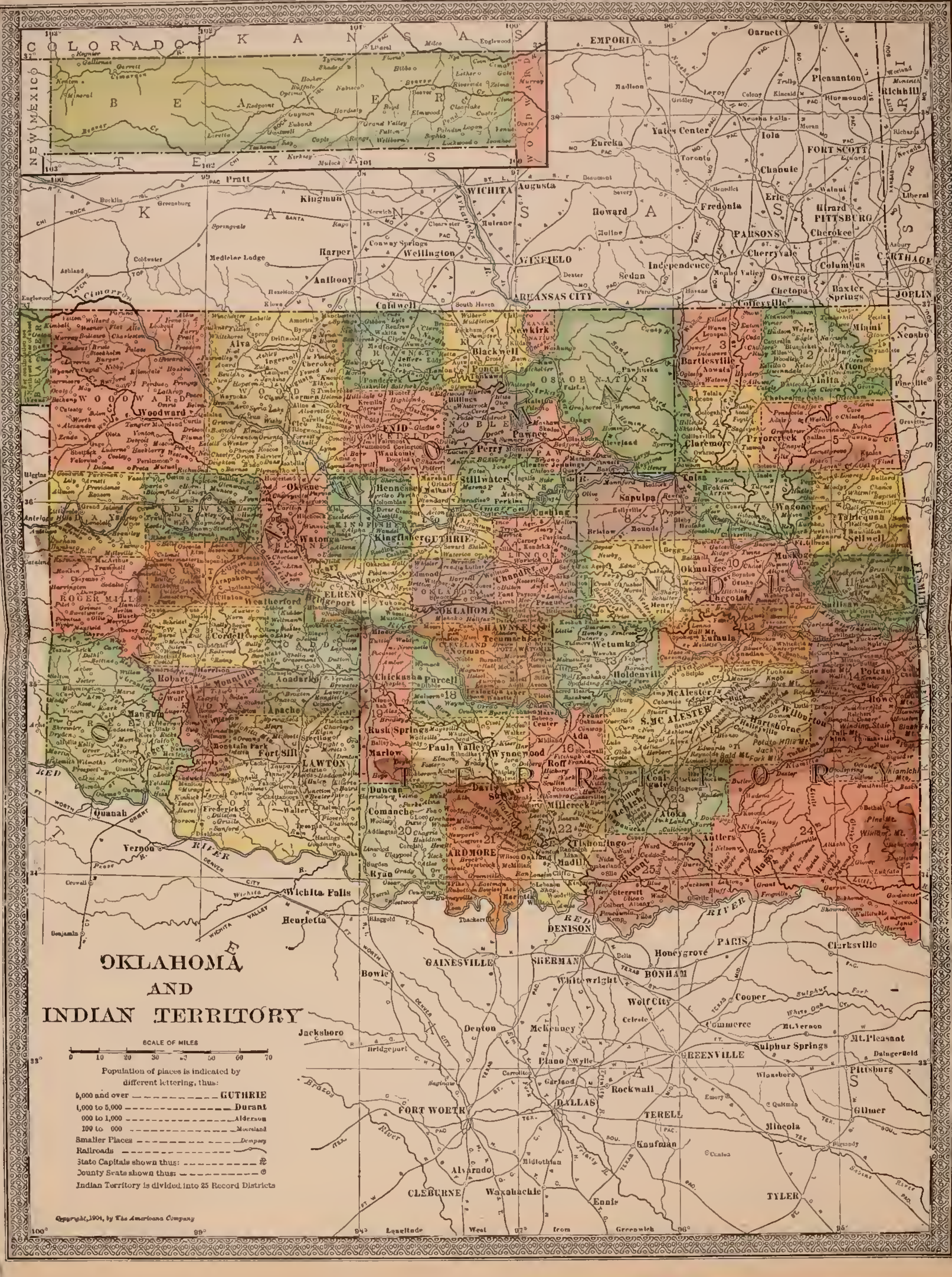
Manufacturing.— The manufactures till recently have been mostly confined to the Indian hand-made blankets, shawls, baskets, and trinkets. But within the decade a considerable genuine manufacture by whites has arisen. With only 20 establishments in 1890, there were 789 in 1900; the capital had grown from $204,329 to $2,624,265, the wage-earners from 167 to 1,714, the value of products from $248,932 to $3,892,181. The one great industry, nearly a third of the total products, was flour and grist milling; next greatest, toward half a million each, were cotton-seed oil and cake; and lumber, saddlery and harness, and car-shop work were also noted.

Railroads.— There are about 1,800 miles of railroad in the Territory; Several great lines cross it, giving the facilities for the vast business growth. The main lines are the Frisco System (St. L. and San F.), the St. Louis, Iron Mountain & Southern, the Missouri, Kansas & Texas, the Choctaw, Oklahoma & Gulf, the Atchison, Topeka & Santa Fe, and the Ft. Smith & Western.

Banks.— In 1902 there were 69 national banks, with capital of $2,779,000, deposits of $5,896,000, cash and other resources $548,000, and loans and discounts of $7,277,000. There were also 20 private banks, having capital of $203,975, deposits of $495,810, cash of $56,354 and loans and discounts of $602,676.

Population.— The total population in 1890 was 180,182; in 1900, 392,060, the increase being all white. The real Indian population had probably somewhat decreased, though it showed on the face a slight increase, from 51,279 to 52,500. But the word "Indian" is misleading; for legal purposes and tribal recognition, any one is an Indian who has even 1-64 or in fact any degree of Indian blood in him; and probably two thirds of the so-called Indians are mixtures of various complexities and elements. The negroes, numbering 36,853, are for the most part the former slaves of the Indians, to whom the United States after the war forced the tribes to grant citizenship and a share of the tribal lands and bounties, or their descendants. These two and the vast white population — married and adopted, leaseholders and tenant farmers, hired farm laborers, business men with permits, coal and railroad company employees, etc.— were distributed among the chief districts as follows (besides 27 Chinese):

Chickasaw Nation, 124,306 whites, 9,066 negroes, 5,872 "Indians." Cherokee Nation, 66,951 whites, 9,162 negroes, 25,630 Indians. Choctaw Nation, 70,332 whites, 10,123 negroes, 10,321 Indians. Seminole Nation, 1,143 whites, 981 negroes, 1,662 Indians. The other reservations — Modoc, Ottawa, Peoria, Quapaw, Seneca, Shawnee, Wyandotte — had 5,762 whites and


OKLAHOMA
AND
INDIAN TERRITORY
SCALE OF MILES
Population of places is indicated by different lettering, thus:
5,000 and over GUTHRIE
1,000 to 5,000 Durant
500 to 1,000 Alderson
100 to 500 Mooreland
Smaller Places Dempsey
Railroads
State Capitals shown thus:
County Seats shown thus:
Indian Territory is divided into 25 Record Districts
Copyright, 1904, by The Americana Company
COLORADO
KANSAS
NEW MEXICO
TEXAS
BEAVER
WOODWARD
KANSAS
MISSOURI
ARKANSAS
OKLAHOMA
INDIAN
TERRITORY
GUTHRIE
OKLAHOMA
ENID
WICHITA
EMPORIA
WINFIELD
ARKANSAS CITY
FORT SCOTT
PITTSBURG
PARSONS
CARTHAGE
JOPLIN
FT. SMITH
S. MC ALESTER
ARDMORE
LAWTON
GAINESVILLE
SHERMAN
DENISON
PARIS
BONHAM
GREENVILLE
DALLAS
FORT WORTH
TYLER
CLEBURNE
Wichita Falls
Quanah
Vernon
Henrietta

1,043 Indians. The concentration of whites in the Chickasaw district had made it the industrial leader of the territory.

The towns which grew there formerly had a peculiar status. They were "white" towns with white men occupying the buildings they had erected, and doing business insecurely, without legal title, but the ostensible owners of the ground were the Indians. The so-called Curtis Bill and the various agreements made with the tribes above referred to have changed this condition, and made it possible for the white man, or any other occupants of towns in the Indian Territory to purchase lots under the various provisions of these bills upon which they owned houses or other valuable improvements. The result is that all the larger towns have been platted, surveyed and sold to the occupants, so that the Indian titles have become almost entirely extinguished. Within a year or eighteen months every town within the limits of the Indian Territory will have been so platted and sold. The changes are so great and constant that statistics are nearly as useless as in a new mining district, but it may be said that the present chief towns are Ardmore, and Chickasha, in the Chickasaw Nation, South McAlister in Choctaw Nation, and Muskogee in the Creek Nation, is the handsomest town in the Territory, with good public schools, churches and four colleges of the four leading denominations — Baptist, Methodist, Presbyterian, and Roman Catholic. These towns now have a population approaching 10,000 each and there are over 20 others with over 1,000. The oldest white settlement is Vinita in Cherokee; the oldest in the southeast is Caddo; the best known has always been Tahlequah, for some generations the capital of the Cherokee Nation.

Internal Conditions and History.— The Territory was part of the Louisiana Purchase. Early in the 19th century many of the Southern Indians, their old hunting grounds invaded by the whites, removed to this virgin forest. In 1832 it was fixed on by the national government as a place for the tribes whom agreements with the Southern States had bound us to deport, and in 1834 special reservations were set apart. The Five Civilized Tribes, as they are called, established governments on the civilized model, with elected legislature, council and governor, courts and schools and responsible financial management, and even newspapers in the Cherokee tongue, with Sequoyah's famous alphabet. But the vast enclave of nearly 70,000 square miles in the heart of a swelling settlement could not be maintained, and the Indians from some constitutional blight do not grow to fill their districts. In 1866 some 5,500,000 acres were purchased of the Indians in the present Oklahoma; on 22 April 1889 over 3,000,000 acres were thrown open to settlement; on 2 May 1890 this and other territory was formed into Oklahoma. Meantime the old system in the eastern part was going to wreck, not so much from the white immigration, following the railroads which began to cross it, as from internal development which was making the primal object of the system a mockery. It was designed to protect the half-helpless Indian from white greed till he could stand on his own feet; in fact, the half-breeds and the intermarried whites were rapidly appropriating everything to themselves, while the full-blood was "crowded out upon the mountain and unproductive land, to take care of himself as best he could." (Dawes Commission.) The tribal governments were under control of these governments and were "recklessly leasing the community lands to cattlemen and coal companies" (Hinton), to railroads, oil and lumber companies, etc. The government, therefore, under the lead of ex-Senator Henry L. Dawes of Massachusetts, set about negotiations to break up the tribal governments, and turn the Territory into a set of ordinary civilized communities with ownership in severalty, protecting the Indian for a time by restraining his liberty of alienation. The Dawes Commission of 1893 began this work; in 1897 the United States extended its judicial power over the district; in 1898 the Curtis Act carried out the work, providing for the enrollment of citizens for allotment of lands, for laying out town sites and incorporating towns with power to elect officers and tax themselves for schools, etc., and giving the President a veto power over the tribal legislatures. The arrangements vary with the different tribes; the Seminoles continue their government after a fashion for the present, the Choctaws and Chickasaws with some modifications till 4 March 1906. The present government consists in reality of four federal judges or one court of appeals and four district courts, with 20 commissioners acting as petty courts and justices of the peace, and a resident Indian Inspector. The statutory code is in the main that of Arkansas.

The educational situation has been a part of the anomalous position of all social matters. The tribes maintained schools and admitted white children on payment of a fee; and the missionaries have operated others. But all were very insufficient, and the tribal schools, once the best of the vicinity, have not kept their quality. The Curtis Act of 1898 for the first time provided a public-school system, in cities and towns, and power of towns to levy taxes for them. In 1900 it was estimated that 50,000 white children were deprived of school advantages. Of academic schools, some claiming collegiate rank, there are good ones in each nation; these have sent many pupils to Eastern colleges. By act of 19 May 1902 municipalities of 2,000 or more inhabitants may issue bonds up to 10 per cent of their assessed valuation for school buildings, sewers, and waterworks on a two-thirds vote and with a 20-year sinking fund. Pop. (1900) 392,062; (1903) fully 500,000. Consult: 'Report of the Dawes Commission' (1903); Curtis Act in U. S. Statutes.

WILLIAM T. HUTCHINGS,
Muskogee, Indian Territory.

Indian or Wild Tobacco, one of the North American lobelias (*Lobelia inflata*), also called asthma-weed and gag-plant,— a tall plant with small light blue flowers quite overshadowed by numerous thin, oval, or obovate dentate leaves; the plant branches as a panicle, is fubescent and the pod is inflated. Its leaves have an acrid taste, and are, as Gray says, "poisonous and a quack medicine"; they were dried by the Indians as a substitute for smoking tobacco, or to mix with it, for the sake of their narcotic properties. The dried flowers still have a place in materia medica. It grows in dry fields and thickets through North America. Compare KINNIKINICK.

Indian Turnip. See JACK-IN-THE-PULPIT.

Indian Yellow, known in commerce as Puree, a pigment of unknown origin which is exported from India, China and probably from Arabia. It comes in the shape of balls, which are outside of a brown tint, and inside of a brilliant yellow. It has the odor of urine, musk or castoreum, is soluble in water or alcohol, and an essential element in its composition is carbonate of euranthin. It is used in India for house decoration, and is valued by artists all over the world as a dazzling pigment.

Indiana ("The Hoosier State"), a north-central State of the United States (No. 19 in order of admission) bounded north by Michigan, south by Kentucky, east by Ohio, west by Illinois; extreme length 276 miles, extreme breadth 177 miles: area (No. 34 in U. S.) 36,350 square miles, 440 water; pop. 1900 (No. 8 in U. S.) 2,516,462, or 70.1 to the square mile. (No. 11 in density.) The State boundary in Lake Michigan is an east and west line 10 miles north of the extreme southern point of the Lake. The Ohio River runs along the southern boundary, but, by a provision of the Virginia cession of Northwest Territory, Indiana extends only to low-water mark on the north bank of the Ohio. In consequence all islands in the Ohio belong to Kentucky, the Supreme Court having recently held this as to Green River Island (Indiana *v.* Kentucky, 136 U. S.) which, although an island at the time of the cession, became connected with the Indiana shore by alluvial deposits, and had been governed and taxed as part of Indiana for many years.

Topography.— The surface of the State is comparatively level, the highest point, in Randolph County, in the centre of the eastern tier of counties, being estimated at 1,285 feet above sea-level, and the lowest, at the southwest corner of the State, being 313 feet above sea-level. The Ohio at the southeast corner of the State is 436 feet above sea-level, and Lake Michigan at the northwest corner is 585 feet above sea-level. From the table-land of the east central part of the State, and western Ohio, radiate low water-sheds separating the drainage basins of Indiana. The northern part of the State is quite flat, the central part slightly rolling, and the southern part rather hilly on account of the valleys cut out by water. There are no mountains, and no large lakes, but there are hundreds of small lakes, chiefly in the northern part of the State.

River Systems.— The southern parts of the State are drained to the Ohio River by the Whitewater and smaller tributaries. The central part of the State — about four fifths of its area — is drained by the Wabash and its tributaries, the most important of which are the White, Tippecanoe, Eel, Salamonie and Mississinewa rivers, and Wild Cat Creek. The northeastern corner of the State is drained by the St. Joseph's and St. Mary's rivers; these unite at Ft. Wayne to form the Maumee, which flows into Lake Erie. The extreme northern part of the State is drained by another St. Joseph's, the Calumet, and smaller streams, into Lake Michigan. A part of the northwestern section is drained by the Kankakee and its tributaries to the Illinois River. The Wabash is navigated to a limited extent, by small boats, as high as Terre Haute, and also the lower part of White River. The remaining streams are not navigable.

Climate.— The climate of Indiana is mild, ranging from an average of 31° F. in the winter months to an average of 76° in summer. The mean temperature is 53°. The average annual rainfall is 43 inches, that in the southern part of the State being slightly in excess of that in the northern part. Serious droughts and destructive storms are rare. In earlier years parts of the State were malarial, but with the clearing of the forests and the drainage of lands this condition has almost wholly disappeared.

Geology.— The earliest geological formation that outcrops in Indiana is the Hudson and Trenton limestone, of the Silurian Age, which appears in the southeastern corner of the State, throughout the Whitewater Valley and the adjacent region. West of this is a belt of Niagara limestone, which broadens at the north and extends entirely across the State, covering all of a dozen counties and large parts of as many more. On the west of this, and also extending to the State line on the north, are belts of Hamilton limestone and sandstone of the Devonian Age. The remainder of the State — the southwestern corner and a broad belt to the north reaching beyond the Wabash — is of the subcarboniferous and carboniferous formations. The northern and central parts of the State are covered by glacial drift, which in some regions is of a depth of 400 feet.

Soils, Agriculture and Forests.— The soil of the State varies in character, but for the most part is fertile. Originally the southern part of the State, and as far north as the Wabash, was covered with a very heavy growth of forest, mostly of hardwood trees. North of this were low prairies interspersed with sand ridges and dotted with hundreds of small lakes. This region is now found very productive of cucumbers, melons and small fruits in the sandy parts. The richest lands are the alluvial valleys of the streams and the drained prairies. The forests have so far disappeared that the State is now encouraging tree planting. Agriculture is the chief industry of the State, the value of farm products in 1899 being reported at $204,450,196. The chief agricultural products were corn, 178,967,070 bushels, wheat 34,986,280 bushels, oats 34,565,070 bushels, potatoes 6,209,080 bushels, hay 3,470,378 tons. The value of animal products was $81,947,922, of forest products $5,235,459, of orchard products $3,166,338, of dairy products $15,739,594. The value of the poultry raised in 1899 was $8,172,093, and of the eggs produced $7,441,944.

Minerals and Mining Industries.— About one fifth of the surface of Indiana is underlaid by coal, workable veins having been found in 19 counties. There are at least 7 distinct veins of workable thickness, varying from 3 to 11 feet. The coals of the State are of two classes — caking or bituminous, and non-caking or block coal. The latter can be burned in blast furnaces without coking. The production in 1901 was 7,019,203 tons, valued at $7,370,163, the State ranking sixth in the Union as to quantity and seventh as to value of the product. The number of people employed in coal mining was 12,968. The mineral product second in value was petroleum, the production of which is a


INDIANA
SCALE OF MILES
0 5 10 20 30 40
Population of places is indicated by different lettering, thus:
25,000 and over....INDIANAPOLIS
5,000 to 25,000.......New Albany
1,000 to 5,000..........Bedford
500 to 1,000..........Orleans
Smaller Places..........Hancock
State Capitals shown thus
County Seats shown thus
Railroads
INDIANAPOLIS
TERRE HAUTE
EVANSVILLE
LOUISVILLE
CINCINNATI
CHICAGO
Lafayette
Logansport
Muncie
Anderson
Marion
Richmond
Elkhart
Joliet
Longitude West from Greenwich

comparatively new industry. In 1901 the oil product of the State was 5,749,975 barrels, valued at $4,795,312. This was largely increased — over one third — in 1902. Next in value of the mineral products of the State is building-stone, of which the chief varieties are the oolitic limestone, the blue Devonian limestone, the gray Niagara limestone, and sandstone. The oolitic, so called because composed of minute fossil shells resembling a mass of fish eggs, has become celebrated throughout the United States on account of its superior qualities. In 1901 Indiana was first in rank in the Union in the production of limestone for building purposes, and fifth in rank as to building-stone of all kinds, the product being valued at $3,028,145. There is also a large production of cement and lime. Good clay is abundant throughout the State, and brick and tile making are extensive industries. Kaolin and glass sand are also found in quantity in several counties, and are profitably mined. Natural gas has been found, by sinking wells, throughout a large part of the State. The supply at one time reached a daily flow of 900,000,000 cubic feet. It served to draw many manufactories to the State, but the pressure is now decreasing. In many places its cessation has been followed by a flow of petroleum. Many other minerals have been found in Indiana, but not in quantities of commercial importance.

Manufactories.— The manufactures of Indiana are chiefly a development of the past 30 years. In the earlier period manufacturing was confined almost wholly to supplies for domestic consumption, and was chiefly conducted at the homes of the people. In 1900 there were reported 18,015 manufacturing establishments in the State, employing 155,956 wage-earners, and producing goods to the value of $378,120,140. The leading classes of manufactures, with the value of products in 1900 and in 1890, are as follows:

	1900	1890
Slaughtering and meat packing	$43,862,273	$27,913,840
Flour and grist mills	30,150,766	31,239,627
Distilleries	22,738,106	9,677,973
Lumber and wood manufactories	34,471,902	32,725,647
Iron and steel (including foundries)	36,566,527	14,285,259
Glass and glassware	14,757,883	2,995,409
Carriages and wagons, and materials	15,891,826	10,531,683
Railroad cars	19,248,909	14,362,711
Agricultural implements	6,415,081	5,756,131
Textiles and clothing	8,618,360	7,736,890
Clay products	4,222,529	3,142,454

It is probable that this rate of increase will not be continued in the next decade, partly because of the decrease of natural gas, partly because of abandonment of plants under trust control, and partly for other reasons. The production of lumber in the State was almost stationary in the past decade, and will probably decrease in this on account of decreasing forest supplies.

Commerce and Navigation.—About one tenth of the people of Indiana (in occupations) are engaged in commerce and transportation. The navigation of the State is limited, being confined to the Ohio River on the south, with the lower Wabash and a small part of the White River, and Lake Michigan on the northwest. The canals of the State are practically abandoned except for water-power. The railroads furnish the chief means of transportation. Commerce is chiefly domestic, but both exportation and importation are steadily increasing.

Fisheries.— Indiana has no fisheries of commercial importance, though it has waters that might be made valuable. Recently laws have been passed for the protection of fish, and some interest is being shown in their propagation.

Railroads and Street Railways.— The railroad mileage of Indiana, in 1902, was 6,651 miles, exclusive of second main and side tracks. In 1850 it was 228 miles; in 1880, 4,320. Railroad lines extend through all but 3 counties in the State. The chief railroad centre is Indianapolis, from which 14 lines radiate. These are connected outside of the city by a belt railway. The valuation of railroad property for taxation in 1902 was $162,797,978. There are street railways in all of the cities and larger towns, the total aggregating 168 miles. In 1899 there began an extraordinary development of electric interurban lines. By the close of 1902 about 400 miles of these were in operation, and 500 miles were under construction, while new lines aggregating over 1,000 miles were projected. These lines have made a material change in the transportation of both passengers and freight, and will apparently furnish large competition with the steam railroads. One of these lines, operating between Indianapolis and Columbus, Ohio, has added sleeping-cars to its equipment.

State Finances.— The assessed valuation of the State in 1901 was $1,397,981,497, from which deductions for mortgage exemption were made amounting to $35,169,250. Individuals are permitted to deduct *bona fide* mortgage indebtedness from their schedules to the amount of $700. The total number of polls was 436,522. The State tax levy for general State government was 9 cents on $100, and 50 cents poll; for the benevolent institutions 5 cents; for sinking fund 3 cents; for State tuition — which is distributed to the school districts for support of the common schools — 11 cents and 50 cents poll; for State institutions of higher education 1⅔ cents; making a total State levy of 29⅔ cents and $1 poll. The reduction of the State debt was begun in 1889, when it amounted to over $10,000,000. On 31 Oct. 1902, it had been reduced to $2,887,615.12, on which the annual interest charge was $101,565.

Banks.— In 1902 there were 137 national banks with $16,618,552 capital, $4,789,956 surplus, $71,533,942 deposits, and $7,210,780 outstanding circulation; 113 State banks with $4,884,400 capital, $915,413 surplus, and $24,240,334 deposits; 5 savings banks, with $7,812,157 of deposits; 37 trust companies transacting bank business, with $4,392,500 capital, $465,947 surplus, and $12,378,348 of deposits, and 203 private banks, which are not required to make returns by the State. Of these last named, however, 68 made returns to the comptroller of the currency, showing $9,671,733 deposits. The only clearing-house organization in the State is at Indianapolis, and the volume of clearings in 1902 was $270,409,456.

Education.— Indiana has always given much attention to education and especially since the adoption of the present school law in 1852. At that time there was created a public school fund, the interest on which was to be distributed to the various school districts. The principal factor in this was the profits which the State had derived from the State Bank of Indiana, amounting to about $3,500,000, to which was added $573,000 of the surplus revenue distributed by Congress in 1836, and several smaller funds. To this additions have been made by fines and other public receipts, until in 1902 the common school fund amounted to $7,978,580.68, to which is to be added the Congressional township fund, derived from the sale of school lands donated by the national government, amounting to $2,465,304.64. This total fund of $10,443,885.32 is held by the several counties, and the interest on it is applied to the support of the public schools. Added to this is a State tax of 11 cents on each $100, and 50 cents on each poll, the proceeds of State liquor licenses and dog licenses, and local taxes assessed by local authorities. From all these sources the actual revenues raised for the public schools in 1902 amounted to $8,585,354.98. The enumeration of children of school age — 6 to 21 years — was 761,801 (of whom 15,002 were colored). A large number of these attended private schools, and the attendance in the public schools for the year was 423,078. The revenue was therefore in excess of $20 to each child in attendance. There were employed 16,039 teachers, and the average number of days of school was, in townships 126, in towns 153, in cities 179, in the State at large 146. The number of public schoolhouses is 5,080 brick, 4,807 frame, 97 stone, and 3 log. The value of schoolhouses and grounds is $22,904,607 and of school apparatus $1,277,455. In these figures are included 704 high schools, which are a part of the public school system. There are also a large number of private schools, notably those maintained by the Roman Catholics and Lutherans for children of all ages, and a number of academies, seminaries, institutes, boarding-schools, military institutions, colleges, normal schools, etc., for intermediate education.

There are three institutions of higher education that receive aid from the State, Indiana University at Bloomington, the State Normal School at Terre Haute, and Purdue University at Lafayette. Indiana University has an income of about $125,000 derived from a State tax levy and the interest on an endowment fund of $600,000 raised by State taxation. It had 1,285 students in 1902. The State Normal is also supported by a State levy, and the city of Terre Haute pays one half the expense of keeping the buildings in repair. It has 1,406 students. Purdue has an income of $150,000 derived from State tax levy and interest on endowments, and including $57,000 paid to it annually by the United States government as an agricultural school. It has 1,180 students.

Among the private institutions for higher education the more important are Wabash College (Presbyterian), University of Notre Dame and St. Meinrad's College (Roman Catholic), DePauw University (Methodist), Earlham College (Society of Friends), Franklin College (Baptist), Hanover College (Presbyterian), Northern Indiana Normal (non-sectarian), Winona Technical Institute (non-sectarian), and the University of Indianapolis. The last named was formed by the union of Butler College (Christian) with the Medical College of Indiana, the Indiana Dental College, and the Indiana Law School, all of which are located at Indianapolis.

An important branch of educational work in Indiana is the development of libraries. A feature of the school system adopted in 1852 was the establishment of a free public library in each township in the State. The State expended $273,000 for books, and the system was received with great public favor, but no provision was made for maintaining or increasing the libraries, and in the pressure of the war times they were allowed very generally to fall into ruin. To some extent these have been replaced as school adjuncts by the libraries of the Young People's Reading Circle, which are found at many of the schoolhouses of the State. These libraries in 1902 contained 436,151 volumes. There has also been a notable development of town and city libraries, 28 towns having accepted donations from Andrew Carnegie, aggregating $660,000, agreeing to maintain libraries in the buildings thus provided. There are 25 others that are maintaining libraries in buildings provided by themselves. The general supervision of library work is lodged in the Public Library Commission, which has charge of a system of traveling libraries furnished by the State. It also maintains a school for the training of librarians engaged in the work in Indiana.

Churches.— The principal religious denominations of Indiana in the order of their strength are the Methodists, Roman Catholics, Disciples or Christians, Baptists, Presbyterians, United Brethren, and Lutherans.

Charitable and Penal Institutions.— The State maintains 9 charitable and 4 penal institutions, at an annual cost of over $1,500,000. Of the former, 4 are hospitals for the insane located respectively at Indianapolis, Logansport, Richmond and Evansville. On 31 Oct. 1902, these had 4,039 inmates. The annual cost of maintenance was $649,834.54, or $173.79 per capita. The other charitable institutions are the Institution for the Blind, Indianapolis, inmates 127, per capita cost $276.40; Institution for the Deaf, Indianapolis, inmates 318, per capita cost $231.66; Soldiers and Sailors' Orphans' Home, Knightstown, inmates 603, per capita cost $174.52; Soldiers' Home, Lafayette, inmates 739, per capita cost $167.30; School for Feeble-Minded, Fort Wayne, inmates 318, per capita cost $127.05. The correctional institutions are the State Prison, Michigan City, inmates 796, per capita cost $133.32, earnings $53,395.86; Indiana Reformatory, Jeffersonville, inmates 923, per capita cost $130.68, earnings $62,350.67; Reform School for Boys, Plainfield, inmates 531, per capita cost $122.13, earnings $298.91; Industrial School for Girls and Women's Prison, Indianapolis, inmates 52 women and 175 girls, per capita cost $191.55, earnings $1,436.69. At the legislative session of 1903 a law was passed for the division of the last named institution and the establishment of a new Industrial School for Girls. The State has the convict-contract-labor system, but efforts have been made to abolish it, and the legislature of 1903 provided for a commission to investigate and report on the subject. The convict labor is all done within the prisons. The State has the indeterminate sentence system with commutation of time for

STATE CAPITOL AT INDIANAPOLIS.

good behavior. In addition to the State institutions each county maintains a poor asylum. In these, and the Marion County asylum for the incurable insane, there were on 31 Aug. 1902, 3,046 inmates, of whom 1,975 were men and 1,071 women. Of these inmates 518 were classed as insane, and 889 as feeble-minded. There are in the State 46 orphans' homes, in which there were on 31 Oct. 1902, 1,565 inmates, of whom 1,025 were boys and 540 girls. At the same date the Board of State Charities reported 811 orphan children maintained in private homes, without public expense.

State Government.— The elective State offices are held for periods of 2 years, with eligibility restricted to 4 years in any period of 6 years, except as to the governor, lieutenant-governor, and geologist, whose terms are 4 years. No one is eligible to the office of governor or lieutenant-governor for more than 4 years in any period of 8 years. The governor's salary is $5,000, with an allowance of $1,800 for house rent. The governor's veto power extends to all laws passed by the legislature, but the veto may be overthrown by a majority vote in both Houses. The legislature meets once in 2 years, and may be called in special session by the governor; regular sessions are limited to 60 days and special sessions to 40 days. The Senate is composed of 50 members elected for 4 years each, and the House of 100 members elected for 2 years each. The members receive $6 a day while in session, and $5 for each 25 miles traveled in reaching the capital and returning home. The State is required to be redistricted for legislative purposes every 6 years. The present Constitution was adopted in 1851, and is very generally considered unsatisfactory, especially as to legislative representation and the location of the appointing power. It can be amended only by the majority vote of both Houses of two consecutive legislatures, followed by a majority vote of the electors of the State.

Congressional Representation.— The State has 13 representatives in Congress.

Population and Divisions.— The population of Indiana territory in 1800 was 5,641, but only about 2,500 of this was within the boundaries of the State. In 1810 the population of the territory, with practically the same boundaries as the State, was 24,520. A territorial census taken in 1815 showed 63,897 inhabitants. After the admission of the State the census returns were as follows: 1820, 147,178; 1830, 343,031; 1840, 685,866; 1850, 988,416; 1860, 1,350,428; 1870, 1,680,637; 1880, 1,978,301; 1890, 2,192,404; 1900, 2,516,462. Of the population in 1900, 142,121 were foreign born, and 57,505 were negroes. The tendency of the negroes is to gather in the cities, more than one fourth of the entire number being found at Indianapolis, and an eighth at Evansville.

The State has 92 counties, whose names and county-seats are as follows:

Adams, Decatur.
Allen, Ft. Wayne.
Bartholomew, Columbus.
Benton, Fowler.
Blackford, Hartford City.
Boone, Lebanon.
Brown, Nashville.
Carroll, Delphi.
Cass, Logansport.
Clark, Jeffersonville.
Clay, Brazil.
Clinton, Frankfort.
Crawford, English.
Daviess, Washington.
Dearborn, Lawrenceburg.
Decatur, Greensburg.
Dekalb, Auburn.
Delaware, Muncie.
Dubois, Jasper.
Elkhart, Goshen.
Fayette, Connersville.
Floyd, New Albany.
Fountain, Covington.
Franklin, Brookville.
Fulton, Rochester.
Gibson, Princeton.
Grant, Marion.
Greene, Bloomfield.
Hamilton, Noblesville.
Hancock, Greenfield.
Harrison, Corydon.
Hendricks, Danville.
Henry, Newcastle.
Howard, Kokomo.
Huntington, Huntington.
Jackson, Brownstown.
Jasper, Rensselaer.
Jay, Portland.
Jefferson, Madison.
Jennings, Vernon.
Johnson, Franklin.
Knox, Vincennes.
Kosciusko, Warsaw.
Lagrange, Lagrange.
Lake, Crown Point.
Laporte, Laporte.
Lawrence, Bedford.
Madison, Anderson.
Marion, Indianapolis.
Marshall, Plymouth.
Martin, Shoals.
Miami, Peru.
Monroe, Bloomington.
Montgomery, Crawfordsville.
Morgan, Martinsville.
Newton, Kentland.
Noble, Albion.
Ohio, Rising Sun.
Orange, Paoli.
Owen, Spencer.
Parke, Rockville.
Perry, Cannelton.
Pike, Petersburg.
Porter, Valparaiso
Posey, Mt. Vernon.
Pulaski, Winamac.
Putnam, Greencastle.
Randolph, Winchester.
Ripley, Versailles.
Rush, Rushville.
Scott, Scottsburg.
Shelby, Shelbyville.
Spencer, Rockport.
Starke, Knox.
Steuben, Angola.
St. Joseph, South Bend.
Sullivan, Sullivan.
Switzerland, Vevay.
Tippecanoe, Lafayette.
Tipton, Tipton.
Union, Liberty.
Vanderburg, Evansville.
Vermilion, Newport.
Vigo, Terre Haute.
Wabash, Wabash.
Warren, Williamsport.
Warrick, Boonville.
Washington, Salem.
Wayne, Richmond.
Wells, Bluffton.
White, Monticello.
Whitley, Columbia City.

Chief Cities.— The largest city in Indiana is the capital, Indianapolis, with a population (1900) 169,164. Next in size are Evansville (59,007), Ft. Wayne (45,115), Terre Haute (36,673), and South Bend (35,999). Each of these cities has a charter specially made for it, though under guise of a general law. These charters are of recent creation — the oldest made in 1891 — and establish advanced forms of city government. Of cities of secondary importance may be named Muncie (20,942), New Albany (20,628), Anderson (20,178), Richmond (18,226), Lafayette (18,116), Marion (17,337), Logansport (16,204), and Elkhart (15,184). There were in all 80 cities and 330 incorporated towns in the State in 1901.

History.— The first-known visits of white men to Indiana were those of Sieur de la Salle, who followed the Ohio River along its southern boundary in 1669–70, and crossed its northwestern corner by way of the St. Josephs-Kankakee portage in 1671. There were no Indians living below the Wabash at that time, and probably not many in the northern part of the State, but those there were LaSalle induced to join his confederacy against the Iroquois, and they all removed to the Illinois River, leaving Indiana practically uninhabited. After some years they began moving to the East, reaching Detroit by 1712, and shortly afterward located at points along the Maumee and Wabash rivers. The Delawares, who afterward lived in the central part of the State, on White River, came there about 1750. It is probable that the French first placed representatives at the Indian villages near the site of Ft. Wayne, and next, about 1720, at Ouiatenon — on the north side of the Wabash just below Lafayette — and that there were stockade forts at these places, but there is nothing to indicate a permanent settlement at either place. The post at Vincennes was established in 1731, largely under the influence of Father De Beaubois, a Jesuit who had been stationed at Kaskaskia. Families located there soon afterward, and it remained a permanent settlement, though there is but one land grant recorded of date prior to 1736. The French posts were small and unimportant, and the history of the region under French and British rule presents no very striking features. In 1778 Vincennes was surrendered to representatives of Gen. George Rogers Clark, and the Wabash country was brought under American control. A recapture by the British was followed by a second taking by Clark in 1779. The region was ceded to the United States by the treaty of 1783, and was included in the Territory northwest of the Ohio River, by the ordinance of 1787. It was thus governed until 1800, when Indiana Territory was formed, including all of the Northwest Territory except Ohio. From Indiana Territory, Michigan Territory was cut off in 1805, and Illinois Territory in 1809, leaving it with practically the present State boundaries. By act of Congress of 19 April 1816, Indiana was authorized to form a State government, and the State was formally admitted by act of 11 Dec. 1816. In the meantime a State Constitution had been adopted on 29 June; State officials had been elected, and the State government had been actually inaugurated on 7 November.

There were almost continuous Indian troubles in the Ohio Valley from 1788 to 1795, when, after Gen. Wayne's successful expedition, peace was made at Ft. Greenville. After that date the American immigration began, and there was no material trouble with Indians until the formation of Tecumseh's confederacy in 1811. The Indians were overwhelmed at the battle of Tippecanoe (q.v.) on 7 November of that year, by the troops under Gen. Harrison, and sued for peace, but when the war with England came on there were Indian hostilities of minor importance continuing until the close of the war in 1815. After that year there was a gradual extinction of Indian titles, the Indians being concentrated in the northern part of the State and finally removed west of the Mississippi. The last removals occurred in 1836 and 1838.

The sobriquet "Hoosier," commonly used to designate the State and its people, was first applied to them about 1830. It was not coined for that purpose, as is commonly supposed, but was a slang word signifying an uncouth rustic, which was in common use in the South at that time, and is still commonly used there in that sense.

The history of the State after its admission was chiefly that of peaceful development — clearing lands, opening roads, building towns and cities, and establishing industries. The most notable feature was the disastrous internal improvement enterprise on which the State entered in 1836. It contemplated transportation routes on 7 main lines, involving the construction of 1,289 miles of railroads and canals. That the routes were fairly well chosen is shown by the fact that they are now practically all occupied by successful railroad lines. The chief defect was that the improvements were mostly high-line canals, and the breaks in these before completion caused such great damage that the estimated cost was enormously increased. The financial panic of 1837 added to the difficulties, and the effects of this were aggravated by the general entering of the States on such enterprises on borrowed capital. The total debts of the several States swelled from about $13,000,000 in 1830 to $207,894,613 in 1842. In 1839 Indiana was unable to realize on the sales of her bonds, and was forced to default interest on those already issued. The canals and roads being unfinished, did not furnish the revenues anticipated. Compromises were effected by which the work done was turned over to creditors, but the State was left with a debt of about $10,000,000 without any property to represent it. In all, Indiana built 453 miles of canals, at a cost of $7,725,262, all of which are now abandoned so far as transportation is concerned. But under private management, and more favorable conditions, the transportation lines developed rapidly, and in 1849 the one railroad originally contemplated was paying 8½ per cent dividends on its stock. In 1860 there were 2,126 miles of railroads in successful operation in the State.

In the war with Mexico, Indiana furnished troops to the number of 4,470. Of these there were killed and wounded 183, and died of other causes 218. When the Civil War began the State occupied an important position, and its resources were utilized to the uttermost by its war governor, Oliver P. Morton. The State furnished 196,363 men for the War, and 784 paid for exemption, or in other words supplied 74.3 per cent of her total population capable of bearing arms, by the census of 1860. Only one State in the Union surpassed or equaled this record, Delaware being credited with 74.8 per cent of her military population. But of the supply credited to Delaware nearly one tenth was in money commutation for exemption, and nearly one tenth of the men in actual service were colored. On the basis of white troops furnished for 3 years or more of service, Indiana supplied 57 per cent of her military population of 1860, and on this basis was surpassed only by Kansas, which is credited with 59.4 per cent. Of the troops sent by Indiana 7,243 were killed or mortally wounded in battle, and 19,429 died of other causes, making a total death loss of over 13 per cent of all troops furnished. One feature of the War period in Indiana, and some adjoining States, was the formation of secret treasonable societies known as Knights of the Golden Circle, and later Sons of Liberty. These attracted much attention at the time, and much comment later, but in reality they were neither extensive nor dangerous. They were organized with a system of "circles within circles," with mysterious rites and blood-curdling oaths, but the masses of the members understood that they were merely for mutual protection, and the treasonable designs were affairs of the inner circles. Among their members there were a number of government detectives who kept the authorities informed as to every movement, and at the final exposure the chief witness for the government was Felix Stidgers, a detective who had become so prominent in the order that he was made "Grand Secretary for Kentucky," and knew all of the secrets of the order. As is aptly stated by Gov. Morton's biographer, "No one can read the history of the secret organizations in Indiana and not feel that, widespread as they were, there was not an instant in which they were not securely within the grasp of the war governor." After the War, Indiana became peculiarly a political battle-ground. In 1868 the Republicans elected Conrad Baker governor by less than 1,000 plurality, and in 1872 the Democrats elected Thomas A. Hendricks to that office by the narrow plurality of 1,148, although Gen. Grant received the vote of the State for President. After 1872 neither party carried the State at two consecutive Presidential elections until after 1896, and neither carried it by a majority of all the votes cast, or by a plurality of as much as 20,000. One result of this close balance has been an improvement in State legislation, the Democrats leading in the legislature of 1889 which they held although they had lost the State offices and the Presidential vote of the State in the preceding year. Indiana in that year adopted the Australian ballot system, being the second State in the Union to do so, with some improvements that have been extensively copied. Other notable reform laws are a school-book law that has made a large reduction in the cost of books used in the common scools; a Board of State Charities law that has greatly improved the charitable and penal institutions of the State; a fee and salary law putting officials on salaries and requiring the payment of all fees into the public treasuries; a compulsory education law; laws for the encouragement of public libraries; laws for the incorporation of cities which provide the most modern modes of city government; laws for the reform of county and township government providing supervisory boards to which local legislation is entrusted and a tax law that has been largely effective in equalizing taxation and has been copied elsewhere. Another feature of Indiana's development that has attracted notice in later years is its production of native writers of poetry and fiction. Among the former may be named Joaquin Miller, John Hay, John James Piatt and James Whitcomb Riley; among the latter Gen. Lew Wallace, Maurice Thompson, Edward Eggleston, Charles Major, Meredith Nicholson, Booth Tarkington and Annie Fellows Johnston. These with lesser lights and some writers of note in other lines form a notable group for a commonwealth whose settlement and development have occurred in little more than a century.

JACOB PIATT DUNN,
Secretary Indiana Historical Society.

Indiana University, the State university located near Bloomington. In accordance with a provision of the State constitution, the legislature passed an act in 1820 providing for the establishment of a State seminary, which was opened in 1824 under the name of Indiana Seminary; in 1827, it was raised to the dignity of a college, and in 1838 the name was changed to Indiana University. In 1868 the university was opened to women, and has since been coeducational in all its departments. The university is the head of the public school system of Indiana, and no tuition fee is charged; the government is by a board of trustees which reports biennially to the governor. Courses are offered in languages, science, and history, all graduates receiving the degree of A.B. The degrees of Ph.D. and A.M. are given for graduate work; there is also a school of law connected with the university which confers the degree of B.L. There is a biological experiment station on Winona Lake, under university control, and a summer session is maintained. In 1904–5 the university reported: faculty, 78; students, 1,538; volumes in library, 53,000.

Indianapolis, Ind., capital of the State, county-seat of Marion County, the largest city in the State and the 21st in the United States; situated on the west fork of White River. It is the centre for 16 radiating railroads, which connect it with Chicago, 184 miles northwest, Cleveland, 283 miles northeast, St. Louis, 240 miles southwest, Louisville, 110 miles south, Cincinnati, 111 miles southeast, Columbus, 181 miles east, New York, 819 miles east, and other termini in Ohio, Michigan, Illinois, and Indiana. Its area is 29.35 square miles.

The site was selected in 1820 as the location of the capital by a legislative commission, and its name was adopted by the legislature in session at Corydon, 6 Jan. 1821. The first plat included a square mile, which was laid out with broad rectangular streets and avenues radiating from a central circle. The character of the plan was undoubtedly influenced by l'Enfant, the designer of the city of Washington, D. C., for one of the surveyors who made the town plat had aided in the work at the national capital. While the additions to the city have not been developed upon the same broad lines, most of them have been treated liberally and the city is noted for its wide streets, well paved and beautifully shaded. The city is very level, nearly all of its area being 700 to 800 feet above sea-level. There are 439.6 miles of platted streets, of which 92 miles are paved, 44 miles with asphalt, 27 miles with brick, 17 miles with wooden blocks, and 4 miles with macadam. The chief business streets are Washington Street, which is a section of the old National road projected and partly completed to run from Baltimore to St. Louis; Market, Maryland, and Georgia streets, all running east and west; Meridian, Pennsylvania, Delaware, and Illinois streets, running north and south, and Massachusetts, Indiana, Virginia, and Kentucky avenues, which are diagonals, radiating from the circular Monument Place. This central circle contains the State's monument to its soldiers and sailors, perhaps the most successful of the innumerable monuments erected by towns, cities, societies, and States in commemoration of the nation's defenders, and is generally regarded as one of the greatest in the world from an artistic point of view. The finest residence streets are Delaware, Meridian, and Pennsylvania. Several other residence districts are particularly well designed and cared for, such as Woodruff Place — a residence park, with esplanades, fountains, statues, etc.,— which has a town government of its own, though completely surrounded by the city; Morton Place, and Meridian Heights.

Public Service.— The first water supply and the first sewer system were constructed in 1870 to 1875, and but little else was done in the way of comprehensive public improvements until after the adoption of the present efficient charter in 1891. Prior to that year the city government had been by mayor and council. Public-spirited citizens who recognized the impossibility of comprehensive public improvements, through the Commercial Club and Board of Trade agitated the adoption of the new charter, which separated the legislative and administrative functions of the city government, making the mayor and his appointees fully responsible for the latter. The first Board of Public Works devised a broad system of improvement, including sewerage, paving and street cleaning, which was supplemented in 1895 by a Park Commission. Under these two boards the progress in the establishment of municipal public works adding to the beauty and convenience of the city has been rapid. As a step preliminary to the era of improvement which began in 1890 a paving exposition was held for the purpose of educating the people of the city regarding paving materials and methods. It was the first ever held in America and attracted attention throughout the country. Official delegations were sent to it from many cities. Prior to 1890 less than two miles of pavements had been laid. The amounts expended since the adoption of the new charter in 1891, including the year 1902, are as follows: for pavements of asphalt, $2,726,668.01; brick, $1,011,214.39; wooden block, $969,652.82; macadam, $154,522.91; gravel, $757,112.50; for alley improvements, $46,655.26; for cement walks, $879,610.21; for brick walks, $65,995.41; making a total for paving of $6,611,431.51. During the same period the expenditure for construction of 105 miles of sewers added to the 23 miles previously in use was $1,828,878.67, and for bridges $240,485.32. The grand total for the 12 years shows $8,680,795.50 expended in these departments of public improvements. The waterworks owned by the Indianapolis Water Company have developed with the city. The system of pumping by direct pressure is used, and a system of filter beds to purify the water taken from White River some miles above the city has been installed. The company has 226 miles of water mains and receives from the city about $85,000 a year for public water and fire protection service. Electric lights are in general use. The city pays about $115,000 a year for about 1,350 electric arcs for street lighting and about $7,000 for about 400 gas and vapor lights. The police department contains 175 men and costs $150,000 a year. The police court, city clerk, city dispensary, and central station are housed in a handsome building of recent construction. The fire department has 100 horses, 9 steam fire-engines, 20 hose wagons, 1 water tower, 1 aerial, and 4 service trucks, 4 chemical engines, and 175 men, and is housed in 22 stations. It costs the city $175,000 a year. There are 50 miles of underground conduits used by the telephone, telegraph and electric light and power companies, and 125 miles of electric street railway lines, owned by the Indianapolis Street Railway Company. The city is the most prominent centre of interurban railway traffic in the United States. Ten systems are in operation or in active construction, and others are early probabilities The city has recently made a contract with the Indianapolis Terminal and Traction Company, lessee of the city lines, under which a great terminal station and belt lines for the passenger and freight traffic of the interurban lines are under construction, the whole making a model system.

Parks and Cemeteries.—The public park system includes 9 parks of nearly 1,200 acres area. Riverside Park, purchased in 1898, contains 950 acres along White River, Garfield Park 108 acres, and Brookside Park 80 acres. Since the establishment of the park commission in 1895 $300,000 has been spent in purchasing new parks and $400,000 in improving them. There are several small parks scattered about the city, such as Military Park, 14 acres; University and St. Clair Squares, each 4 acres; Spades Place, 8 acres; Indianola Place, 2 acres; Highland Square, and combinations of park, boulevard, and residences as Elmwood, Fletcher, Morton, and other places, of which the largest is Woodruff Place, above noted. The city street railway company maintains two parks a short distance outside the city limits. The first cemetery of the city, Greenlawn, has not been used as such for many years and is kept in park form by the Board of Park Commissioners. Crown Hill cemetery, one of the notable cemeteries of the country, embraces over 540 acres. There are also Roman Catholic, Lutheran, and Jewish cemeteries.

Buildings.— The Indiana State House, costing $2,000,000, and built of Indian oolitic stone, is perhaps the most notable building. With its grounds it occupies two large blocks. The county building was completed in 1878 at a cost approximating $1,750,000. The new Federal building, containing the post-office, custom-house, and United States courts, is under construction at a cost of $2,400,000. Other municipal buildings of note are the police building, the public library, containing also the offices of the public schools, and some of the new public school buildings. Tomlinson Hall, a bequest by Dr. J. M. Tomlinson, is a public building, its lower story being used as a market. The Indianapolis Art Association is considering plans for an art museum and school. Among the prominent business buildings ornamenting the city, special mention may be made in the order of their construction of the Commercial Club, Majestic, Law, Stevenson and Newton Claypool buildings and Claypool Hotel. The Columbia Club building is an important feature of one quadrant of Monument Place, which surrounds the Indiana State Soldiers and Sailors' monument. This massive shaft is the central and most notable decorative feature of the city. It is 285 feet high, including the bronze statue, and its base is ornamented with symbolic groups of statuary and reliefs in stone and bronze. It was designed by Bruno Schmitz and cost over $500,000. Four epochs in the history of the State are commemorated by the statues of George Rogers Clark, William Henry Harrison, James Whitcomb, and Oliver P. Morton, which are grouped about its base. The width of Washington street, 120 feet, and of the streets of the original plat, 80 and 90 feet, give space for the best possible display of architectural features.

Transportation.— Indianapolis is the centre of trade for the State. With the completion of the Indianapolis Southern Railway every county in the State except three, which are on the Ohio River, can be reached by railroad in less than one day's travel. Consolidations have placed most of the railroads in two systems. One of these, the Pennsylvania lines west of Pittsburg, now operates the Madison and Jeffersonville lines, which reached the city in 1847, and the Vincennes line, completed in 1868; the Indiana Central to Columbus and the East, completed in 1853, and the Terre Haute and Richmond, later the Vandalia, completed in 1852, and now reaching St. Louis; also a line to Chicago, partly over the Lake Erie and Western. The other, the Big Four system, operates the Bellefontaine road to Cleveland, completed in 1852; the Indianapolis and Cincinnati, which reached the city in 1850; the Indianapolis and Lafayette, of 1852, now reaching Chicago; the Indianapolis, Bloomington and Western to Peoria, finished in 1870, its eastern extension to Springfield, O., completed about 15 years later; the Indianapolis and St. Louis, completed in 1876. Through trains are also run to Benton Harbor, Mich., and to Louisville, over branches of these lines. The

SOLDIERS' MONUMENT.

Cincinnati, Hamilton and Dayton Railroad Company operates the Cincinnati and Indianapolis Junction road, completed in 1868, and the Indianapolis, Decatur and Springfield road to Springfield, Ill. The Indianapolis, Cincinnati and Louisville operates a line to Chicago, which was completed about 1880. The Lake Erie and Western Railroad Company operates the old Peru and Indianapolis road, completed in 1854, and reaches Michigan City, Toledo and Peoria.

The construction of the system of interurban electric roads began about 1890 with the Broad Ripple line, now a suburban city line. The next to be constructed was the Indianapolis and Greenwood line in 1900, now reaching Columbus, Ind. It was quickly followed by the Indianapolis and Eastern, which now connects with lines to Columbus, Ohio, and other Eastern points. The Union Traction Company entered the city with a line from its centre in Anderson in 1901 and completed a new line north to Tipton and other points in 1903. The Indianapolis, Shelbyville and Southeastern is another line completed in 1901. Lines entering the city in 1903 are the Indianapolis and Martinsville, the Indianapolis and Plainfield, and the Indianapolis and Northwestern, reaching Crawfordsville and Lafayette. The Indianapolis and Cincinnati is under construction in 1903 to Rushville, and contracts have been let for the Indianapolis and Southern railroad. The steam railroads are served within the city by the Union Railway Company owning the Union passenger station and the belt railway for facilitating the transfer of freight. The interurban electric roads will in like manner be served by the Indianapolis Terminal and Traction Company owning a large terminal station and belt lines for passenger and freight business.

Manufactures.— During the brief natural gas era in Indiana, Indianapolis benefited largely by the cheap fuel. Since the failure of the gas supply the superior shipping facilities of the city and relatively cheap coal fuel have attracted many more manufactories, and more than 160 industries are carried on in about 2,000 establishments. According to the United States census of 1900 there was invested in 1910 establishments capital amounting to $36,828,114, employing 27,478 persons, including proprietors, and turning out products valued at $68,607,579. Among the most important industries are slaughtering and meat packing, whose product was $18,781,442 in the census year from 7 establishments; iron work of all sorts, $6,727,990; flouring and grist mill products, $3,820,373; carriages and wagons and material therefor, $2,812,498; furniture factory product, $1,685,827; saws, $1,587,827; malt liquors, $1,770,939; printing and publishing books and newspapers, $2,924,385; clothing, $2,190,050, half of it factory product; lumber and lumber-mill products, $1,588,797.

Finances and Banking.— The assessed valuation of the city in 1870 was $24,656,460. In 1891 at the beginning of the era of public improvements it was $93,595,930, and in 1902 it had increased to $132,927,210. The tax rate for State, county, township, city, and school purposes was $2.08 in 1902. The bonded debt is $2,421,000. The city's expenses are about $1,200,000 a year. The post-office receipts are $635,000. The custom-house receipts are $165,000, and the valuation of imports $350,000. There are 14 banks and trust companies, including seven national banks. The aggregate capital of the national banks is about $4,300,000, their surplus about $1,900,000, and deposits over $18,000,000. The six trust companies have a capital of $2,900,000 and individual deposits of about $7,500,000. The trust companies and private banks carry savings accounts. There are about 90 building, loan and savings associations in various stages of progress and liquidation.

Churches.— Indianapolis is the seat of a Roman Catholic bishop, with an auxiliary bishop and of an Episcopal bishop. Including missions there are 12 Roman Catholic churches in the city, 47 Methodist, 16 Presbyterian, 7 Episcopal, 34 Baptist, 10 Congregational, 7 Lutheran, 15 Christian, 3 German Evangelical, 3 Evangelical Association, 3 Friends, 2 United Presbyterian, 5 German Reformed, one each of 11 other denominations. There are 4 Hebrew congregations.

Charities.— In the city there are 15 hospitals, State, county, college, church, charitable, and private, 4 homes for the aged, 6 industrial schools and orphan asylums, 4 homes for women and girls, 16 organized charitable and relief societies, and several such institutions as the Y. M. C. A., Y. W. C. A., Friendly Inn, Bureau of Justice, Humane Society, Day Nursery. The township trustee is a source of official relief. The charities of the city are most efficiently administered, as a result of co-operation between organizations largely brought about through the efforts of Rev. Oscar C. McCullouch. In 1894 a plan of relief for the unemployed, whereby over 5,000 people were provided with the necessaries of life throughout winter without pauperizing influences resulting, became widely known as the "Indianapolis Plan of Relief." The plan was devised and carried out on behalf of the people of the city by a Commercial Club committee composed of Hugh H. Hanna, Col. Eli Lilly, and William Fortune.

Education.—There are 60 public school buildings, including 2 high schools, one giving manual training, in which about 700 teachers are employed, with a total enrolment of about 35,000 pupils; 22 Catholic schools, 2 Lutheran schools, 5 private schools and academies, besides the schools in connection with institutions. The University of Indianapolis is an organization formed in 1896 to unite several institutions of the city, including Butler College, first incorporated in 1850 as the Department of Liberal Arts; the Medical College of Indiana, organized in 1869; the Indiana Dental College, organized in 1878, and the Indiana Law School. There are in all five medical schools, prominent among them being the Central College of Physicians and Surgeons, founded in 1879, two dental colleges, a law school, and 21 business, music and other special schools. The United States Arsenal grounds in the city were purchased in 1902 for a technical institute. Free kindergartens are operated under the Free Kindergarten Association, and 23 kindergartens and a normal school are maintained largely from public funds, besides a number of private kindergartens. The Art Association of Indianapolis maintains the John Herron Art Institute, including art gallery, school, and museum. The Propylæum is a building erected by an association composed exclusively of women.

Libraries.—The most notable libraries are the public library with about 100,000 volumes, under the control of the board of school commissioners, and the State library with about 35,000 volumes. The State law library with 40,000 volumes, and agricultural and horticultural libraries in the State House, and the county library and bar association's library in the court-house may be noted. There are seven branches of the public library, including the newly erected Bona Thompson library of Butler College and many small special libraries of schools and associations.

Newspapers and Literature.— In 1903 the city had 9 daily papers, 23 weeklies, 38 monthlies, and 5 with other periods of issue. The list of trade and class papers published in the city is particularly notable. Indianapolis is the home of many writers whose names are familiar to the public, and it has in recent years become an important western book-publishing centre.

Organizations.— The development of the city has been markedly influenced by organized work in various directions. There are a great number of literary, art, and musical societies, and largely as a result of this activity there is a high standard of cultivation in such matters. This has had a notable influence in establishing in the social life of the city a standard of merit rather than determining the standing of the individual on questions of lineage or wealth. There are many social clubs, among the most notable being the University, Country, Contemporary, and Woodruff Clubs, the Deutsche Haus, the Männerchor, and the Elks, while the Columbia, Marion, and Indiana Clubs are political organizations, established in comfortable homes. The Columbia Club building, located on the Circle, is one of the finest club-houses in the United States. The Commercial Club, with a membership of over 1,000, which owns as its home an eight-story office building, was a dominant force in the new era of progress and development which started in 1890, and devotes itself to the welfare of the city. The Board of Trade, an older organization with a membership of about 500, has also been active in this direction. Organizations of various kinds, commercial, trade, fraternal, social, literary, art, musical, and miscellaneous, number over 500.

Government.— The administrative department is in the hands of a mayor, elected biennially, and of boards appointed by him. The council consists of 15 members elected one from each ward, and 6 members elected at large, with a two-years' term of office. The city clerk and police judge are also elected biennially. The mayor's appointees are the city comptroller, attorney, civil engineer, boards of public works, 3 members of public health and charities, 3 members of public safety, and of commissioners of public parks 4 members. The school system is in charge of a board of 5 school commissioners elected at special elections held for that purpose only.

Population.— Beginning with two or three families in 1819 or 1820, Indianapolis has shown a steady and rapid growth, having a population of 1,085 in 1830; 2,698 in 1840; 8,091 in 1850; 18,611 in 1860; 48,244 in 1870; 75,056 in 1880; 105,436 in 1890; and 169,164 in 1900. Since the last census the increase in population has been still more rapid. The growth of the city has been almost exactly parallel with that of Buffalo, but 20 years behind, and the parallelism promises to continue. In 1890 Indianapolis was 26th in population, and in 1900 it was 21st in the United States.

History.— The first settler, George Pogue, arrived in March of 1819 or 1820. The legislature of Indiana, meeting at Corydon, by committee selected, in 1820, the site for a State capital, and named it Indianapolis, 6 Jan. 1821. Another committee laid out the plat. Lots were slowly sold for several years, and the government was actually removed to the new capital in 1824, the first session of the legislature being held there in 1825. The first State House, modeled after the Parthenon, was completed in 1835. A town government was instituted in 1832 under three trustees, a town council was established in 1838, and a city government under mayor and council in 1847. The present metropolitan form of government, with the mayor as the responsible administrative officer and the council as the legislative branch, was adopted in 1891. A volunteer fire department was formed in 1826, which had much help from the State when the capitol building was completed. The first fire chief was appointed in 1853, and the department was changed to a corps of paid men in 1859. The police department was first established in 1854. The new town began to support a newspaper in January 1822, and a church in 1823. The first railroad reached the city in 1847, and several others were completed in the next four years. Their effect upon the town is seen in the large increase in population. The State capital was the centre of great activity during the War, and there was great expansion in business and manufactures as well as increase in population, most of which was retained. The city did its full share in raising regiments for the War, and is said to have expended a million dollars in contributions, bounties, and war expenses. Camp Morton, on its outskirts, was first a camp for training soldiers, and later for prisoners of war. The free school system now cited as a model by educational experts, was begun in 1853 with the accumulations of several years of special taxation spent in buildings and grounds. The Citizens' Street Railway charter was granted 18 Jan. 1864. The slaughtering and packing business, now so large a factor in the city's trade, began its great expansion in the same year. Public improvements were but few in number until the adoption of the new charter in 1891.

Indianapolis has numbered among her prominent citizens Benjamin Harrison, Thomas A. Hendricks, and others high in the affairs of the national government.

WILLIAM FORTUNE,
Prest. Municipal Engineering Co., Indianapolis.

Indiano'la, Iowa, city and county-seat of Warren County, 18 miles south of Des Moines, on the Chicago, B. & Q. and the Chicago R. I. & P. R.R.'s. There is a large and increasing trade here in grain, butter, eggs, fruit, live stock and garden products. Here is the seat of the Simpson Methodist Episcopal College, founded in 1867. The electric light plant is owned by the city. Pop. (1890) 2,254; (1900) 3,261.

Indians, American. Columbus, when he discovered America, believed he had reached a part of Asia, or of India, and in a letter of February 1493 wrote of «the *Indians* (in Spanish, *Indios*) I have with me.» Thus the aborigines of the New World came to be called «Indians» (French *Indiens*, German *Indianer*, etc.), or, to avoid confusion with the natives of India, "American Indians," for which rather cumbrous term the word "Amerinds," susceptible of many modifications by means of prefix and suffix, and easily adaptable to the exigencies of modern European and other civilized languages, has been suggested by an eminent American lexicographer and is used more or less by a number of anthropologists and other writers. The word "American," originally applied to the Indians, is still somewhat in use, and Dr. D. G. Brinton styled his comprehensive sketch published in 1891, 'The American Race'; but its employment to designate the white population of the continent seems to bar its ethnological application to the aborigines without some qualifying term. By some writers the Indians are called the "Red Race," and, more popularly, "Redskins" (in French *Peaux-Rouges*, in German *Rothäute*), or "Redmen," terms of no exact somatic significance. A few American, and many European, ethnologists continue to separate the peoples who created the civilizations of Mexico, Central America, Peru, etc., from the Indians, while others exclude the Eskimo, and others, again, the "Mound-Builders." But somatic, cultural, and linguistic evidence justifies the conclusions of Powell and Brinton in using the term "American Indians" to include not only the aborigines now existing, or known to have existed since the discovery, but also all the pre-Columbian peoples of America concerning whom we have little data,— the most divergent are no more than sub-varieties of American man. This unity is the great ethnic phenomenon of American aboriginal history. The study of Indian languages, archæological remains, arts, and industries, games, social and religious institutions, mythology and folk-lore indicates a general psychic unity, while the somatic diversities do not transcend those observable in the other great races of mankind. Whether one investigates, as McGee has so admirably done, the Seri of the Gulf of California, who represent about the lowest type of savage culture on the North American continent, or the Mayas of Yucatan, whose approach to a phonetic system of writing touches the high-water mark of Amerindian achievement, one receives the same impression: that it is a question not of very recent civilized or semi-barbaric intruders from Asia or from Europe, but of a race (whatever their remoter origins may be) who have dwelt for ages in an American environment, which has shaped them into the peoples met with by the whites at the time of the Columbian discovery. The limited effect of the "discovery" of the Norsemen may be held to discount any "discoveries" by Europeans before them; while, on the other hand, the American-Asiatic contact revealed by the investigations of the Jesup North Pacific expedition is as much American as Asiatic, and the "Bering Sea" culture is a local phenomenon no more fundamentally indigenous to the Old World than to the New. The arguments in favor of a trans-Pacific Malayo-Polynesian influence upon primitive America are no stronger than those that can be adduced to support the contrary opinion. The culture of the "Mound-Builders" does not in any way transcend the possibilities of what the American Indian was and is yet capable of, nor is it necessary to assume the presence of foreign culture-elements to explain the civilizations of Mexico, Yucatan, Colombia, and Peru. Since very primitive times America has been essentially the "ethnic island" of Brinton, Keane, and other investigators. The impress of America has been upon the aborigines so long that physically, socially, linguistically they have been "Americanized" in so marked a fashion that their right to be considered one of the "races" of mankind is not to be dismissed without cause. To group them merely as a branch of the Mongolian, or, again, of the Malay "race," is to obscure many points of great importance in the prehistory of America or to ignore them altogether. The American Indian is in too many respects a modified (and anciently so) variety of mankind to be thought of as expressing in any serious degree the type of the Mongolian or the Malay.

Language and Culture.— The ethnic isolation of the American race has already been noticed. The apparent independence of the culture-centres of North and South America is another interesting fact. With the exception of a few possible traces of the presence of tribes of Arawak lineage in ancient Florida and the spread of art-*motifs* of the Caribbean type over a portion of the adjacent Gulf region, no direct evidence of the influence of South America upon North American culture is forthcoming. The independent origin of Mexican and Peruvian civilizations seems certain, and convincing proofs of the community of origin of Peruvian and Chibchan and even of Mexican and Mayan are lacking. The possibility of inter-cultural relations having once existed is, however, not to be denied. The Pacific coast, from the Gulf of California to the Argentine and Chile, has been a nursery of culture just as the Mediterranean area was for the Eurafrican peoples. There has been a Mexico and a "greater Mexico," a Peru and a "greater Peru," while the Mayas and the Chibchas have also had their extensive spheres of influence. To the Pueblo culture north of Mexico corresponds the Calchaqui culture south of Peru. On the northern borders of Mexico still lie the savage Seri and Yaqui, and the culture-areas of Colombia and Peru have also their primitive frontagers,— and this was so in the time of the ancient Montezumas and the Incas. This juxtaposition of civilization and savagery is one of the characteristic facts of American ethnology, as it was once likewise of the history of the Mediterranean area in the Old World. In both areas we meet with a large number of peoples who rose above savagery, but, for some reason or other, failed to develop high stages of culture. That the more material evidences of civilization should be so confined to the Pacific coast is, to some writers, a significant fact suggestive of Asiatic relations; but the intellectual power of such Atlantic peoples as the Iroquois and some of the Muskhogean tribes of North America, and the moderate but distinct progress made by a few of the Brazilian tribes of the Atlantic area relieve us from any such theory, environment, and historical incident in America quite sufficing to account for the phenomena involved. (See Ethnology.) Certain other resemblances and contrasts in the various aspects of aboriginal culture in America merit attention here. At the extreme north of the continent, one stock, the Eskimo, with closely related forms of speech, kindred mythology, and folk-lore, similar customs and social institutions, etc., extends in a narrow line from east to west, even overflowing into Asia, while at the extreme south (much less extensive) the Fuegians, numbering altogether less than 10,000, are divided into three distinct linguistic stocks (Yahgans, Onas, Alikulufs). Eastern and northern North America, and the corresponding regions in South America, are areas of wide distributions of single stocks. The Pacific coast of America, as compared with the Atlantic, is a place where, in diverse spots, languages seem to pullulate. This region (including the narrow limits of Mexico and Central America) contained probably more independent tongues than all the rest of the continent. Indeed, within the present bounds of the State of California alone 22 such tongues are found, with several others in Nevada, and in Prof. Cyrus Thomas' list of the stocks of Mexico and Central America, made in 1902, nearly 30 are recognized.

The multiplicity of languages in primitive America has called forth explanatory theories of various sorts, among them Horatio Hale's suggestion of the origin of linguistic diversity through the spontaneous language activity of the child. As Gatschet has noted, the very existence of such a multitude of tongues all over America is proof that neither in ancient nor in later times has this continent been the scene, on a vast scale, of the suppression and extermination of peoples one by the other, which have been characteristic features of Old World history. In spite of the common belief to the contrary, mutual destruction was probably never so rife as when the coming of the white man introduced new means of warfare, and, crowding the natives for subsistence, led them to attack each other more effectively. The recent studies of Dixon and Kroeber in California have strengthened the view of a certain parallelism of language and culture.

That some culture-elements, however, have spread from tribe to tribe is shown by the distribution of certain inventions discussed by Mason, the northward movement of such plants as maize, the use of tobacco, the transmission of many themes and incidents of myths and legends (as demonstrated by Boas), the modes of occurrence of certain art-forms, etc. Interminglings of culture of a more or less local, though often of an extensive, character, have taken place in the Bering Sea area, in the Columbia River region, in the habitat of the Pueblo Indians of New Mexico and Arizona, in the southeastern part of the United States, in the Isthmian region of Central America, in Ecuador, in the Pampean country of the Argentine, etc.,— larger and more significant intermixtures have, perhaps, taken place in earlier times in Mexico, the Mayan country, Colombia, and Peru. A number of the borrowed culture-elements may be explained as the result of trade and commerce, by means of which useful or artistic objects, food, plants, etc., were easily conveyed long distances under primitive conditions. The wide-spread custom of adoption would also account for not a few instances of alien culture-grafts. So, too, with the exogamic marriage, when the women are culture-bearers. Where language-mixture has taken place it is more or less easily detectable in most American Indian stocks and tongues. When families of the same stock possess, in the one case (Algonkian) dialects which differ as much as Micmac and Blackfoot, in the other (Iroquoian) as much as Cherokee and Mohawk, we are justified in looking for culture-differences as well in such widely separated peoples. Doubtless the results of careful somatological, sociological, and other investigations of the various tribes of American aborigines will furnish us ultimately with diverse ways of classifying them. At present, however, the most serviceable classification is a linguistic one, the result of the labors of Major J. W. Powell and the Bureau of American Ethnology, supplemented by the work of Dr. D. G. Brinton.

Linguistic Stocks.— The Bureau of American Ethnology has issued the Powell map showing the extent of the 58 linguistic stocks north of the Mexican boundary line: that is, of families or forms of speech, so independent of one another as to be catalogued as distinct stocks: apparently no more closely related than the Aryan and the Semitic families of the Old World. For South America no such authoritative map is extant. The exact number of such linguistic stocks in America has not yet been determined with certainty, but the following list probably represents the best view of the matter to-day:

1. Adaizan (Louisiana)
2. Algonkian (northeast North America)
3. Alikulufan (Tierra del Fuego)
4. Andaquian (Colombia)
5. Arauan (northwest Brazil)
6. Araucanian or Aucan (Chile)
7. Arawakan (Central and N. E. South America)
8. Atacameñan (S. Bolivia)
9. Athapascan (N. W. Canada, etc.)
10. Attacapan (Louisiana)
11. Aymaran (S. Peru, N. Bolivia)
12. Barbacoan (S. Colombia)
13. Beothukan Newfoundland)
14. Betoyan (Colombia-Venezuela)
15. Caddoan (Texas)
16. Calchaquian or Catamareñan (N. Bolivia)
17. Canichanan or Canisianan (N. Bolivia)
18. Carajan (S. Brazil)
19. Cariban (N. E. South America)
20. Cayubaban (N. Bolivia)
21. Charruan (N. E. Argentine)
22. Chetimachan (Louisiana)
23. Chiapanecan (Central America)
24. Chibchan (Colombia and Isthmian region)
25. Chimakuan (Washington)
26. Chimarikan (California)
27. Chinantecan (Oaxaca, Mexico)
28. Chinookan (Washington)
29. Chiquitan (N. Bolivia)
30. Chocoan (N. W. Colombia and Isthmus)
31. Chumashan (California)
32. Churoyan (Colombia-Venezuela)
33. Coahuiltecan (Mexico-Texas, mouth of Rio Grande)
34. Coconucan (S. Colombia)
35. Copehan (California)
36. Costanoan (California)
37. Cunan (Isthmus of Panama)
38. Doraskean or Changuinan (Panama and Nicaragua)
39. Eskimoan (Northern fringe of North America)
40. Esselenian (California)
41. Guahiban (Venezuela)
42. Guaraunian (Venezuela)
43. Guaycuruan (Gran Chaco, Paraguay-Bolivia)
44. Huavean (Isthmus of Tehuantepec)
45. Iroquoian (Ontario-Erie region, with offshoot in S. E. United States)
46. Itonaman (Bolivia)
47. Jivaroan (Peru, Ecuador)
48. Kalapooian (Oregon)
49. Karankawan (Texas)
50. Kechuan or Quechuan (Peru)
51. Keresan (New Mexico, Pueblos)
52. Kiowan (Nebraska-Wyoming)
53. Kitunahan (S. E. British Columbia, N. Idaho)
54. Koluschan (Alaska)
55. Kulanapan (California)
56. Kusan (Oregon)
57. Laman (Peru)
58. Lencan (Central America
59. Lulean (Gran Chaco)
60. Lutuamian (Oregon)
61. Mainan (Ecuador, N. W. Brazil)

A GROUP OF UTE INDIANS.

62. Mariposan (California)
63. Matacoan (Gran Chaco)
64. Matagalpan (Nicaragua)
65. Mayan (Yucatan, Chiapas, Guatemala, etc.)
66. Mocoan (Colombia)
67. Moquelumnan (California)
68. Mosateñan (Bolivia)
69. Moviman (Bolivia)
70. Muskhogean (S. E. United States)
71. Natchezan (Louisiana)
72. Onan (Tierra del Fuego)
73. Otomian (Central Mexico)
74. Otomacan (Venezuela-Colombia)
75. Palaihnihan (California)
76. Paniquitan (Colombia)
77. Panoan (Peru)
78. Payaguan (Gran Chaco)
79. Payan (Honduras)
80. Peban (Peru)
81. Piman (S. Arizona, N. W. Mexico)
82. Piaroan (Colombia-Venezuela)
83. Puinavan (Colombia-Venezuela)
84. Pujunan (California)
85. Puquinan (Peru)
86. Quoratean (California)
87. Salivan (Colombia-Venezuela)
88. Salinan (California)
89. Salishan (British Columbia, etc., to the south)
90. Samucuan (S. Bolivia)
91. Sastean (California)
92. Serian (N. W. Mexico)
93. Shahaptian (Oregon-Idaho)
94. Shoshonean or Uto-Aztecan
95. Siouan (Carolinas and Missouri Valley)
96. Skittagetan (Q. Charlotte Is.)
97. Subtiaban (Nicaragua)
98. Tacanan (Bolivia)
99. Takilman (Oregon)
100. Tañoan (New Mexico, Pueblos)
101. Tapuyan (S. Central Brazil)
102. Tarascan (Michoacan, Mexico)
103. Tequistlatecan (Oaxaca, Mexico)
104. Ticunan (N. W. Brazil)
105. Timotean (Venezuela)
106. Timuquanan (Florida)
107. Tonikan (Louisiana-Mississippi)
108. Tonkawan (N. W. Texas)
109. Totonacan (Vera Cruz, Mexico)
110. Tsimshian (British Columbia)
111. Tsonekan (Patagonia)
112. Tupian (E. Central Brazil)
113. Uchean (Georgia)
114. Ulvan (Nicaragua)
115. Waiilatpuan (Oregon)
116. Wakashan or Kwakiutl-Nootka (British Columbia)
117. Washoan (Nevada-California)
118. Weitspekan (California)
119. Wishoskan (California)
120. Xicaquean (Honduras)
121. Xincan (Guatemala)
122. Yahganan (Tierra del Fuego)
123. Yakonan (Oregon)
124. Yanan (California)
125. Yaruran (Venezuela)
126. Yukian (California)
127. Yuman (Lower California, Arizona)
128. Yucan (Peru)
129. Yurucarean (Bolivia)
130. Zaparoan (N. W. Brazil)
131. Zapotecan (S. E. Mexico)
132. Zoquean (S. E. Mexico)
133. Zuñian (New Mexico)

Of the stocks enumerated, 51 belong to South America and 56 to North America north of Mexico. The status of investigation is such that the number assigned to South America is approximate only, and may ultimately be considerably increased or reduced. Some stocks, like the Adaizan, Beothukan (exterminated by whites), Chetimachan, and a few of the minor stocks in South America, are extinct or nearly so. A goodly number — including, for example, many of the stocks on the northwest Pacific coast, the Texas-Louisiana country, parts of Central America and the Pacific region of South America — were or are of limited area; others, like the Eskimoan, Athapascan, Algonkian, Siouan, Shoshonean, Arawakan, Cariban, Tupian, etc., are noteworthy by reason of the extent of their domain. Some, like the Kootenay, consist of practically a single language, while others, like the Algonkian, Siouan, Athapascan, Salishan, Aztecan, Mayan, Arawakan, Tupian, Cariban, etc., have developed numerous dialects, sometimes only remotely resembling the mother-tongue. Doubtless, with the perfection of linguistic research, some changes will be made in the list of stocks, or perhaps a method of groups may be devised in which stocks showing certain resemblances other than those of a lexical nature may be classed together. The studies of Dixon and Kroeber indicate the possibility of this for the numerous Californian stocks, and a similar result may be predicted for certain other regions of the continent. As said, all the American Indian stocks are far from being of the same significance, many of them having hardly any historical importance. A few words about some of the most typical and most important must suffice here.

North American Stocks.— The Eskimoan stock is noteworthy by reason of being the first of all the aboriginal peoples of America to be visited by representatives of European culture,— the Norsemen in the 10th century, etc. It is also the only primitive people who, unaided by civilized races, occupy a portion of both hemispheres, for the Eskimo stretch from Labrador to a considerable distance within the borders of northeastern Asia. They illustrate the victory of man over a difficult environment, for they are a merry and sociable people in spite of the inclement and depressing character of their arctic surroundings. They have also a marked sense of humor, as the institution of the nith-song, or settlement of disputes by public judgment of the comparative merits of the two parties in competitive singing, would indicate,— the themes of the singing being the dispute and sarcasm at the expense of the opponent. The Eskimo are also very skilful carvers and engravers of ivory, their spirited drawings of animals, etc., resembling in marked fashion the similar art-products of prehistoric man of the French river-drift, a likeness which has induced some authorities (Dawkins, De Mortillet) to assume a racial connection between these two peoples. Mason has recently suggested that these drawings owe a good deal to the contact with Europeans (introduction of iron tools, etc.), but Boas considers that their close resemblance to the bark and rock pictographs of the Indians forbids the conclusion that these drawings are of other than native origin. The unity of language, and (to a considerable degree) of custom, mythology, etc., among the various Eskimo tribes is remarkable when one remembers the extent of their distribution. The use of the Eskimo dog with the sledge, the kayak, the harpoon, the snow-house (iglu), and the invention of many mechanical devices, show them to be gifted with native intelligence.

The Athapascan stock is notable for the contrasts in culture and diversities of culture-capacity presented by its members. Some of the Athapascan peoples of northwestern Canada and Alaska are among the lowest types of American man, and a few of them have hardly yet come to knowledge of the white man, the advent of the fur-trader being, according to J. M. Bell, a matter of the last two or three years in part of their domain. To this stock belong also the Apaches, once the terror of the civilization of the Southwest, whose depredations, in earlier times, disturbed the peace of the native civilization of Old Mexico. It is fair to say, however, of them that individual Apaches (Dr. Montezuma, for example) shows good capacity for adopting the chief elements of white American culture. Several small tribes of Athapascans are scattered through Washington, Oregon, and California, the most noteworthy being the Hupa, on Trinity River, the "Romans of California," as they have been called. The Navaho, who have assimilated to a considerable extent the culture of the whites, were good agriculturists before the coming of the Spaniards, from whom they adopted the sheep, a fact which modified their environment and their response to it. The contrast between the rude tribes of the "Barren Grounds" of Canada and the Navaho of New Mexico and Arizona is, as Horatio Hale pointed out, one of the most remarkable instances of culture-change by process of environmental variation on record. The recent loan-word *Klondike* comes from an Athapascan dialect.

The Algonkian stock, members of which were found from Labrador to South Carolina, and from the confluence of the Ohio and Mississippi northwesterly to the foot of the Rocky Mountains and the borders of the domain of the Athapascans, are of interest for many reasons. The great area over which they are spread has brought members of this stock into contact with many other Indian peoples,— the Naskopi, Crees, and northern Ojibwa with the Eskimo; the Micmacs with the Eskimo and Beothuk; the Ojibwa and related tribes of New England, New York, and Pennsylvania, the Lenâpé of New Jersey, the Nanticokes, Powhatans, etc., of Maryland, Virginia, and the Carolinas with the Iroquois (who, both north and south, form an *enclave* in the Algonkian territory); the western Ojibwa, etc., with the Siouan tribes in the upper Mississippi region, and in the southern Mississippi country the Illinois and kindred peoples with the Caddoan and other stocks; the Blackfoot in the extreme northwest of the Algonkian area with the Athapascan Sarcees and the Kootenay. The aberrant Cheyennes and Arapaho (recently studied by Kroeber) belong to the Algonkian stock. Another evidence of the importance of this stock is the fact that many other stocks and tribes are known to us by names of Algonkian origin: *Eskimo, Athapascan, Siouan,* and possibly also *Iroquoian* and *Muskhogean; Chipwyan, Assiniboin, Mohawk,* etc. Of all the Indian stocks of North America none have made a greater impression upon the whites (French and English) than the Algonkian. This is seen when we remember that Powhatan and Pocahontas, King Philip, Pontiac, Tecumseh, Black Hawk, etc., the Indians who have appealed most to our historians, novelists, and dramatists, have all been of Algonkian lineage. This stock has also contributed to the vocabulary of spoken and written American-English some 140 words, of which many are hardly felt to be of Indian origin: *Carcajou, Caribou, Caucus, Chipmunk, Hickory, Hominy, Manitou, Maskinonge, Menhaden, Moccasin, Moose, Mugwump, Opossum, Pappoose, Pemmican, Persimmon, Powwow, Pung, Raccoon, Sachem, Skunk, Squash, Squaw, Tammany, Terrapin, Toboggan, Tomahawk, Totem, Tump, Tuxedo,* etc. A people who have contributed to such a cosmopolitan tongue as English important words like *Caucus, Mugwump, Tammany,* and *Totem*, deserve more than passing mention. Our civilization owes to them also more material things than these,— tobogganning and lacrosse, canoeing (in large measure) and numerous devices of agricultural and domestic industry adopted by the early colonists from the aborigines. From the Algonkian Indians the whites also learned how to make maple sugar and maple syrup. (See AMERICANS.)

The Iroquoian stocks are famous through the confederacy of the "Five (afterward Six) Nations" and the great "League of the Iroquois" (so sympathetically studied by Morgan). Their physical characteristics at the time of the war of 1861–5 were such that they exceeded the recruits of all other races (white included) in points of excellences demanded by military requirements. The high position occupied by woman among the Iroquois lifts them above many of their Amerindian kindred. The story of the Iroquoian statesman of the 16th century, Hiawatha, and his founding of the League that was to end all war and unite all the nations in one lasting bond of peace is a historical fact, which Longfellow's confusion of the Iroquoian patriot with the Algonkian demi-god Manabozho cannot altogether obscure. In political and social organization the Iroquoian tribes attained a position that was largely *sui generis*. The tale of their long struggle to preserve their independence against the whites will be found in Morgan and Parkman, while the Jesuit Relations contain their reaction to the efforts of the missionaries to convert them to the Christian faith, as well as the account of the fratricidal strife resulting in the extermination of the Hurons. The fame of the Iroquoian tribes (for example, Mohawks) as fierce warriors has caused the general public to neglect them in other respects. Through the researches of Horatio Hale and others it has been shown that the Cherokee of the Carolinas (recently so well investigated by Mooney) belong to the Iroquoian stock, together with several minor tribes in the south Atlantic region. This stock has produced a number of eminent men: Hiawatha (q.v.), Red Jacket (q.v.), Joseph Brant, and Dr. Oronhyatekha (q.v.), the present head of the Independent Order of Foresters; J. N. B. Hewitt, of the Bureau of American Ethnology at Washington, is also of Iroquoian blood. Sequoia, the half-blood Cherokee, who invented the alphabet now in use by his people, deserves mention here likewise. As compared with the prominent part played by them in the French-English and colonial wars, and in the Revolutionary War, War of 1812, etc., the Iroquoian people left little impression upon the culture and the speech of the English in America,— the words from their language which have crept into our own have been originally place-names: *Chautauqua, Conestoga* (horse), *Saratoga* (trunk), etc. To the French of Canada they have given a few more words. In the place-names of the region about lakes Ontario and Erie (Ontario, Niagara, Erie, Cataraqui, Oswego, Cayuga, Seneca, Onondaga, Tuscarora, Oneida, Ticonderoga, Tonawanda, Genesee, Ohio, etc.) the Iroquoian peoples are generously remembered, while their Cherokee kinsmen in the south have likewise left their impress upon the topographical nomenclature of the country. In both New York and Ontario, where considerable numbers of Iroquois still live, with no immediate danger of dying out, but particularly in the latter province on the Grand River Reserve, the pagan and Christianized Iroquois have existed side by side in the same community for so long a time as to make this phenomenon, the details of which have been pointed out by David Boyle, of great value to sociologists. See CANADA, INDIANS OF.

THE SNAKE DANCE OF THE MOKI INDIANS.

The Muskhogean stock (Choctaws, Chickasaws, Creeks, Seminoles, etc.) as their subsequent career in the "Civilized Nations" of the Indian Territory with the Cherokee has shown, are among the most gifted intellectually of the aborigines of America. Gatschet notes as characteristic of this stock: Their color-symbolism for peace and war, their totemic system, the use of the "black drink," the doctrine of the "Master of Life," sun-worship, mound-building (some regard this stock as having been one of the so-called "Mound-Builders"), the ceremony of the *busk*, etc. This stock has had many intertribal wars, and the Creeks and particularly the Seminoles of Florida are famous for their contests with the whites.

The Siouan stock (Crows, Mandans, Assiniboins, Hidatsa, Sioux, Winnebagos, Omaha, Tutelos, Catawbas, Biloxi, etc.) are noteworthy by reason of their migration from the Atlantic slope in the region of the Carolinas to the trans-Mississippian and Missouri country, where their culture was conditioned by the presence of the buffalo and the adoption (from the whites) of the horse. Their wars with the surrounding tribes, particularly the Algonkian, and their subsequent numerous collisions with the whites (Minnesota massacre of 1862, the troubles in which Sitting Bull figured, etc.), are matter of history. The use of buffalo-skins made it possible for some of the Sioux tribes to develop pictography to a high degree. The researches of J. Owen Dorsey and Miss Alice Fletcher have shown the Omaha in particular to be gifted with a religio-social consciousness of a marked character, reflected in their name-giving and the ceremonies associated with the passage from childhood to manhood, in which individuality is much emphasized. That their capacity for producing men of ability is not confined to those of the primitive type (Sitting Bull) is indicated by the way in which individual members of this stock (Dr. Eastman, La Flesche, the collaborator of Dorsey, etc.) have responded to the stimuli of modern culture. The Dakotan federation is well remembered by the names of the twin States of the Northwest; Minnesota, Nebraska, etc., are terms of Siouan origin; while the minor place-nomenclature of the northwestern States contains a multitude of names from the same source.

The Shahaptian stock is noteworthy on account of the Nez Percés and the famous chief Joseph (still living), one of the most remarkable Indians of any age, whose "retreat" in 1877 has been compared to the celebrated march of the Ten Thousand of old.

The "Pueblos" Indians, as they are called from their village life, have risen in New Mexico and Arizona above the stage of savagery into a state of semi-civilization, representing the triumph of man over the adverse conditions of the desert and the inroads of fierce enemies of the lowest culture. Their relations to the so-called "Cliff-Dwellers" has been the subject of some ethnological speculation. (See Pueblos.) The diversity of culture among the Pueblos is not as great as that of speech. Besides the Moqui or Hopi, who belong to the Shoshonian stock, there are found in the Pueblos group three other distinct linguistic stocks,— Keresan, Tañoan and Zuñian. The Pueblos culture has apparently been developed independently in several local centres, and the studies of Bandelier, Hodge, Fewkes, Cushing, etc., have thrown much light on the origins and interrelations of stages of culture largely the reflex of environment.

The Shoshonean or Uto-Aztecan stock offers the most wonderful contrasts in its members of any Amerindian stock. Linguistic and other evidence appears to justify the conclusion that not only certain peoples of the Sonoran country (Cahitas, Coras, Tepehuanas, etc), some of whom achieved a sort of half-civilization in contact with their more cultured neighbors, but the Bannacks, Shoshones, and Utes (even the wretched "Root-diggers") are kith and kin with the ancient Aztecs upon whose civilization Cortes intruded, and the tribes of Nahuatl lineage who carried that culture more or less from central Mexico to beyond Lake Nicaragua. The change from the low type represented by the Utes to the high type of the old Mexicans may have been due in large measure to environment. Intermediate stages are represented by some of the Sonoran tribes. The Mexican or Aztec branch of this stock has furnished to English and other civilized languages a number of interesting and valuable words: *Axolotl, chocolate, coyote, cacao, tomato, ocelot, chilli, copal, chinampa, jalap*, etc. The Moqui group of the Pueblos Indians belong also to the Shoshonean stock.

The Mayan stock (Cakchiquels, Huastecs, Tzotzils, Kekchis, Quiché, Tzendals, Mayas, etc.), creators of the civilization destroyed by the Spaniards in Central America, left, besides graven monuments in large numbers, other evidences of their having invented a system of "writing," which is the nearest approach by any of the aboriginal peoples of America to a phonetic method of record,— the solution of the Mayan hieroglyphics is perhaps *the* question of American archæology. Their calendar-system, nagualism in religion, and the important role of woman in religious and social functions, deserve especial notice. The recent explorations of the Peabody Museum (Cambridge) have resulted in many new discoveries.

Central and South American Stocks.— The Chibchan stock, whose culture varied from that of the savage Aroacos of the mountains of Sta Marta to the civilization of the country about Bogota represent a rise from barbarism independent of that to the south in Peru, etc. There is some reason to believe that the "gold-culture" of the Chiriqui country and allied remains in the same region to the borders of Nicaragua may be due to the Chibchan stock,— the Talamanca, Guaymi, and a few other dialects of Costa Rica, etc., show affinities with Chibchan tongues. Their use and working of gold were of a high order, but neither in architecture nor in pictography could they compare with the Peruvians, the Mexicans, and the Mayas. They had a characteristic hero-legend of Bochica, and a tale of the great flood. The shrine of Lake Guatavita was a famous religious resort. Some of the famous "El Dorados" were in their territory. The Quechuan stock, which is best known through the civilization of the Incas, superimposed upon an older, widespread culture, represents but one phase of higher human activity in the Peruvian area. The extension of Quechuan language especially von Tschudi and Brinton agree in attributing not to the military achievements of this people, which antedated the coming of the Spaniards by only a few centuries, but to intellectual and culture influences millenniums old. The marks of their language can be traced from near the equator on the north to the Pampean tribes on the south. Common in the Peruvian area seem to have been a highly developed agriculture (stimulated, as in the southwestern United States, by the necessity for irrigation and artificial treatment of the soil),— maize, tobacco, potatoes, cotton, etc., the breeding of the llama and the paco, the making of pottery (useful and artistic), metal-working of a fine and ingenious sort, stone architecture more massive and imposing than artistically beautiful, or of the highest order as regards decorative art. The Inca form of government was never probably so far removed from the system common to most of the American stocks as some writers have believed. The Incasic conquest has caused the Peruvians to be styled the "Romans of America," but the analogy is misleading. Beyond the use of picture-writing and the employment of the quipu (knotted colored strings) for purposes of record, the Peruvians had not advanced, and the semi-phonetic system, like that of the Mayas, was not developed by them. Ancestor-worship and sun-worship (state religion) were professed by the Peruvians, but the most far-sighted of their thinkers touched almost upon monotheism. The hero-god of the Peruvians was the sea-born Viracocha, about whom centred a rich and imaginative mythology. The mixture of races in the production of ancient Peruvian culture is indicated by the diversity of cranial type among the skulls from the old burial grounds and mummy-caves. North of the Quechuas, on the coast about Trujillo, were the Yunca-Chimus, etc., whose civilization is represented by the ruins of Gran Chimu and other remains in the valley of Trujillo, which preceded the period of Inca domination. Southeast of the Quechuan culture was that of the Aymaras on the Andean table-lands. To them are usually assigned the ruins of Tiahuanaco, near Lake Titicaca, which in their completeness were probably the most imposing structures raised by the hand of aboriginal man in America,— in architecture they differ in several notable ways from the buildings of Inca origin. Dr. Uhle has very recently sought to show the "succession of cultures" at Pachacamac, Trujillo, and their relations to that of Tiahuanaco. The Peruvian tongues have furnished modern English, etc., many words: *guano, condor, alpaca, pampa, paco, llama, coca, quinine, jerked* (beef), *vicuña*, etc.

In the northern part of the Argentine Republic (Province of Jujuy, etc.) the architectural and archæological remains brought to light by recent investigators (Ambrosetti in particular) indicate the presence of a "civilization," — village life in a desert environment, offering striking analogies with the culture of the Pueblos Indians of Arizona and New Mexico. This Calchaqui culture is evidently much more than the mere reflex of Quechuan-Aymaran conquest which it was formerly considered to be. Its origin and growth, however, remain to be clearly demonstrated.

The Araucanian stock, whose language has been studied by Lenz, are famous for their long resistance to the Spanish arms (the story of the "conquest" has been written in the last few years by Guevara), part of which gave rise to De Ercilla's epic of 'La Araucana.' To the Araucanian stock belong tribes on both sides of the Chilean Andes and a number of the nomadic peoples of the Pampas, where they seem to be intruders rather than aborigines. Chilean Spanish has borrowed many expressive terms from Araucanian.

The Patagonians, Tzonek, or Tehuelche, famous since the time of Pigafetta as "giants" (many of them exceed six feet and some are said to reach seven). To them belongs the "Setebos" of Shakespeare's 'Tempest.'

The Tapuyan stock of Brazil is looked upon by some authorities as the oldest people of the continent — some would affiliate with them the Fuegians, in this respect — representing a race once inhabiting a great part of South America. The man of the caves of Lagoa Santa and the man of the remarkable *sambaquis* or shell-heaps of the Brazilian coast are by many authorities considered to have related to the Tapuyans. Characteristic modern Tapuyans are the Botocudos, so called from the labret they wear in the lower lip. According to Ehrenreich, some of these ancient men of Brazil show affinities with prehistoric man of eastern Europe.

The Tupian stock (or Tupi-Guaranis, as they are also called), whose language was much used by the missionaries for general intercourse with the natives and is the basis of the *ligoa geral*, or "common language" of the region of the Amazons, were perhaps the highest in culture of the Brazilian tribes, having the elements of agriculture, village life, pottery (well developed and rather artistic), urn-burial, etc., but nothing beyond the Stone Age. Intermixture with both whites and negroes has taken place in the Tupi area, and the rich and imaginative tales of animals, etc., belonging to Tupi mythology have thus been given a wider extension, while negro and white influences have made themselves felt, both on the language and the literature of these people. According to Hartt, the Tupi language has influenced the Portuguese of Brazil quite as much as has the latter the former. Tupi-Guarani speech has furnished to the various European tongues a considerable number of words — to English, *ipecacuanha, jaguar, tapioca, tapir, toucan*, etc.

The Cariban stock were long famous for their cannibalism (the word *cannibal* is a corruption of one of their ethnic names), real and attributive, and their skill in making and using canoes. The shaman, or medicine-man, had great power among them, and they practised the curious and remarkable custom of the *couvade*. Rock-inscriptions and pile-dwellings are found in their territory. Some of them have been reduced to sad straits by the contact of the whites, but some of the Venezuelan tribes of this stock are still good, typical representatives of the American Indian.

The Arawakan stock, through its representatives (the Bahamian Lucayans, the natives of Haiti, Porto Rico, Cuba, etc.), was the first of the aboriginal peoples of the New World (exclusive of Greenland and Labrador) to come into contact with the white race, and likewise the first to come under its devastating influence. Many of the tribes of this stock were of a mild and gentle disposition, good agriculturalists, pottery-makers, workers in stone, wood and gold, and excellent canoe-men (the word canoe comes from an Arawak dialect). They were

1. Labrador Eskimo Woman. 2. Mexican of the coast. 3. Mexican of the highlands. 4. Yucatan Indian Woman. 5. Ecuador Indian. 6. Peruvian Indian. 7. Brazilian Indian (Ipurina).

users of cotton, and to them we owe the first Indian invention adopted by the whites (*hammock*, both name and thing are Arawak). From the Arawaks, too, the Spaniards first learned the use of tobacco. Like the Caribs they practised the *couvade*. The name of the stock is said to mean "flour-eaters," on account of their use of cassava, which has also passed over to the white. The Arawak and Carib stocks have furnished to English and to the other civilized languages of Europe a large number of important words, the exact ethnic distribution of which is not easy to determine with exactness: *Agouti, anotto* (and French *roucouyenne*), *barbecue, cacique, caiman, cannibal, canoe, cassava, colibri, hammock, hurricane, iguana, macaw, maize, manati, potato, tobacco,* etc. And with these names has gone the use of many of the things indicated and made known for the first time to Europeans. The debt of the Spanish and Portuguese settlers of South America and the West Indies is in these respects very great, for, naturally new fruits, plants, trees, etc., and many of their products came to be known by their aboriginal names or by corruptions of them. Thus a number of "balms" and "balsams" and other medicinal products retain in the pharmacopœia names of American Indian origin — *copaiba, tolu,* etc. Timber-trees, ornamental and dye-woods, have also largely kept their native appellations throughout Central and South America — the list would run into the hundreds. Large also is the catalogue of birds and other animals bearing Indian names.

Original Habitdts.— The question of the original habitats of the important aboriginal stocks is one of the most interesting in American ethnology and archæology. The researches of Rink and Boas in particular seem to have demonstrated that the primitive home of the Eskimo was in the region west of Hudson Bay, whence they spread northward and westward to Alaska, etc., and eastward (north and south) to the Arctic islands, Greenland and Labrador. See ESKIMOS.

The earliest habitat of the Athapascans was in northwestern Canada, to the westward of the home of the Eskimo. From there they migrated over the lake country, across the Rockies to the southward, leaving colonies along the Pacific to northern California, and sending out, through Arizona and New Mexico to the borders of the Nahuatl territory, the important branches of the Apaches and Navaho — the raids of the Apaches often reaching far into Mexico.

The original habitat of the Algonkian stock was, as Brinton and Hale have assumed, "somewhere north of the St. Lawrence and east of Lake Ontario," while that of the Iroquoian lay "between the lower St. Lawrence and Hudson Bay." The final result of the migrations and wars of these two stocks was to leave the Iroquois of the Ontario-Erie country entirely surrounded by Algonkian tribes. From their primitive home the Algonkian sent out numerous branches west, south, southwest, etc., making the extent of territory covered by them very large, and bringing them into immediate contact with many other Indian tribes and with the white settlers over a vast area. The Iroquois (in the Cherokee and the kindred tribes of the south) had branches, which were so separated from their northern kin as to be long taken for non-Iroquoian peoples.

The Muskhogean stock, according to Gatschet, have been from time immemorial inhabitants of the country between the Appalachian Mountains, the Atlantic, the Gulf of Mexico, and the Mississippi. The scene of their earliest development was in the neighborhood of the Mississippi, or possibly even beyond it.

The chief migrations of the Caddoan (Pawnee) peoples have taken place in historical times northward and southward from the Platte River, from which region they expelled in part the Siouan tribes, etc. If their own traditions are reliable, their primitive home lay farther to the south, on the Red River of Louisiana.

The primitive home of the Siouan stock (characteristic Plains Indians since the introduction of the horse) was eastward in the region of the Carolinas. This fact has been revealed by the study of the Tutelo and Catawba languages belonging to this eastern area, and by inspection of the traditions of the various Siouan tribes. The main bodies of Siouan migrants followed the Ohio and the Missouri far to the north and west; the Mandans, Assiniboins, etc., reaching to within the borders of Canada. Other minor bodies traveled to the southwest, their representatives still existing in the Biloxi, etc., of southeastern Mississippi. The Siouan tribes seem to have followed the buffalo in its retreat westward, and their migration from the Carolinas is of considerable sociological interest. At one time their trans-Mississippian habitat included practically all the territory between the Arkansas and the Saskatchewan from the great river to mid-Montana, with the Winnebagoes jutting out on Lake Michigan. Their forays and trade-excursions led some of them from time to time across the Rocky Mountains — the present writer, in 1891, met a friendly party of them far within the Kootenay territory.

The original habitat of the Shoshonean or Uto-Aztecan stock, which embraces the Ute, the Sonoran, and the Aztecan (Nahuatl) peoples, and has representatives from the north of Idaho to the Isthmus of Panama, was probably somewhere in the northwestern section of the United States. The primitive home of the Shoshonean section was "somewhere between the Rocky Mountains and the Great Lakes," and the traditions of the other two branches bring them from the far north, as compared with their present southern abode.

The Mayan stock, creators of the civilization of Central America, according to their own traditions, came from somewhere to the north,— the position of the Huastecan branch of this stock north of Vera Cruz suggests that the Mayan emigrants from the home-land skirted along the Gulf of Mexico from some region considerably to the north.

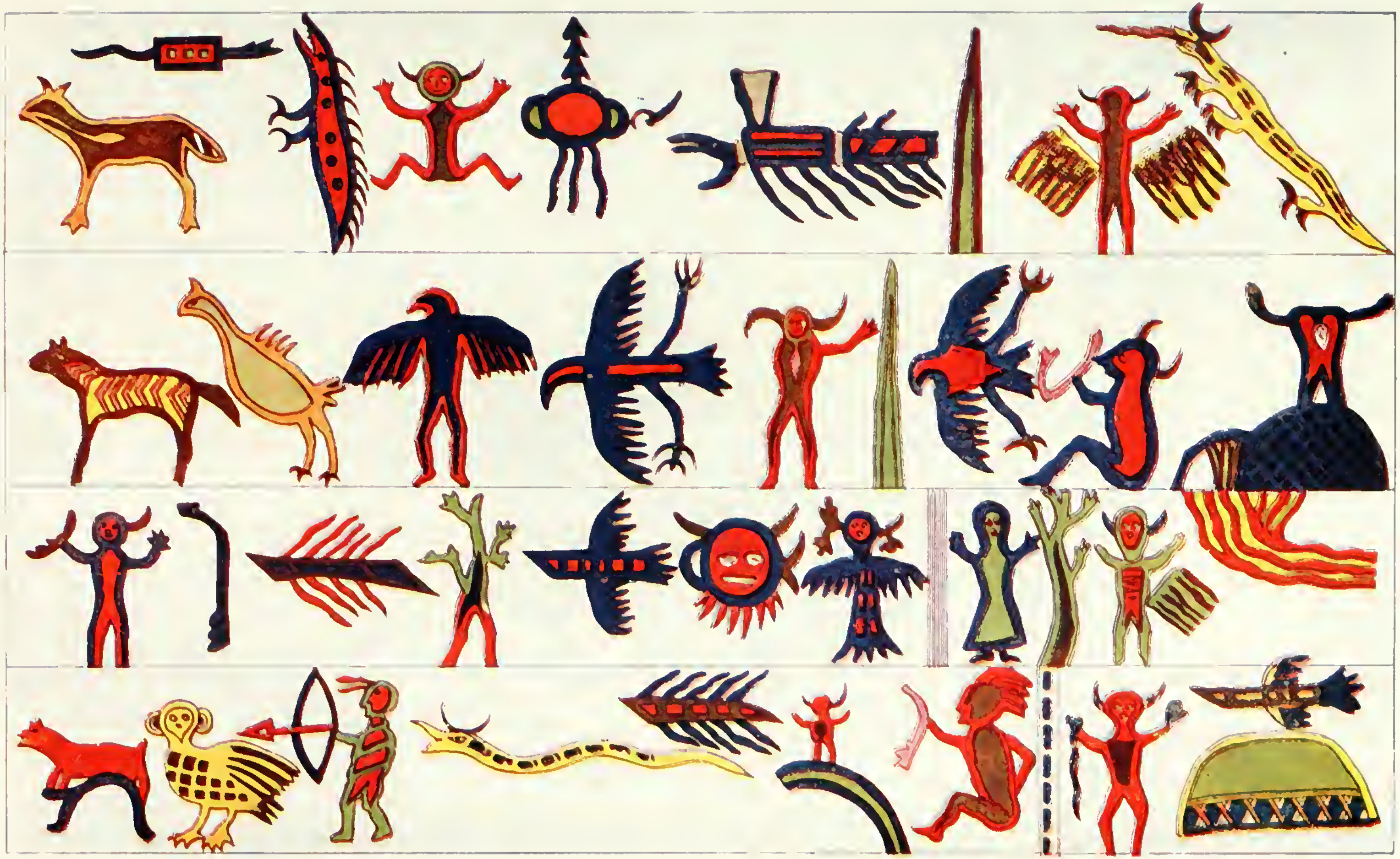
The Arawakan stock (including the natives of the Bahamas and the Antilles, except the intrusive Caribs) had an extension in South America comparable only to that of the Algonkians and Athapascans in the northern half of the continent,— from the high Paraguay to the Goajiran peninsula in Venezuela, and in its greatest expansion from the Xingû to the Amazon and Orinoco. Its primitive habitat was in some part of the Brazilian interior, probably between the Xingû and the Paraguay, the general trend of their migrations having been northward. The Cariban stock, another very extensive people, who at the time of the Colombian discovery were to be found in the smaller West Indian islands, and the northern part of the continent from the Essiquibo in Guiana to about the Isthmus of Panama, came originally, as the presence of the Carib Bakairi on the Xingù indicates, from the high interior of Brazil, at the sources of the Xingù and Tapajos.

The Tupian stock were widely extended at the time of the discovery along the Atlantic coast region from the La Plata to the Amazon, with branches scattered along the Paraguay and the Madeira to the foot of the Andes. Their primitive home, Brinton, with reason, assumes to have been in the central highland country to the east of Bolivia. The general direction of the earliest migrations of this stock was therefore southward (down the Paraguay to the Atlantic), after which the Tupi branch followed the coast to the Amazon. The Tapuyan stock, who once occupied the region between the Xingù and the Atlantic coast (from the latter they have been driven by the Tupis), are probably the oldest human residents of part of this area, their tenure of the seacoast reaching far back into prehistoric times.

The Chibchan stock, to which was due the civilization of the Bogota region of Colombia, had their original habitat in the Andean highlands of central or southern Colombia, whence they wandered northwest into the Isthmus of Panama and northeastward up the Magdalena.

The Quechuan stock, authors of the most remarkable of South American civilizations, according to their own traditions spread from vtry small beginnings in the country about Lake Titicaca; but von Tschudi and Brinton, for linguistic reasons chiefly, find the primitive home of this people to have been in the extreme northwest of their characteristic area. The Aymara stock, which some authorities consider to have been a branch of, or perhaps an older member of the Quechuan, had its original habitat to the southeast of the latter. The relation of the Aymaran stock to that which produced the Calchaqui civilization of the northern Argentine is not clear.

Language and Writing.— Although the languages of the American aborigines constitute so many independent families of speech, the vocabularies of which are entirely divergent one from another, nearly all (if not all) of them possess centain general grammatical characteristics which justify us in classing them together as one great group of human tongues. Brinton enumerates as points of resemblance: Development of pronominal forms, fondness for generic particles and for verbs over nouns, and incorporation,— the inclusion of subject or object (or both) in the verb, etc. Most American Indian tongues may be called "holophrastic," from the practice of compressing a whole "sentence" into a "word," the length of which is sometimes very remarkable. As an example may be cited the Micmac Algonkian) *yālec lemāktāwepokwŏse*, "I am walking about carrying a beautiful black umbrella over my head." This word, according to Rand, is derived from *pokwŏsăn*, "an umbrella"; *māktāwāc*, "I am black"; *wolāc*, "I am beautiful"; *yăleā*, "I walk about." From the Kootenay language may be cited: *Nātltlāmkinē*, "he carries the head in his hand" (*n*, verbal particle; *ātl*, "to carry"; *tlām*, composition form of *āaktlām*, "head"; *kin*, "to do anything with the hand": *inē*, verbal); *hinūpqanāpinē*, "thou seest me" (*hin*, "thou," (subject pronoun); *ūpqa*, "to see"; *āp*, "me" (object pronoun); *inē*, verbal). As typical incorporative languages the Iroquoian and Eskimo may serve. All the incorporative forms of speech in America do not, however, proceed upon identical lines: and some that do incorporate, like Kootenay and Eskimo, often have one or more cases. According to Dixon and Kroeber many Californian languages do not possess the feature of incorporation at all (such are, for example, Maidu, Pomo, Yuki, etc.). As types of incorporating languages less complete than Iroquoian we have Kootenay, Siouan, Aztecan. Some of the Central and South American tongues seem also to have little incorporation. Otomi and Maya appear to be evolving in somewhat the same direction as modern English, away from incorporation and grammatical plethora. Many of the Amerindian tongues are both prefix and suffix languages; others prefer prefixes, others, again, suffixes. Some possess, and some do not, a plural form for nouns; a dual; gender-distinction in pronouns; a high development of demonstratives; reduplication; syntactical cases, etc. A few possess grammatical gender and some exhibit differences in the words used by men and women. In the matter of phonetics the languages of the American aborigines are remarkably divergent, some being extremely harsh, guttural and consonantic, others equally smooth, soft, and vocalic. The absence of certain consonant sounds and the equivalence of certain vowels and consonants characterize some forms of American speech. Euphonic changes are of major or minor importance. Sentence-construction differs greatly in various tongues. The position of the adjective is not always the same. The Haida language has even a distinction like that between our *shall* and *will*. Careful investigation of the many Indian languages, as yet studied imperfectly, if at all, may reveal other interesting linguistic phenomena. How much has been written about and in some of the languages of primitive America may be seen from the bibliographies of Pilling! Our knowledge of them varits from a brief vocabulary of the Esselenian to the exhaustive dictionary of Yahgan compiled by Bridges. The native literature runs from the unrecorded tales of the northernmost Athapascans to the poetry of the ancient Mexicans and Peruvians, some of which has been handed down from pre-Columbian times. The only actually phonetic (syllabic) alphabet now in use among the Indians (except the syllabaries introduced by missionaries among the Athapascans, Crees, etc.) is post-Columbian, — the invention of a half-blood Cherokee. A sort of alphabet has, however, sprung up more recently among the Winnebagos. The development of picture-writing varied very much among the numerous tribes, as may be seen from Mallery's classic study of the subject. Sometimes, as is the case with the Kootenays, ability to draw does not seem to have been accompanied by exuberant pictography. The Walum Olum of the Delawares, the "calendars" of the Kiowa, Sioux, Pima, etc., are special developments of primitive records, the highest form of which is seen in the manuscripts ("books") of the Aztecs and Mayas of a religio-historical character. The pictographic records of the Ojibwa "medicine men" have been studied by



PICTURE WRITING OF THE OJIBWAY INDIANS

Hoffman, and the rite-literature of the Cherokee by James Mooney. The native literature of primitive America has been the subject of special monographs by Dr. D. G. Brinton. The Spanish-American countries have furnished several writers and investigators of Indian descent.

Religion.— The mythology and religion of the American Indians have received particular treatment at the hands of Müller, Brinton, Powell, etc. Perhaps the most general myth of importance is that of the divine hero, teacher, and civilizer, who after accomplishing his labors, leaves the earth, promising to return at some future time. This myth is found in Mexico (Quetzalcoatl), Yucatan (Kukulkan), Colombia (Bochica), northeast North America (Manabozho, Gluskap, etc.) Somewhat analogous is the myth of the twin reformers of the primitive world among the Pueblo Indians, Navahos, etc. The Iroquoian stock have the myth of the contest of the good and the bad mind. The Algonkians have a myth-cycle of the rabbit, the tribes of the northwest Pacific coast one of the raven and thunder-bird, the Rocky Mountain peoples one of the coyote, the Brazilian Indians one of the jaguar, etc. Some of the tribes are very rich in animal myths and, as Mr. Mooney asserts, the characteristic tales of "an 'Uncle Remus' nature" found among the Cherokee and other peoples have not, as many suppose, been borrowed from the negroes of the South. Even the famous "tar-baby" tales have their independent Amerindian analogues. Flood-legends are widespread in America and vary from the simple, locally colored stories of rude Athapascans to the elaborate conceptions of the civilized peoples of Mexico, Central America, etc. The cardinal points and the number four have developed with many tribes a rich symbolism, with which the chief colors are often connected.

The "medicine men" of the Ojibwa, the Cherokee, the Apache, have been investigated by Hoffman, Mooney, and Bourke, and a large amount of accurate and authentic information concerning shamanism among the Amerindian peoples has been accumulated. The power of the "medicine man" varies much from tribe to tribe,— with some he is a personage of little or no importance; with others he is the controlling influence in secular as well as in religious affairs. The acme of such influence is found among some of the tribes of Guiana and Brazil. These "medicine men" had often their secret societies and "lodges" into which chosen neophytes were admitted with appropriate ceremonies. They had also, with many tribes, the control of the rites to which the youth were subjected at the time of puberty, with others they performed such marriage ceremony as existed. Besides these shamans, there were "prophets" and religious reformers, especially since contact with the whites. The widespread "Ghost Dance," in its more recent outbreaks, has been studied in detail by Mooney. Worthy of note is also the "new religion" of the Iroquois, and the "Shaker" religion of the Indians of Puget Sound. The investigations among the Pawnee by Miss Fletcher and G. A. Dorsey have demonstrated the existence of a relatively high form of primitive religion in a rather unexpected quarter,— their worship of the morning star in connection with agriculture was, however, at one time accompanied by human sacrifice. The mortuary rites of the American Indians, corresponding to diverse ideas of the soul and its future in the other world, varied from simple neglect of the corpse to what is represented in material form by some of the mounds of the Mississippi Valley and the stone tombs of Peru. The mortuary customs of the aborigines of North America have been made the subject of a special monograph by Dr. Yarrow, and the doctrine of "animism" among the South American peoples has been treated at length by Koch. The contemplation of the *totem* (properly Ojibwa *ododema*),— tribal or family mark,— of certain Algonkian tribes has given rise to theories of "totemism," concerning which there is much dispute in the world of science. "Fetishism," as exemplified in the Zuñis, has been investigated with some detail by Cushing. Cannibalism (the word *cannibal* is the corrupted form of a South American tribal name) has been rarer in America than is generally believed. Outside of its occurrence through necessity in ways known to civilized peoples, it was chiefly partial and ceremonial. Epicurean cannibalism flourished along the coast of South America and on some of the Caribbean islands; ritual cannibalism among certain tribes of the northwest Pacific coast, in ancient Mexico, etc. The almost extinct Tonkaways of Texas have the reputation of being the "last of the cannibals," while the Attacapas owe their name to this practice attributed to them by their neighbors. In the legends of the Cree and Ojibwa tribes of the Algonkian stock, a cannibal giant (wendigo) figures, and a horror of human flesh eating is expressed at the present time, whatever may have been the case in the past. From the condition of human bones and other remains in the shell-heaps of various parts of the coast, some authorities have come to the conclusion that cannibalism did exist in prehistoric ages among some of the Indian tribes. Religious ideas approximating to monotheism are attributed by some chroniclers and investigators to some of the more enlightened aboriginal rulers of Mexico and Peru. In these regions of the continent, as also in Central America, architecture and the arts of commemoration and record were at the service of religion. See MYTHOLOGY.

Amusements.— The games of the American aborigines, some of which, like lacrosse, have passed over to their conquerors, are of sociological and religious significance in many instances. Stewart Culin has made a special study of the games of the North American Indians, and rejects the theory favored by Tylor and others, that many of them (for example, Mexican *patalli*), are imports from Asia. The games of the civilized Aztecs seem to be but "higher developments of those of the wilder tribes," and those of the Eskimo are modifications of games found among other aboriginal peoples of America. Among characteristic Amerindian games may be mentioned: The gambling game with sticks, the hoop-and-pole game, the ball-race of the southwestern United States, the ball-games of eastern North America, the woman's game of double ball, foot-races, the snow-snake, etc. Culin holds that back of every game lurks "a ceremony in which the game was once a significant part." The variations in games do not follow linguistic lines. One centre whence games have radiated and where some of their oldest forms are still to be found, is in the southwestern United States, from which their migrations can be traced north, northeast, east, and south. Interesting modifications arise from conditions of environment.

Arts and Inventions.— The arts and inventions of the American Indians correspond to the extent and variety of their environment. The mass of the inhabitants of the continent at the time of its discovery were hunters and fishers, or agriculturalists of the Stone Age, most of whom had some knowledge of pottery-making. The house followed the lines of climate and culture, from the snow *iglu* of the Eskimo and the rude *wickiup* of the Utes to communal houses of the Mohegans, the Iroquian "long-house," phalansteries of the Pueblan and Central American areas, and the stone dwellings of a more or less pretentious sort of the civilized peoples of Mexico, Central America, and Peru. The cavate lodges and cliff-dwellings of Arizona and New Mexico, the wooden (sometimes underground) houses of the northwest Pacific coast, the skin-tents of the plains tribes and the wigwams of the Algonkians, the earth-lodges of the Mandans, etc., correspond to environmental stimuli. A like variation may be seen in the cradles of the American aborigines, studied by Mason, and in their means of transport on the water.— kayaks, "bull-boats," woodskins and balsas, dug-outs, canoes of pine and birch bark, large and small, and of all varieties of design and finish. In North America the Algonkians and Iroquois, and in South America the Indians of the great Brazilian water-ways, have made themselves celebrated for their skill in navigation. So too has the Eskimo with his kayak and the Peruvian with his balsa. The Algonkian Etchemins are literally "the canoe-men." The seagoing canoes of the fishing tribes of the coast of Alaska and British Columbia also deserve mention. On land some of the American Indian tribes have used the dog (Eskimo in particular) and the sled (the Algonkian toboggan, adopted by the whites for amusement purposes, is a special form), while in Peru the llama has been employed for ages for "packing," but not for draft purposes. The use of the horse and the modifications of primitive culture thereby induced in the Indians of the plains of the Missouri-Mississippi valley, the llanos of Venezuela, the pampas of the Argentine, etc., are, of course, post-Columbian. So, too, the influence of sheep culture upon the Navaho and their primitive industries, and of the cow among certain South American tribes. The only animals domesticated by the Indians whose use amounted to a considerable factor in their social and religious life were the dog and the llama, the latter in Peru and Bolivia only. The other half-domesticated animals and birds are of little importance as culture elements. The domesticated dogs of pre-Columbian America represent several diverse species of *Canidæ*. The absence of such domesticated animals as the cow, the horse, the sheep, etc., in pre-Columbian America accounts for certain limitations of its culture as compared with that of the Old World. Pets, however, bird and beast, were very common, especially in Brazil and Guiana. The disappearance of the wild buffalo and other animals of the chase, since the coming of the whites, has been fateful for some tribes,— the contact with the latter as represented by the various "fur companies," etc., has caused many changes in the life of the aborigines, seldom for the better.

As Mason has pointed out, the Amerindian traps and other devices for the capture of wild animals indicate intellectual skill and marvelous adaptation to the habits and actions of these creatures. The Eskimo harpoon and its appurtenances, the simple and composite bow, the arrow-poisons of some North American and many South American peoples, the manufactures of obsidian and jade in ancient Mexico, cotton weaving and dyeing in the more southern regions, maguey-paper making in Mexico and Central America, stone carving (from Mexico to the Argentine), feather-work (in the southern United States, Mexico, Central America, and parts of South America), gold working (in the Isthmian region, Colombia, etc.), the hammocks of the Venezuelan tribes, the fish-poisoning devices of many peoples of South America in particular, the fine pottery of many regions of the continent, the *quipus* or knotted record-strings of the ancient Peruvians, the primitive drum-telephone of certain Brazilian Indians, the blow-gun (southeast United States and South America), cassava preparation (northern South America), the bolas of the Pampean tribes, etc., represent the diversity of invention and manufacturing skill among the American aborigines. The lamp of the Eskimo and some of the Indian tribes of northwestern North America is *sui generis* (its importance has been emphasized by Hough). Methods of computing time, season, etc., vary from the slanting stick of the Algonkian Naskopi to the elaborate calendar systems of Mexico and Central America. Of musical instruments, the drum, the flute, the pan-pipe, and the "musical bow" were known to the American Indians. Songs and dances to the accompaniment of these were in vogue. Practically all stages of primitive culture were to be found in pre-Columbian America, if we may judge from the tribes now surviving, from the savage Seris to the ancient Mexicans, Mayas, and Peruvians. Moreover, within the bounds of the same linguistic stock, as noted above, there may be found tribes representing a high and a low stage of development; as for example, the Aztecs and the Utes of the Shoshonean stock, the Dogribs and the Navahos of the Athapascan, etc. Some tribes were pre-eminently fishers, others hunters. Many excelled in both, like the Eskimo and some of the peoples of the northwest Pacific coast. Some sort of agriculture was widespread in America — the cultivation of corn, beans, varieties of pumpkin and squash, etc., was known all over eastern North America, and the regions of the southwest, etc.; and typical tropical and semi-tropical and other plants and fruits (potato, tomato, maize, pineapple, tobacco, varieties of cotton, manioc, sweet-potato, cacao, coca, etc.) were cultivated in the more southern regions of Mexico, Central and South America. The spread of tobacco and maize in North America and of certain other plants in Central and South America indicates agricultural receptiveness on the part of the many tribes concerned. The capacity of the American Indians generally for agriculture has been underrated probably, as both the desert-born cultivation of the Pueblos Indians and the tropically stimulated cultivation of the Indians of South America indicate. The arid regions of the Peruvian coast offer another example of considerably developed agriculture. In America the utilization of the gifts of earth varied from the seed picking and root digging of the Utes to the market gardens and chinampas of ancient Mexico. How the necessities of agriculture can shape a religious system may be seen from the rites and ceremonies of the Pueblos Indians, the cult of "mother corn," etc. With some tribes tobacco was more or less of a sacred plant, also tht mescal.

Position of Woman.— The relation of women to agriculture gave them a higher standing with certain tribes than would otherwise have been the case. With the Iroquois the position of women was very high and to them was allotted a considerable share in the government, peace negotiations, etc., and female chiefs were by no means unknown,— women were the "mothers of the nation." Among the Mayan peoples of Central America woman's position was also high. Many of the priests were women, and they were also commonly the leaders of their tribes in rebellion against the Spaniards — the most famous was Maria Candelaria, "the American Joan of Arc," who led the insurgent Tzendals in the 18th century. In ancient Mexico and Peru the position of woman was perhaps not quite so high. Among some tribes the position of woman was very low, and her sexual peculiarities added to the disesteem in which she was held, as for example, among the Tacanan Araunas of Bolivia. The Athapascan tribes vary much in their treatment of woman,— with some she is little better than a slave or servant, while with at least one Alaskan people of this stock female chiefs existed at times. The "purification" of women at the period of their menses, and the segregation of girls at the time of puberty, were accompanied with many rites and ceremonies among various tribes from the rude Athapascans to the civilized Aztecs. The curious custom of the *couvade* (imitative child-bed on the part of the husband) prevailed among many. Venezuelan, Guianian, and Brazilian peoples. The relations between environment and the share of the sexes in culture has been investigated by Mason; according to whom the zenith of virile Amerindian art is reached in Peru, while in Colombia we find woman as farmer, weaver, and potter. In the Oregon-California region one art, basket-making, reaches its acme of development in the hands of woman. A large female influence in religion is noticeable among the Pueblos Indians. Among some tribes, for example, the Hurons, the weregild for killing a woman was greater than that for a man. Some sort of matriarchal system, with maternal descent, prevailed very commonly in pre-Columbian America; among certain of the Koloschan Indians, for example, a man was considered to be in no sense related to his father, his sole parent being the mother. Besides this extreme form, numerous other varieties occur among the tribes now existing, the system in vogue among the Iroquois, etc., being more complicated and adapted to social needs. The systems of marriage known to the American Indians varied from the absence of any particular rite or ceremony to selection of the wife by the old women of the tribe, as among the Hurons, or the uniting of the couple by the "medicine men." Some of the tribes of the Brazilian forests, ranking very low in culture, are strictly monogamous; while peoples of higher civilization, like the Chibchans, Mexicans, Peruvians, etc., were polygamous or concubinative, or both. Marriage by purchase was found over a large area of America; but here as in other parts of the globe, the "money" received was often rather a compensation to the parents for the loss of their daughter than a real sale of her to a suitor. Divorce, in many forms, is known to the primitive Americans, both by mere word of the husband and according to set forms and rites. Consanguineous marriages were strictly avoided by many tribes; but among a few, such as some of the lowest Athapascans, incest was not condemned. In the matter of the sex-relations, as in many other fields, the American Indians exhibit almost all possible phases from the monogamic chastity of some of the lowest peoples to the unnatural indulgences of the Peruvians. Runaway matches and marriages for love, in spite of the contrary opinion entertained by some authorities, have been by no means uncommon throughout the continent. Suicide on account of unsuccessful wooing by both sexes is also not at all rare. Some peoples, too, have developed love-songs of a romantic order, for example, the *yaraveys* of the Quechuas.

Government.— The systems of government of the American Indians and their tribal organizations range from the simple democracy of the Kootenays and some of the Brazilian Indians to the elaborate state institutions of the ancient Mexicans and Peruvians, which in several respects resembled the corresponding institutions of mediæval Europe or the ancient classic world. The power of the chief, however, seems everywhere to have had limitations, and some tribes distinguished the permanent peace chief and the temporary war-chief. Chiefs were generally elected, either from the body of the tribe or from certain specified families. "Totemism" and secret societies are not found to any extent, if at all, among certain tribes (the Kootenay, for example); while with many of the peoples of the northwest Pacific coast they are perhaps the chief feature of aboriginal society, as Boas has recently shown. Property rights are represented in many stages, from the semi-anarchic Eskimo to the Aztecs of Old Mexico and other peoples of Central and South America. Slavery existed among many tribes, and on the northwest Pacific coast a sort of traffic in human chattels had arisen. See SLAVERY.

Trade and Commerce.— Within the spheres of the culture-centres of Mexico, Central America, Peru, etc., trade and commerce were well developed. The Columbia River region was the scene of a less developed trade; while the southeastern United States, the region of the Great Lakes and country west and south of them, had also their important distributing points. The region of Bering Strait was likewise an Asiatic-American commercial centre.

Education.— With the lower tribes generally, such education as was imparted to the children was given by the father to the boys and by the mother to the girls. Peoples like the Iroquois, the Siouan Omahas, etc., used the instruction of tales, legends, and proverbs. The ancient Aztecs and some of the other semi-civilized peoples of Mexico and Central America had schools for boys and others for girls, in which the duties proper to each sex were taught under the supervision of the priests.

Physical Characteristics.— The physical characteristics of the aborigines of America mingle uniformity with diversity. The skin color, popularly styled «red» or «copper,» is designated by Mantegazza, "burnt coffee," and by Brinton «brown of various shades, with an undertone of red.» This but varies from rather dark to rather light. Among the lighter tribes have been reckoned the Koloschan Tlinkit, the Bolivian Yurucari, etc., and among the darker the Charmas of the Gran Chaco, the Bolivian Canisianas, and a few other tribes of South and Central America. The hair is generally termed "black," but, as Brinton notes, there is in it «a faint under-color of red,» which shows up more in childhood and seems much more prominent with certain tribes than with others. Red hair is known among American Indians, but in some cases (certain South American tribes, for example), its occurrence may be due to infusion of white blood. The eyes of the Indians are, with rare exceptions, dark brown. The stature varies from rather low to rather high, represented on the one hand by some of the shorter Brazilian tribes and on the other by the Patagonian «giants.» Among the peoples presenting many individuals of tall stature, may be mentioned the Yumas and Pimas, some of the Muskhogean tribes, some of the Crees, Ojibwa and eastern Algonkians, Pawnees, Iroquois, Siouans, Huaveans, Ramas, some of the Cariban tribes, Yurucari, Cayubabas, Guaycuruans, Patagonians, etc. So far as is known no dwarfish people comparable to the dwarf races of the Old World existed in America, although the skeletons from certain Peruvian tombs prove the existence of a dwarfish element in the general population; and the stature of many individuals among certain Brazilian tribes is so low as to induce some authorities, with Kollmann, to predicate the former existence of a dwarf race. In the relations of trunk and limbs and in the relation of one limb to another many variations occur among the Indians, due to occupation (canoeing, etc.,— and, since the advent of the whites, horse-riding). In primitive America all the chief forms of skull (often with artificial flattening, etc.) are found. Among the dolichocephalic (long-headed) peoples are the Eskimo and Iroquois generally, some of the Muskhogean tribes, Otomis, Aymaras (partly), Tapuyas, and Tupis (largely), etc. Of the brachycephalic (broad-headed) may be mentioned the Araucanians, Caribs, Arawaks, Patagonians, Mayas, many of the tribes of the Pacific coast region of North America, etc. The civilized peoples of Mexico, Central America, and Peru appear to have been of stature below the average and of varied skull form tending to brachycephalic, indicating mixtures of types. In the Columbia River region type-mingling is indicated also by both stature and skull-form. The Peruvian region is another centre of race-mixture, as evidenced by skull-form. The oldest skulls discovered in prehistoric burial-places or in geological *situ* are not distinct from the American types,— the latest found, the «Lansing skull,» is quite Indian. The skull capacity of the Indian is below that of the white in general, but many exceptions occur. The brains of the less cultured Indian peoples (Fuegians, Eskimo), show no decided anatomical inferiority to those of civilized Europeans. Great varieties of build and set of body are found among the American Indians, from the half-starved Fuegians to the well-fed and corpulent Iroquois. Small feet and hands are very common. Among many tribes in various parts of the continent handsome men and women of considerable beauty are to be found. In the case of women an admixture of white blood often enhances their beauty.

Race-Fusion.— The intermingling of the American Indians with the intruding white race has been much greater than is generally believed. The extent of this fusion of races varies from certain parts of North America with their classic Pocahontas examples to Uruguay, in South America, where 90 per cent of the population are said to be of mixed blood. The Eskimo of Greenland have intermarried with the whites (Danish fathers, native mothers), so that except in the parts remote from settlements no pure-blood Eskimo exists: and the same is true of a good deal of Labrador, where the contact has been with fishermen of English descent. The Micmac, Abnaki, and related Algonkian tribes of Maine, New Brunswick, etc., have a large admixture of white blood (French fathers, native mothers), and all over Canada and the northwestern United States in the early days of colonization and exploration the French traders, trappers, *voyageurs,* and *coureurs des bois* mingled freely with the native women, particularly those of the various Algonkian peoples of the Great Lakes and the West. The Hudson's Bay Company, by introducing employees of English and Scotch descent into the Canadian Northwest, made possible other *métis,* of which those of Scotch descent on the father's side are said to be healthy and sturdy specimens of humanity, with more than ordinary capacities. As indicated by the present condition of the Iroquois on the reservations in Quebec, Ontario, and New York, some infusion of white blood has taken place from very early times. Here the combination of white mother (often an adopted captive) and native father is more common than is usual in race-mixture. The Cherokee had an admixture of white blood in ante-Revolutionary days, to which Mooney attributes much of their culture-achievement since that time. In Mexico, Central America, and South America generally, as Talcott Williams has very recently noted, the half-breed element is very large indeed, for the native population was never exterminated by the whites as some histories still teach. Of the 40,000,000 inhabitants of South America it has been estimated that less than 10,000,000 can lay any claim to pure white blood. There is reason to believe that the future of some of the South American countries will be as much in the hands of the Indians as in those of the whites. In Mexico, parts of Central America, Colombia, Peru, and Chile, the strain of Indian blood represents able and intellectual aboriginal peoples. In certain parts of South America, and, sporadically in northeastern North America, intermingling of Indians and negroes has occurred, giving rise to the so-called Cafusos, etc., of Brazil, and a few other small groups. The mixture of white-Indian-negro is also found here and there. In some of the Spanish-American countries there is a special vocabulary to designate the numerous degrees of *métissage.* In the Canadian Northwest the half-breeds have taken a prominent part in the development of the country (one noted *métis,* Norquay, was premier of the province of Manitoba), and they are likewise noteworthy in the annals of the northwestern United States. In Mexico and Central America, not alone the *métis* but

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the Indians themselves have produced celebrated men. Juarez, the liberator of Mexico, a really great man, was a full-blood Zapotec, and President Barrios of Guatemala a Cakchiquel (Mayan stock).

Treatment by Whites.— The ill treatment of the American Indian by the whites has often been such as to stamp with eternal dishonor the conquering race. Massacres, broken treaties, land-robbing, commercial swindles, etc., mark the path of advancing "civilization," — English, Dutch, French, Portuguese, and Spanish have all been guilty at some time or other. The English in Newfoundland, the Americans in the West, the Castilians in northern Mexico and Yucatan, have exterminated or sought to exterminate whole tribes. We must, however, believe that the accounts of the early chroniclers concerning the "millions" of Indians slaughtered by the Spaniards, were the customary exaggerations of those who sing the victor's deeds. Peru and Mexico, for example, would not contain so many Indians to-day were those stories literally true. Against the centuries of dishonor in the treatment of the Indians by the whites, we may place the efforts of missionaries of all faiths, from the good Las Casas in New Spain to Duncan of Metlakahtla. The Jesuits among the Iroquois and Algonkians in North America, the Moravians among the Eskimo and some of the Algonkians and Iroquois, have all done good work, which only the incapacity or worse of governmental authorities has made null. The missions in California and the "reductions" in various parts of South America (Paraguay in particular) might have succeeded in keeping the Indians gentle and loyal sons of the Church had the good fathers been forever in charge, but the oncome of the more strenuous life of the whites doomed them to helplessness. The story of the Paraguayan experiment is one of the most interesting in the annals of mankind, but also one of the most disheartening. Against such failures a few bright spots may be set, — the Fuegian mission, for example; but even there all is not well. Signs of a better treatment of the Indians still within the borders of the United States are not wanting, and it is to be hoped that the present educational fads with which white children are being experimented upon will be kept far from the Indian schools.

Influence on Civilization.—The contributions of the aborigines of America to the world's stock of civilizing factors and influences are much more numerous and of greater importance than is generally thought. Besides the innumerable place-names in all parts of America of Indian origin, the Algonkian, Peruvian, Brazilian, West Indian, Guianian, Venezuelan, and Mexican words in English, French, Spanish, and Portuguese (whence many of them have spread into all the civilized languages of the world) are able remembrancers of the conquered race. The literature of the Spanish-American countries and of Brazil has been more or less affected by the stimuli of native theme and treatment. Many of the old dances and folk-customs still survive even where Christianity has been at least outwardly accepted and have sometimes been adopted by the descendants of the European colonists. The 'Hiawatha' of Longfellow, and the tales and dramas based upon the deeds, adventures and romantic episodes in the lives of King Philip, Pocahontas, Pontiac, Tecumseh, etc., to say nothing of the novels of Cooper and his successors, indicate that the Aryan mind of the Anglo-Saxon order has found treasure in the Amerindian soil. In Mexico and other parts of Spanish America the cathedrals and other religious edifices, by intention or by happy chance, often occupy sites sacred ages before the Columbian discovery to pagan deities, — so the new religion gathers strength from the old, and the dislocation of faith so common in Protestant countries is avoided to a very large extent. Of more material things, we owe largely to the Indian the paths over which our highways and our railroads run, while many of our cities and towns have only sprung up on the old campsites of our predecessors. The great importance of some of these "Indian ways" in the history of the United States has been pointed out by Hulbert. The Indians' knowledge of the great water-ways of the country, of portages and trails through forest and over mountain, has made possible colonization and settlement otherwise utterly out of the question. Indian hunters and fishers, scouts, guides, canoe-men, carriers and packers, in all sections of the American continent, have been indispensable to the progress of white civilization. Nor have Indian slaves and servants been few or without social significance in some quarters; while French, Spanish, and English have at times availed themselves of the services of Indian warriors, — the Iroquois enlisted for the North and some of the Cherokee for the South in the Civil War, and then the government has sometimes set one tribe off against another. In Canada and part of the northwest of the United States, where commingling of the races has taken place, the civilization of the land owes even more to the half-breed, *voyageur, coureur des bois*, etc., than to the Indian himself. (See CANADA.)

Throughout the continent — more especially, however, in parts of South America — devices for hunting and fishing and appliances in woodcraft, primitive agriculture, etc., were transferred to the European colonists during the period of settlement, and many of them are still in active use. Fish-poisoning by narcotics, the use of the blow-gun for killing birds and small animals without damaging the skin, methods of stalking beasts of the chase, certain traps and snares, etc., belong here. In connection with agriculture we have menhaden-manure, guano, etc., the planting of corn and beans or pumpkins together, the burning over of land before tillage, etc. But it is upon the food-supply of the world that the American Indian has exerted the greatest influence. Potatoes (common and sweet, both), maize, and the tomato, now in use by all the civilized world, were first cultivated by him and taken over by the whites after the discovery. Cacao, vanilla, jalap, the kidney bean, several varieties of squash and pumpkin, manioc, Jerusalem artichoke, coca, agave, quinoa, persimmon, and perhaps also the peanut, came to us from the Indians. Maple-sugar and maple-syrup, pemmican, jerked beef, etc., are from a like source. Tobacco, the great narcotic, was one of the first gifts of America to the Old World. Of drinks the American Indian has given us Paraguayan *maté*, "Labrador tea," and several other like concoctions, chocolate, Mexican *pulque*, and a considerable number of other intoxicating beverages from South America.

Many medicines and medicinal plants were made known to the whites by the Indians, and in the era of settlement and colonization the "Indian doctor" (male and female) was not unimportant.—New England, for example, had its "Joe Pye," after whom the "Joe Pye weed" (*Eupatorium purpureum*) is named. The Californian Indians have furnished perhaps the three most important contributions of recent years to the American pharmacopœia. South America, besides numerous locally known remedies, etc., has furnished the world-famous *quinine*, and *ipecacuanha*, while the drugs *cocaine* and *curari* must ultimately be credited to the aborigines of America. Many dye-stuffs and dye-woods were first given to the civilized world by the Indians, both for domestic use and for employment in the larger world of æsthetic manufacture. These dyes range from the poke of northeast North America for dyeing basketry to the famous roucou or anotto of Venezuela, used, among other purposes, for staining cheese. Pottery and other household utensils of Indian manufacture are used throughout Spanish America. The hammock of the Arawak Indians belongs now to all civilized peoples. All that india rubber means, civilization owes to the Indian. Both in small things and in great the American aborigines, through their gifts to the white race, will long be remembered, even if, as some authorities (upon imperfect evidence) believe, they are rapidly passing away. On this point one may cite the remark of Deniker that Humboldt in 1825 estimated the total population of America at 13,000,000 whites, 6,000,000 half-breeds, 6,000,000 negroes, and 9,000,000 Indians, while a computation made in 1895–7 reckoned 80,000,000 whites, 37,000,000 half-breeds, 10,000,000 negroes and 10,000,000 Indians.

There might be mentioned here also the "Chinook Jargon" of the Columbia River region, the "Lingua Geral" of Brazil, and the minor jargons and trade languages of other sections of the continent, which prove how the Indian has compelled the white man, more or less, to use his language in some form or other for the purposes of friendly or commercial intercourse.

Antiquity of Man in America.— The question of the antiquity of the American Indian culture is difficult to settle satisfactorily. Time must be allowed for the divergence of the original stock into the numerous (more numerous in pre-Columbian eras) tribes and peoples inhabiting America at the time of its discovery, —time for the production of the Eskimo and the Iroquois, the Carib and the Patagonian. Time, again, must be allowed for the development of the Aztec from the primitive Shoshonean, the Mayan from the rude stock of that people, the Chibchan from the savage Bolivian, the Peruvian from the ancient barbarian of equatorial America. Then the civilizations of Mexico, Central America, and South America, as such probably took ages to rise and flourish. Town and village life, with all its social and religious implications, the differing architectural monuments of the various centres of American civilization, etc., did not spring up in a day, any more than did the culture of mediæval Europe. The domestication of the dog, the llama, etc., the change of maize, tobacco, the squash, the tomato, the potato, the pineapple, etc., from wild to cultivated plants, require a long lapse of time. Moreover, it is now known that American Indian languages do not now change and have not in the past changed at the fast rate once assigned to them by philologists. So, while one may not believe that America was the original habitat of the human race, he may be certain that very many millenniums have elapsed since the "Red Man" began his career as the autochthone of the New World. There seems every reason to believe that at the close of the Glacial Age man had spread over a considerable portion of both North and South America, and was contemporary with European man of an early epoch. To calculate man's residence in the American environment by years is impossible on present evidence. Dr. Stoll assures us that the linguistic phenomena met with in the Mayan dialects alone require thousands of years for their evolution, and some of the results deduced from the Mayan hieroglyphs by certain investigators imply the existence of civilization of the Central American order for very many millenniums. Perhaps it is fair to say that man has been in America at least 25,000 years and not more than 200,000, and that the civilizations of Mexico, Central America, and South America were probably as long-lived as those of Rome, Greece, etc. They were also in many respects just as typical of human attempt and achievement, for the American Indian was a man as we are men.

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The 'Publications of the Bureau of American Ethnology,' embracing original monographs by eminent specialists, are a lasting monument to the founder of the Bureau, the late Maj. J. W. Powell, to whom all students of the aborigines of the New World owe a debt of deepest gratitude. Among workers not connected with the Bureau, the death of D. G. Brinton in 1899 removed perhaps the most gifted and representative Americanist.

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Indicator, in steam engineering an instrument invented by James Watt, to record, graphically and automatically, the pressure in an engine cylinder at every point of the stroke. By means of the diagram that the indicator

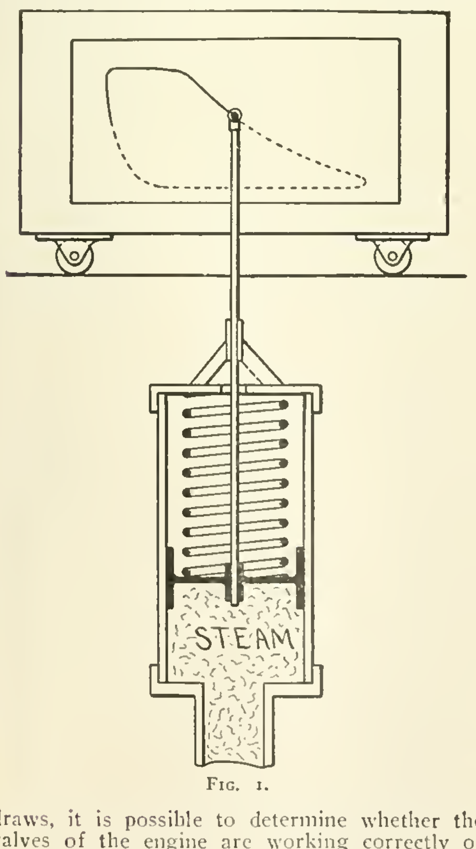

Fig. 1.

draws, it is possible to determine whether the valves of the engine are working correctly or not, and it is also possible to estimate the horsepower that the engine is developing, with considerable accuracy. Commercially, the steam-engine indicator may be had in many forms; but all are based on the same fundamental principle, which will be understood by reference to the diagram presented in Fig 1. The paper upon which the indicator diagram is to be drawn is here supposed to be secured, flat, to a carriage which travels back and forth upon a track; the motion of the carriage corresponding precisely

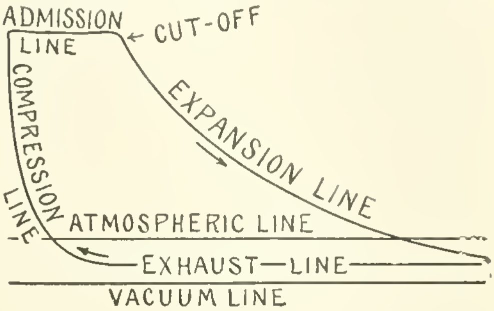

Fig. 2.

to the motion of the piston of the engine. In practice it would be inconvenient to have the carriage travel a distance equal to the whole stroke of the engine, and hence some form of reducing motion is used, so that the motion of the carriage may follow the motion of the engine piston accurately, but with materially reduced velocity. The indicator diagram is draw by means of a pencil-point carried on the piston rod of a small steam cylinder which is situated below the carriage, and which opens freely into the cylinder of the engine from which the diagram is to be taken. The piston of the indicator is pressed downward by means of a spring whose strength is accurately known, so that the increase of pressure corresponding to a rise of one inch in the position of the pencil-point is known. When the indicator is in operation, the pencil rises and falls proportionately to the pressure of the steam in the engine cylinder, and the carriage, with its attached paper, travels back and forth, horizontally, at the same time, keeping pace precisely with the motion of the piston of the engine. Under these circumstances the pencil-point traces a diagram somewhat like that shown in the illustration. In practice, the paper upon which the diagram is drawn is usually wrapped about a cylindrical drum, which rotates back and forth as the instrument works, following the motion of the engine piston just as the carriage here shown is supposed to do. In Fig. 2 an enlarged view of an indicator card (or diagram) is given, together with the technical names of some of its more important parts. The arrows show the direction in which the pencil travels as the diagram is drawn. The "admission line" is the part that is drawn while the engine is in full communication with the boiler, and drawing steam from it. The angle marked "cut-off" corresponds to the moment at which the steam supply is cut off, and the expansion of the steam begins. The "expansion line" is drawn during the expansion of the steam, and on the return stroke, after the exhaust valve has opened, the "exhaust line" is drawn. When the exhaust valve has closed again, the steam remaining in the engine cylinder is compressed until the end of the stroke, the indicator meanwhile drawing the "compression line." The "atmospheric line" is the straight, horizontal line drawn by the engine when the connection is broken between the engine cylinder and the indicator cylinder, and the latter is open freely to the air. The "vacuum line" is the line that would be drawn by the instrument under like circumstances, if a perfect vacuum could be maintained in the indicator cylinder. The "vacuum line," of course, must be drawn in by hand. It is parallel to the "atmospheric line," and at a distance below it corresponding to a pressure of about 14.7 pounds per square inch, on the scale to which the diagram is drawn. The diagram shown in Fig. 2 refers to a condensing engine. In a non-condensing engine, the exhaust line would not be lower than the atmospheric line, and would, in fact, be above it, if there were any sensible back-pressure in the engine during exhaust.

For detailed information concerning the indicator and its uses, consult: Pray, 'Twenty Years with the Indicator'; Peabody, 'The Steam Engine Indicator'; also, for less extended treatment, any good book on steam engineering.

Indictment, ĭn-dīt'mĕnt, a formal charge made before a legal tribunal against an accused person. The essential requisites of a valid indictment are,— first, that the indictment be presented to some court having jurisdiction of the offense stated therein; second, that it appear to have been found by the grand jury of the proper county or district; third, that the indictment be found a true bill, and signed by the foreman of the grand jury; fourth, that it be framed with sufficient certainty; for this purpose the charge must contain a certain description of the crime or misdemeanor of which the defendant is accused, and a statement of the facts by which it is constituted, so as to identify the accusation; fifth, the indictment must be in the English language, but if any document in a foreign language, as a libel, be necessarily introduced, it should be set out in the original tongue, and then translated showing its application, 6 Term. 162. The formal requisites of an indictment are, first, that the venue, which at common law should always be laid in the county where the offense has been committed, although the charge be in the nature transitory, as a battery. The venue is stated in the margin thus: "City and County of ——, to wit." Second, the presentment, which must be in the present tense, and is ordinarily expressed in the following formula: "the grand inquest of the State of ——, inquiring for the city and county aforesaid, upon their oaths and affirmations present." Third, the name and addition of the defendant; but in case an error has been made in this respect, it is cured by the plea of the defendant. Fourth, the names of third persons, when they must be necessarily mentioned in the indictment, should be stated with certainty to a common intent, so as sufficiently to inform the defendant who are his accusers. When, however, the names of third persons cannot be ascertained, it is sufficient in some cases, to state "a certain person or persons to the jurors aforesaid unknown." Fifth, the time when the offense was committed should, in general, be stated to be on a specific year and day. In some offenses, as in perjury, the day must be precisely stated, but although it is necessary that a day certain should be laid in the indictment, yet in general the prosecutor may give evidence of an offense committed on any other day previous to the finding of the indictment. Sixth, the offense shall be properly described. This is done by stating the substantial circumstances necessary to show the nature of the crime, and next the formal allegations and terms of art required. As to the substantial circumstances: the whole of the facts of the case necessary to make it appear judicially to the court that the indictors have gone upon sufficient premises, should be set forth; but there should be no unnecessary matter, nor anything which on its face makes the indictment repugnant, inconsistent, or absurd.

According to the rules of pleading in criminal actions at common law there are certain terms of art used, so appropriated by the law to express the precise idea which it entertains of the offense, that no other terms, however synonymous they may seem, are capable of filling the same office; such, for example, as traitorously in treason; feloniously in felony; burglariously in burglary; maim in mayhem, etc. In New York, and in nearly all of the States which have adopted the code system, the common law rules of pleading in criminal actions have either been greatly relaxed or entirely abolished. Many of the statutes of the subject are similar to the New York statute, Code Crim. Pro. § 273, which in substance provides that all common law rules of pleading are abolished, and the forms of pleading prescribed by the code shall be substituted, and § 275 of the same code provides that all an indictment must contain is, the title of the section, specifying the name of the court to which the indictment is presented, and the names of the parties, and a plain and concise statement of the act constituting the crime, without unnecessary repetition. It is also provided in § 283 of the New York Code Crim. Pro. that words used in a statute to define a crime need not be strictly pursued in the indictment; but other words conveying the same meaning may be used.

Indigestion. See DYSPEPSIA.

In'digo, the name of a genus of plants, and of the blue coloring matter obtained from them. The indigo plants are tall herbs of the pea family, forming the genus *Indigofera*, of which there are several color-yielding species in various warm parts of the world. The one yielding the indigo of commerce, and formerly extensively cultivated, is *I. tinctorium*, which is native to India, grows five feet high, and has bipinnate leaves. The coloring matter most abounds in the leaves, and especially as the time of flowering occurs, and that is the time when the crop is gathered by cutting down the plant, and making immediate use of the green stems or foliage, or by drying them for subsequent treatment. This coloring matter is a chemical substance called *indican*, the glucoside of indoxyl, which is converted by oxidation into indigo. Until the discovery of the sea-route to India the only blue vegetable dye available in Europe was that derived from the woad (q.v.), which was limited and costly; this dye-substance was therefore regarded as one of the most valuable of new commodities and a large capital was soon embarked in its cultivation in India, Ceylon, China, and other regions, where a profitable industry continued until after the middle of the 19th century. The indigo was obtained by macerating the leaves and stems in vats for several hours. Fermentation arises and the water becomes clear yellow. It is then run off into a lower basin, where it is subjected to incessant agitation and gradually turns green, whereupon the indigo begins to form in flakes and settle. The residuum is then thoroughly boiled, filtered through linen, molded into small cakes and dried. The best quality comes from Bengal and eastern India. Indigo plantations were made with more or less success in Brazil, Central America, and Mexico; and one of the foremost inducements held out to settlers in the southern colonies, from Maryland to Louisiana, was the probability of its successful cultivation there. The experiments never yielded results of much importance, partly because crops of tobacco, cotton, and food-stuffs were more profitable. Since the discovery of cheap methods of forming blue dyes from coal-tar the cultivation of indigo has declined greatly, but still supplies a steady demand from cloth-dyers who wish an imperishable blue of certain tints.

The wild indigo of the United States is any of several species of a closely related genus *Baptisia*, which flourishes especially in the Southern States. The best known is the yellow-flowered false indigo (*B. tinctoria*), or indigo brown, from which country people obtain a blue dye, and a domestic medicine.

Indigo Dyeing.— Before it can be employed in dyeing, the indigo must be brought into solution; and as indigo itself is insoluble, it must be first transformed into a soluble substance, so that it can penetrate the pores of the cloth, where it is subsequently again restored to the form of indigo. To bring the indigo into solution, it is ground up to a soft paste with water, after which it is thrown into vats along with ferrous sulphate, slacked lime, and water. The ferrous sulphate reacts with the lime to form calcium sulphate and ferrous oxid, the latter being immediately oxidized at the expense of part of the oxygen of the indigo, which in its turn is reduced to a substance called indigo-white. This dissolves in the presence of excess of lime, and the fabric to be dyed is dipped into the vat after the liquid in it is clear. On removing the fabric the indigo-white which has penetrated its pores is reoxidized by the air to indigo blue; and by repeating this treatment a shade of blue of any desired depth may be obtained. The dyed fabric is finally passed through dilute acid to remove any adhering lime or ferric oxid. Indigo appears to exist in the plant in the form of a glucoside known as "indican," which has the formula $C_{52}H_{62}N_2O_{34}$, and to be developed from this glucoside in the course of the fermentation by the action of a special bacillus, which closely resembles the bacillus of pneumonia. Indigo is now made artificially, the total production of synthetic indigo being probably about one fourth of the world's consumption. Although artificial indigo-blue appears to have the same chemical formula ($C_{16}H_{10}N_2O_2$) as the natural product, and to be identical with it in every way, it is more expensive than the natural product at the present time. If it could be made more cheaply, it would work as great a revolution in dyeing as did the introduction of alizarin in the place of madder. (See COAL TAR COLORS, and the references there given.)

Indigo-bird, a numerous and beautiful North American finch (*Passerina cyanea*), the male of which is dark greenish blue, while the female is grayish brown. They are migratory, but in summer spread over most of the United States, placing their neat nest and unspotted bluish eggs in garden bushes as well as in wild thickets. The male has one of the brightest and most persistent songs of any American bird; and he is easily habituated to captivity.

Indigo-snake. The gopher-snake (q.v.).

In'direct Damages, claims for damages not directly inflicted by the illegal act complained of, but by other causes themselves due to that act. The great historical case is that of the United States claim for many hundreds of millions of dollars' worth of loss, resulting from Great Britain's bad faith or carelessness in letting the Alabama (q.v., and ALABAMA CLAIMS) escape from her ports to prey on our commerce. It was alleged that aside from the actual loss to our shipping and cargoes, we had been damaged to a far greater extent by the resultant effects, chiefly of three sorts: (1) The prolongation of the Civil War due to the encouragement given to the South and the straitening of the North. (2) The destruction of commercial lines and relations, which took long to recover after the War. (3) The raising of the rates of marine insurance. As these claims exceeded the cost of a war plus the indemnity we should have exacted if victorious, Great Britain refused to consider them; and the commission threw them out altogether as contrary to international law.

In'dium, the name given to a metal discovered by spectroscopic analysis in 1863. It is of a silver white color, soft, and marks paper like lead; its specific gravity is 7.421 at 16.8°. The lead indium is related to cadmium and zinc, both associated with it in nature. The spectrum of indium exhibits two characteristic lines, one violet α and another blue line β; besides these two fainter blue lines are visible if the burner in which the metal is volatilized be fed with hydrogen instead of coal gas.

Individual Psychology. This term is applied to that branch of psychology which deals with the mental variations of individuals from one another. It is thus contra-distinguished from general psychology, which undertakes to determine the facts and laws of conscious processes as a whole and without special reference to their peculiar manifestations in any particular persons or group of persons. The field of individual psychology may be regarded as a part of the larger field of variational or differential psychology in which are to be included studies upon special races and upon social groups of various sorts. Such studies are carried on with special reference to detecting and describing the characteristic mental traits of such groups, but often with little emphasis on typical variations from other similar groups. Obviously the range of problems in individual psychology must be as broad as mind itself, for persons may vary in regard to any mental characteristic. It will only be practicable to mention a few of the problems thus far investigated, *e. g.*, mental type, temperament, and genius, the psychology of special mental defect, the psychology of the criminal, the psychology of sex, and that of professions or classes with their peculiar variations of mental constitution.

To exhibit more concretely the kind of material with which individual psychology works we may comment briefly on the first three of these topics. The determination of *mental type* is a problem of individual psychology in the narrow sense of the term in so far as it has to do with the ascertaining of the characteristic features of the mind of any particular person. In so far as it bears on the problem of discovering what actually are the typical groupings of such characteristics among people in general, it obviously belongs to the broader field of variational psychology.

1. Minds may differ from each other as regards the delicacy or sensitiveness with which they respond to stimulations of the sense organs. One may be more sensitive than another to slight variations in temperature, in color, in tone, etc. As a matter of fact, among normal persons such differences of sensitivity are relatively slight when the conditions of training and discipline are similar. As a general rule the higher mental functions show more variation than the lower ones such as sensitivity. Minds may differ as regards the special form of sense material toward which they manifest a predilection, *e. g.*, the musically minded person not only finds sounds of greater emotional interest than the unmusical person, but he also has a better memory for auditory experiences and his conscious processes in their entirety are likely to be much more influenced by auditory factors. A further development of such mental preference for one or another kind of sense material is found in the fact that certain individuals carry on most of their thought processes in terms of visual images, whereas others employ auditory images, and still others motor images. Probably the normal condition is represented by an admixture of various forms with some particular group dominating slightly over the others. Again, in memory we meet striking differences in addition to those of the imagery type already mentioned. For example, certain persons learn very rapidly and also forget rapidly. Others learn with difficulty but retain well that which they have learned. Occasionally we find persons who combine ability to learn quickly with capacity to retain permanently. It seems certain from psychological investigations that individuals supposed to possess particularly good memories are generally proficient only in certain directions. A universally efficient memory is rarely, if ever, found. People differ also very markedly as regards their ability to concentrate their attention. Some persons can concentrate very intensely for a short time but must then rest. Others are able to localize for more extended periods, and still others find it all but impossible ever to secure any intense concentration. Variations of a striking kind are also disclosed in the formation of judgments. Certain persons judge almost entirely in accord with the objective facts presented to their notice. Others are influenced in various degrees by subjective influences and show themselves peculiarly susceptible to suggestion. It is a matter of common observation that persons vary radically as regards temperament and feeling. One of the most practically important variations is represented by the difference in the rate at which the conscious processes proceed. Just as certain persons naturally walk and talk more rapidly than others, so do the mental processes vary as regards the speed with which they occur. Psychologists have demonstrated a rather characteristic daily variation as regards both rate and efficiency of mental activity. Many persons work best at night. Others are morning workers and still others afternoon workers.

2. The old familiar classification of temperaments recognizes the four types: sanguine, melancholic, choleric and phlegmatic. Both the choleric and the sanguine are supposed to be subject to rapid oscillations of emotional interest, but with the sanguine individual interest is rarely intense, whereas with the choleric it is rarely anything else. The melancholic and the phlegmatic represent the more persistent and dogged forms of interest but, like the previous pair, are distinguished by differences in the intensity of the interest, the phlegmatic person being less, the melancholic more, intense. These classifications are likely to be extensively revised by current investigation.

3. The modern study of genius has not only contributed to a more definite conception of the nature of genius and the general mental characteristics of the remarkable individual, but it has also revealed the hereditary character of marked intellectual superiority, and the relation between certain types of genius and mental defect.

Galton has gathered statistics to show that the frequency of genius is related in a definite and orderly way to the total number of persons in any given group. He has also shown that the genius appears with a background of heredity which affords a reasonable explanation of his peculiar characteristics. The view often urged by such writers as Lombroso that genius is essentially a morbid and degenerate mental phenomenon, seems to be sound only in so far as concerns the *liability* of persons of remarkable mental qualities to nervous derangement of various sorts. That insanity itself and genius are in any intrinsic sense identical is not generally granted. Among the interesting problems which deserve further study in the case of genius may be mentioned the determination of the extent to which the genius owes his superior endowment to heredity, as contrasted with education and favorable nurture; the ascertainment of the conditions which hinder or encourage the development of genius; the discovery of the general mental types to which the various remarkable individuals conform.

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Indo-China, the southeastern peninsula of Asia, formerly known as Farther India, including

Anam, Burma, Cambodia, Cochin-China, French Indo-China, Tongking (qq.v.), and other districts.

Indo-Europe'ans, the Aryan race (q.v.). For accounts of the Indo-European languages see ARYAN; INDO-GERMANIC LANGUAGES.

Indo-German'ic Languages, the languages which are ancient and modern varieties of one primeval form of speech, anciently spoken in Central Asia. These languages are sometimes called the Indo-Celtic languages, the Japhetic languages, or more commonly, the Aryan languages. There are three forms of human speech, the monosyllabic, or isolating languages, such as the Chinese, whose words are unchangeable roots, each of which stands separately and is modified by the juxtaposition of other monosyllabic roots; the agglutinating languages, such as the South African, the Japanese, and the American Indian, in which, instead of being isolated, the roots are placed in close association, so as to agglutinate or agglomerate into one word. Some Eskimo words are as long as the longest compound epithet of Aristophanes. The third group are the inflectional languages. The Indo-Germanic languages are inflectional. In these the roots of all words are not necessarily modified, but they may be modified, in order to express certain relations, and the roots are also added to by suffixes and prefixes. The Indo-Germanic languages do not extend over so wide an area as the monosyllabic languages, but are spoken by the most civilized and intellectual peoples of the world. The Indic branches are the ancient Hindu languages, the principal of which is Sanskrit, and the modern Hindu languages. The Iranic or Persian branch includes, Zend, Old Persian, Armenian, Parsee, modern Persian and the dialect spoken by the mountaineers to the northwest of India. The great Hellenic branch was spoken anciently by the inhabitants of Greece, of the west coast of Asia Minor, of the islands of the Ægean, as well as of the south and southwestern coasts of Italy. It is spoken in a modified form in Greece and the Greek islands of to-day. Parallel to the Hellenic is the Italic branch, which includes the primitive Italic languages, Oscan, Etruscan, Umbrian, and Latin, as well as the classic Latin of Virgil and Cicero, which settled into the Italian of Dante and, on being extended over western Europe, grew through many modifications into French, Provençal, Italian, Spanish, Portuguese and Roumanian. Distinct from this branch was the Celtic, which survives to-day in the Welsh and Gaelic dialects. The Teutonic tongues include the Gothic of Ulfilas (4th century A.D.) the Norse languages, the Low German and the High German group. The Sclavonic languages are spoken in Russia and Poland and include the Lithuanian and the Old Prussian. There are several other Indo Germanic tongues and dialects which philologists have not been able to classify; such are the Etruscan in Europe and certain languages of Asia Minor. Compare: Schleicher, 'Compendium der vergleichenden Grammatik der Indo-Germanischen Sprachen' (1871); Corrsen, 'Ueber Aussprache, Vocalismus, und Betonung der lateinischen Sprache'; and most important Brugmann and Delbrück, 'Grundriss der vergleichenden Grammatik der Indo-Germanischen Sprachen' (1897 *et seq.*).

Induction. It is a familiar fact that an electrified (or magnetized) body causes electrical (or magnetic) disturbances in other bodies in its vicinity, when it is not in direct and visible connection with them, and the process by which these disturbances take place is called "induction." The ultimate mechanism of induction is still somewhat obscure, but something has been learned of its general nature. In the early days of physical science it was believed that bodies can act upon one another even across spaces that are absolutely void, and at the present time it is sometimes convenient to assume them to act in this manner, in forming mathematical equations for the treatment of physical problems. It is no longer believed, however, that this is what actually happens in nature; the phenomena of electric and magnetic induction being now attributed to motions or stresses in the ether which transmits light. (See ETHER.) Newton was of the opinion that induction is an ether-phenomenon, and in the first half of the 19th century Faraday may be said to have established the ether hypothesis upon a substantial experimental foundation. In later years Maxwell developed Faraday's conceptions mathematically, and added much more evidence that was partly theoretical and partly experimental; so that at the present time there are few or no physicists who doubt that induction is a manifestation of some form of activity in the light-bearing ether. Opinion is still divided, however, as to the precise nature of this activity. In fact, we cannot hope to gain any very precise information on this point until much more is known about the constitution of the ether itself.

The charging of a condenser is a phenomenon in electrostatic induction. If the condenser consists of two parallel plates (for example), of a given size and set at a constant distance from each other, and we charge it to a given potential, the quantity of electricity that must be put into it in order to charge it in this manner depends to a considerable extent upon the nature of the dielectric (or insulating material) which separates the plates. If the charge that is required when air is the dielectric is taken as unity, then with plate glass as a dielectric the charge will have to be 8.45 (according to Hopkinson), in order to bring the potential of the condenser up to the same value as before. If the space between the plates is filled with common turpentine, a charge 2.23 times as great as that required with air as the dielectric must be communicated to the condenser. It is evident, from these facts, and from others of the same nature, that electric induction depends, to a large extent at any rate, upon the nature of the medium which separates an electrified body from the other bodies upon which the inductive influence is felt. The constants that are given above are known as the "specific inductive capacities" of the dielectrics to which they refer.

Electrodynamic induction is the basis of practically all of the electrical machinery that has been found serviceable to man. The fundamental fact of electrodynamic induction may be stated as follows: If a closed electrical circuit, such as might be formed by joining the two ends of a copper wire, is placed in a magnetic field, then no current will be produced so long as the circuit is everywhere stationary, and the strength of the magnetic field remains every where invariable. If the intensity of the magnetic field is increased, a current of electricity will flow around the circuit while the intensity of the magnetism is changing, the intensity of the current being proportional to the rapidity with which the intensity of the magnetism varies. As soon as the magnetism again becomes constant, the current in the circuit ceases. If the intensity of the magnetic field be diminished instead of increased, a current will also be produced in the closed circuit, but it will be opposite in direction to that produced by increasing the magnetic field. Currents produced in this manner are called "induced currents." Instead of varying the magnetic field while the circuit is fixed in position, we may move the circuit about in the magnetic field. If the magnetic field is everywhere uniform in all respects, and the circuit is moved so as to always remain parallel to itself, then no induced current will be produced; but if the circuit is moved from a region where the magnetism is strong to one where it is weak, or *vice versa*, a current will be induced in the circuit, just as if the circuit were kept stationary and the intensity of the magnetism varied. Induced currents are also produced when, instead of being translated from one region to another, the circuit is rotated in a magnetic field, in such a way that the number of lines of magnetic force passing through it is either increased or diminished. In the induction coil the intensity of the magnetic field is varied, while the circuit in which the induced current is to be produced is kept stationary. In dynamos, on the other hand, the magnetic field is maintained sensibly constant, while the circuit in which the induced current is to be produced is rotated or otherwise moved about.

A current moving in a closed circuit produces a magnetic field in the space above it, and this magnetic field, when it varies on account of the variation of the current that produces it, causes the production of induced currents in any closed circuit that may happen to be near. Let us conceive two closed circuits, A and B, to be situated near each other, and let there be a current produced by any means in the circuit A. So long as the current in A is constant, no current will be produced in B; but if the current in A is variable, an induced current will be observed in B, whose intensity depends upon the rate at which the current in A is varying, upon the resistance of the circuit B, and also upon a certain numerical factor, whose value depends upon the sizes and shapes of the two circuits, upon their positions with respect to each other, and upon the nature of the medium (air, oil, or whatever it may be) in which they are placed.

If a pair of circuits, A and B, are near each other, and A is carrying a constant current of intensity C_1, while B is carrying a constant current of intensity C_2, then the displacement of either circuit, relatively to the other, would cause induced currents to flow in both; and hence (in general) neither circuit can be moved without the energy of the system being affected. The difference between the energy of a pair of coils that are near together, and the energy of a similar pair of coils that are conveying identically the same currents but are infinitely remote from each other, is equal to MC_1C_2, where M is a numerical factor whose value depends upon the sizes and shapes of the two circuits, upon their relative positions, and upon the medium in which they are placed. The factor M is called the "coefficient of mutual induction" of the pair of circuits.

The various parts of a single circuit act upon one another inductively, just as separate circuits do; and a circuit that is wound upon a spool, or otherwise coiled so that its parts come near together, possesses greater energy than the same circuit would have, if it was not so coiled. This fact is expressed by saying that every circuit has a certain amount of "self-induction." The energy that a circuit possesses in virtue of its self-induction is proportional to the square of the current that it is carrying, and to a certain numerical constant called the "coefficient of self-induction," whose value depends upon the size and shape of the circuit, and upon the medium in which it is placed. Like the coefficient of mutual induction of a pair of circuits, the coefficient of self-induction of a single circuit can be computed, for certain simple cases, by methods given by Maxwell, in his 'Treatise on Electricity and Magnetism'; but in the general case the computation is exceedingly difficult, and altogether impracticable; so that the values of these coefficients for given circuits are usually determined experimentally, except when a very rough estimate will serve.

The general subject of induction is essentially mathematical in its character, and cannot be properly explained nor understood without the use of the calculus. Consult Nipher, 'Electricity and Magnetism'; Maxwell, 'Treatise on Electricity and Magnetism.' See also the articles ELECTRICITY and MAGNETISM, in this encyclopedia. A. D. RISTEEN, PH.D.,
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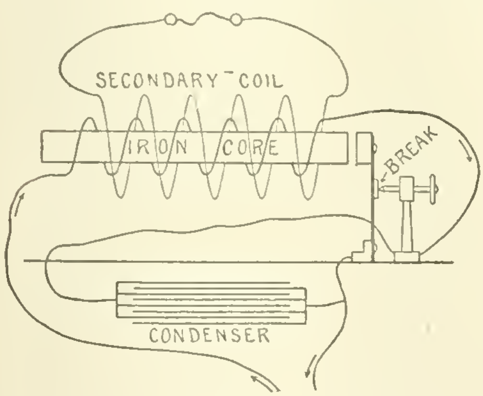
Induction Balance, in physics, an apparatus designed for detecting the presence of fragments of metal, or for studying the electrical conductivity of metals. It consists essentially of four coils of fine wire, an electric battery, a circuit breaker, and a telephone. Let the coils be designated, respectively, by the letters A, B, C and D; A being similar to B in all respects, and C being likewise similar to D. Coils A and B are placed in circuit with the battery, and coils C and D are placed in circuit with the telephone. The coils are disposed in pairs, A being placed near C, and B near D. If the current through A and B is rapidly interrupted, an induced current will, in general, flow through C and D, at each make and break; its presence being indicated by the sounds that it produces in the telephone that is in circuit with C and D. It is possible, however, to dispose the coils and their connections so that the current that A induces in C shall be sensibly equal and opposite to that which B induces in D. When the balance is perfect, no sound will be heard in the telephone. If a piece of metal be now brought near the coil A, the intermittent current in A will induce currents in the mass of the piece of metal, and these, in turn, will act upon the coil C, producing induced currents in this coil which are not compensated by similar currents in D. The loss of balance will be at once indicated by the recurrence of sounds in the telephone; and in this way the metal fragment will betray its presence. The induction balance has been used successfully for locating bullets in the human body. When applied for this purpose to President Garfield, however, it failed to give any useful indications,— owing, it is said, to difficulties of manipulation due to the presence of metal in the mattress upon which he lay. The instrument is so sensitive that if it is balanced with a genuine coin near one of the coils, and the genuine coin is then replaced by a counterfeit imitation, the telephone at once betrays the substitution. The intensity of the sounds produced in the telephone depends not only upon the size and position of the disturbing piece of metal, but also upon its specific electrical resistance; and hence the balance may be used to compare the specific resistances of metals.

Consult Hopkins, 'Experimental Science'; Thomson, 'Recent Researches in Electricity and Magnetism'; Bell, 'The Induction Balance,' in the American Journal of Science for 1883.

Induction Coil, an electrical instrument used for the production of high potentials, and depending for its action upon the fact that induced currents are generated in a circuit, when the strength of the magnetic field to which the circuit is exposed is varied. (See INDUCTION.) The essential features of the instrument are represented, diagrammatically, in the accompanying cut. A soft iron core is surrounded by two



coils of wire, one outside of the other. The outer coil is the one in which the high tension induced currents are produced; it is called the "secondary coil," and is not in direct electrical connection with any other part of the instrument. The inner coil, which is called the primary coil, is wound close to the iron core, and is connected to a battery, so that when the current from the battery is flowing, the primary coil causes the iron core to become magnetised. As is explained in the article INDUCTION, no current is generated in the secondary coil, so long as the magnetism of the iron core remains constant; but whenever the magnetism of the core increases or diminishes, a current is produced in the secondary. A device called a "break" or "interrupter" is therefore provided, so that the magnetism of the iron core may be rapidly established and destroyed. The commonest form of interrupter is that indicated in the cut, which does not call for special explanation, since it is used in electric bells and other simple forms of electrical apparatus. The Wehnelt electrolytic interrupter is greatly in favor among physicists, however, and is now often used in connection with induction coils, especially when they are to be run with the commercial current used for incandescent lighting, where the potential difference that is used is something over 100 volts. In the Wehnelt interrupter the primary coil on the iron core is made of a few turns of relatively thick copper wire, its purpose being solely to effect the magnetisation of the core; but the secondary coil, in which the induced currents are generated, is made of fine wire, and in order to multiply the inductive effect as far as possible, the secondary is made of great length, often containing many miles of wire. In the celebrated Spottiswoode coil the secondary contained no less than 280 miles of wire. The primary coil, being wound directly upon a soft iron core, commonly has a very considerable amount of self-induction, so that when the circuit is broken by the interrupter the current does not suddenly cease, but continues to flow across the interval at the break for an appreciable fraction of a second, as is readily seen by the strong sparking that occurs at the moment of interruption. In order to reduce the sparking as far as possible, a condenser of suitable capacity is provided, so that when the break is made in the circuit, the "after-current" due to the self-induction of the primary can discharge into the condenser, instead of passing across the break in the circuit and causing a spark. The condenser causes the interruption of the current in the primary coil to be much more sudden, and it materially increases the potential that is developed in the secondary coil, since this is proportional to the rate of variation of the magnetism of the core, and is much greater when the magnetism falls off abruptly than when it persists for an appreciable fraction of a second after the break has been made.

The induction coil was brought into something like its present form by Ruhmkorff, and is frequently known, in consequence, by his name. Improvements in the winding of the secondary coil were introduced by Ritchie, of Boston, about 1857. Ritchie's most important improvement consisted in disposing the secondary wire in sections, which were so related to one another that the risk of internal disruptive discharge through the coil itself might be reduced to a minimum. Induction coils are very generally used in studying the discharge of electricity through gases, for exciting x-ray tubes, and for producing high potentials required in wireless telegraphy. Consult Bonney, 'Inductions Coils'; Alsopp, 'Induction Coils and Coil-Making'; Wright, 'The Induction Coil in Practical Work.'

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Induction, Mathematical. Despite the age-long tyranny exercised by the Aristotelian logic — a tyranny having, at least in the domain of science, scarcely a match except in the case of Euclid's elements — the forms of thought, those diagrammatic representations of the orderliness of the reasoning processes, sustain to-day perhaps even greater interest than ever before (see SYMBOLIC LOGIC). The mathematician's interest in these forms is two-fold, attaching to them both as norms for testing the validity of arguments and as constituting exceedingly subtle matter for mathematical investigation.

Of all argument forms, there is one which, viewed as the figure of the way in which the mind gains certainty that a specified property belonging but not immediately by definition to each element of a denumerable (see ASSEM-

BLAGE THEORY) assemblage of elements does so belong, enjoys the distinction of being at once perhaps the most fascinating, and, in its mathematical bearings, doubtless the most important, single form in modern logic. This form is that variously known as reasoning by recurrence, induction by connection (De Morgan), mathematical induction, complete induction, and Fermatian induction — so called by C. S. Peirce, according to whom this mode of proof was first employed by Fermat. Whether or not such priority is thus properly ascribed, it is certain that the argument form in question is unknown to the Aristotelian system, for this system allows apodictic certainty in case of deduction only, while it is the distinguishing mark of mathematical induction that it yields such certainty by the reverse process, a movement from the particular to the general, from the *finite* to the *infinite* (see ASSEMBLAGE THEORY).

Of the various designations of this mode of argument, "mathematical induction" is undoubtedly the most appropriate, for, though one may not be able to agree with Poincaré (see *Bibliography* below) that the mode in question is *characteristic* of mathematics, it is peculiar to that science, being indeed, as he has called it, "mathematical reasoning par excellence."

The nature of mathematical induction as it is ordinarily understood may be made clear by an example. Perhaps the simplest application of the method is found in the proof of the theorem:

$(\alpha)\quad 1+2+3+\ldots\ldots+n=\frac{1}{2}n(n+1)$

where n denotes any positive integer whatever. Suppose it ascertained by observation or otherwise that

$(1)\quad 1+2=\frac{1}{2}2(2+1)$,

$(2)\quad 1+2+3=\frac{1}{2}3(3+1)$.

Facts (1) and (2) justify the *suspicion* that (α) may be a fact. The proof by mathematical induction that (α) is indeed true runs as follows: It is *assumed* that (α) is true for some definite but unspecified integer n. Then by adding $n+1$ to each member of the assumed equation, n having the same meaning as in the assumption, one finds that

$$(\beta)\quad 1+2+3+\ldots\ldots+n+n+1 = \tfrac{1}{2}(n+1)(n+2).$$

So it is seen that, if (α) *be* true for *some* integer n, it *is* true also for the *next* greater integer $n+1$. But by (2), (α) is true when n is 3: it is, therefore, true for $3+1$, or 4: therefore, for $4+1$, or 5. The argument is then usually closed by saying "and so on, hence (α) is true for any integer whatever," or by an equivalent speech. The reader will recall that the binomial theorem, the Newtonian expansion of $(a+b)^n$, where n is any positive integer, is justified in essentially the foregoing manner. Numerous other examples of propositions similarly established may be found in the better recent text-books of algebra.

The nature and the role of the foregoing *etcetera*, "and so on," demand consideration. Without it, the argument as stated seems obviously incomplete. But how is the *etcetera* to be logically justified? By reference to some axiom or principle of thought? If so, what? Or can the phrase be in some way dispensed with without damage to the argument?

Before attempting to answer them it may be well to show the inevitableness of the questions by a further analysis. Suppose it established, in regard to some property p (where, for example, p might signify the validity of the binomial theorem for some integral exponent): (1) that p belongs to the integer 1, that is, referring again to the mentioned example, the theorem is valid for the exponent 1; (2) that, *if* p belong to an integer n, it belongs to $n+1$. Propositions (1) and (2) furnish the means of generating, one after another, a sequence of syllogisms by which one proves first that p belongs to 2, then to 3, then to 4, and so on. Note that in order to ascertain by this analytic (syllogistic) method whether p belongs to a specified integer m, it is necessary to determine in advance the same question for each of the integers 2, 3, ..., $m-1$, in the order as written, a process requiring a number of syllogisms which is greater the greater the number m. Accordingly *this* method, of successive deductions, is not available for determining whether p belongs to each in the (infinite) *totality* of integers. Equally powerless to that end is experience (including observation), for this can take account of the individuals of a finite assemblage of objects at most. Either analysis or experience may avail if a sequence be finite, but if it be infinite both must fail. Not less vain is it to invoke finally the aid of induction as the term is understood and employed in the physical sciences, for this latter, resting upon a purely assumed order in the external universe, is confessedly *inductio imperfecta*, and, being such, can yield approximate certainty only.

Nevertheless, despite the inadequacy of the means mentioned, as soon as hypotheses (1) and (2) are admitted and the indicated sequence of deductions is *begun*, "the judgment imposes itself upon us with irresistible evidence" that p is a property of *all* the integers. Why? That is, how justify the "and so on"? It appears to be clear that the answer must be the adduction or invocation of an additional presupposition of formal thought, a presupposition whose formulation shall mark a conscious extension of the domain of logic by affirming as axiomatic that apodictic certainty can and does transcend every limited sequence of deductions or observations. Such presupposition, which may be called the axiom of infinity, is stated by Poincaré, in answer to the foregoing question, "why," as follows: "It is the affirmation of the power of the mind which knows it is capable of conceiving the indefinite repetition of a same act as soon as this act is found to be once possible." The act or operation, which can not indeed be indefinitely repeated, but which by the axiom can be conceived as so repeated, is, in the present case, the construction of the syllogisms of the sequence above mentioned.

The *etcetera* in question is capable of justification without appealing, apparently at least, to the axiom of infinity, namely, by use of the so-called indirect method of proof, the method known as *reductio ad absurdum*. Thus let it be *supposed* that the argument sought to be indefinitely extended by means of the phrase "and so on" does not admit of indefinite extension along the ordered sequence of integers. There will, then, be a first integer, say $m+1$, for which the property p fails. As, by hypothesis, $m+1$ is the first integer for which p fails, p belongs to the preceding integer m; but since p belongs to m, it also belongs, by (2), to $m+1$. Hence the supposition that the argument does not admit of indefinite extension is false; and the conclusion is obvious. This procedure is convincing, but it is plainly less a natural completion than an "unindicated" fortification of the process it supplements. It is, besides, not entirely clear that the axiom of infinity is not surreptitiously subsumed by it.

By far the most penetrating investigation of the nature of mathematical induction was made originally by Richard Dedekind (see *Bibliography* below). His procedure and result are, in brief, as follows: Let S denote a system of elements (things of any kind) such that there is a scheme or law ϕ of depiction by which S may be depicted upon itself, that is, a scheme by which each element e of S may be thought as corresponding to one and but one element e' of S and so that no two elements of S shall be thought as corresponding to a same element of S. The correspondent e' of e is called the picture or image of e. Every part of S (including S itself as a special case) thus depicted upon itself is named *chain under* ϕ. Denote by A an arbitrary part of S and by A_0 the assemblage of all the elements common to all the chains (in S) that contain A. It is obvious that, S and ϕ being given, there is one and but one A_0 for a given part A of S. A_0, which is easily seen to be itself a chain, is described as the *chain of A under* ϕ. Now let Σ denote an assemblage of elements. Dedekind proves the following

Theorem.—*In order to prove that A_0 is part of Σ it is sufficient to prove: (1) that A is part of Σ; and (2) that, if an element of A_0 belong to Σ, the image of that element belongs to Σ.*

Dedekind's proof, simplified, runs thus: Let $A_0 = A_1 + A_2$ where A_1 denotes the assemblage of all those elements of A_0 that belong to Σ. By (2), A_1 is a chain, and, by (1), contains A. Hence, by definition of A_0, A_2 has no element, whence $A_0 \equiv A_1$. Such is the beautiful and marvelously fundamental theorem which its author characterizes, perhaps a little extravagantly, as "the scientific basis" of mathematical induction. It is at any rate *a* basis, and by virtue of it, as shown below, proof by mathematical induction need have no recourse to an *etcetera* consisting of an endless sequence of syllogisms.

It will be instructive to apply Dedekind's theorem to the *completion* of the proof by mathematical induction of the binomial theorem

$$(\alpha) \quad (a+b)^n = a^n + na^{n-1}b + \cdots\cdots\cdots$$

for positive integral exponents. Let it be granted that

$$(\beta) \quad (a+b)^1 = a+b,$$

and supposed it established in the usual way that, (γ), if (α) be valid for some integer, as $n-1$, then it is so for the next, n. Denote by S the sequence of integers,

$$S \equiv 1, 2, 3, \ldots\ldots, n-1, n, \ldots\ldots,$$

by ϕ the scheme by which each number in S except 1 is the image of its predecessor, and let A be 1. Then A_0 is S identically. Let Σ denote the assemblage of positive integers for which (α) is valid. The reader will now observe that Dedekind's theorem enables one to prove by a *single* stroke, so to speak, that (α) is valid for all positive integers. For, by (β), (α) is valid for 1, that is, A is part of Σ and (1) is satisfied; and, as A_0, or 1_0, is S, it follows from ( ) that (2) is satisfied; γ hence S is part of Σ.

With the modern increasing interest in the philosophy of mathematics, mathematical induction has steadily gained in interest and acknowledged importance. Certain questions respecting its presuppositions and field await definitive answers. It is agreed that every argument by mathematical induction is a mathematical argument, no matter what the subject-matter, but there is difference of opinion as to whether every mathematical argument is mathematical induction either in terms or in disguise. Were this converse true, mathematics (see Mathematics) would be definable in terms of this mode of ratiocination. This and kindred questions are considered in the works cited below.

Bibliography.—Dedekind, 'Was Sind und Was Sollen die Zahlen' (also in English); Poincaré, 'Sur la nature du raisonnement mathematique,' Revue de Métaphysique e de Morale, Vol. II.; Schröder, 'Algebra der Logik,' Vol. III.; Russell, 'The Principles of Mathematics,' Vol. I.; Keyser, 'Concerning the Axiom of Infinity and Mathematical Induction,' Bulletin of the American Mathematical Society, Vol. IX.

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Indulgence. An indulgence is a partial or total remission by the Church, through an extra-sacramental channel, of the temporal punishment due for sin after its guilt and eternal penalty have been removed by the sacrament of penance. The theological basis upon which the doctrine rests is that all the acts of Christ, the God-Man, were of infinite value, that the acts of the Saints are his acts because vivified by divine grace, and from this treasury of divine, supereminent merit the Church is able, so to speak, to pay the debt of temporal punishment for the repentant sinner.

Certain cardinal principles of Catholic life are requisite to obtain a correct idea of the Catholic doctrine of indulgences. Growth and adaptation have characterized the Christian organism from the Apostolic Council of Jerusalem to the Œcumenical Council of the Vatican. The development of doctrine upon which such explicit emphasis was laid by the late Cardinal Newman, is of prime significance for the student who would institute a comparison between the teaching and practice of the Church in the matter of indulgences at the present day and during apostolic times. We may observe in passing that the principle of doctrinal development is in perfect harmony with the scientific spirit of the present age. Growth and adaptation are now believed to be distinguishing features of every living and progressive organism. We should not, therefore, expect to find the Catholic system of indulgences, in all its complex details, flourishing in the primitive Church. In harmony with the law of development, essential to every organization among men, we believe that the Church's "proud boast of *semper eadem*" is not defeated by calling attention to the richness, variety, and flexibility of the outer forms of its polity and liturgy, or to the varying emphasis given to special dogmas in the course of its history, in response to the needs of particular eras. Unity in diversity is the Church's most appropriate motto. The doctrine and practice of indulgences, therefore, which obtain throughout the Catholic world at the present time must be sought for only in germ in Sacred Scripture and in the practice of the primitive Church, just as the bole, the branches, and the foliage of an oak tree, "the monarch of the forest," existed potentially in the acorn from which it sprung.

Indulgences being the remission of the temporal punishment due to sin, the interpretation of their true character should start from the Christian idea of the nature and purpose of punishment. It is therefore strange that writers of all schools of opinion concerning indulgences should fail to correlate the two concepts. At the present day the conviction prevails almost universally among non-Catholic students of penology that punishment is exclusively disciplinary and correctional. No theory could be more alien to the spirit of the entire Old Testament or to the mind of the early Christian Fathers. The inflexible and rigorous justice of God making death the wages of sin, appears in almost every page of the history of his covenant with Israel. The New Testament, founded on the atonement by Christ, only mitigates this view by impressing on the minds of men the possibility of vicarious satisfaction for their transgressions. But although Christ's atoning and vicarious sacrifice was all-sufficient in itself, or objectively considered, to satisfy the offended justice of his Heavenly Father, nevertheless the Christian economy of redemption demands each individual's co-operation at every stage in order to appropriate Christ's merits and make them subjective to himself. The opposite view (that is, the belief), that the creature has no active part in his sanctification and salvation, inclines toward Pantheism, robs good works and the Christian sacraments of genuine value, and differentiates the Lutheran from the Catholic position. According to Catholic teaching, the guilt of sin is cleansed from the soul by the application of the merits of the precious blood of Christ through the instrumentality of the Sacraments, whose efficacy, in the case of adults, depends on the subjective disposition of the recipient. The eternal punishment due to sin disappears with the guilt to which it is annexed. But, besides having these supernatural and eternal relations and consequences, sin viewed even within the circumscribed limits of man's natural life on earth, is an act of treason against God in his own kingdom involving forfeiture of all rights to life and all the good things with which God's providence has so bountifully enriched it. This temporal consequence of sin calls for a temporal reparation. The canonical penalties therefore imposed in the Church during the first centuries were intended to pay this temporal debt to the Divine justice, and were not merely disciplinary or correctional; and the sinner, in submitting to them, or in seeking mitigation from them through the intercession of the martyrs, recognized the necessity of his own personal act to satisfy the justice of God, either directly or vicariously by appropriating through the charity of the Church the superabundant merits of Christ and his Saints.

An indulgence granted to the living is an act of jurisdiction, or exercise by the Church of the power of the keys conferred on it in the well-known words of the Gospel of St. Matthew: "And I will give to thee the keys of the Kingdom of Heaven, and whatever thou shalt bind on earth, it shall be bound in Heaven, and whatever thou shalt loose on earth, it shall be loosed in Heaven." Every Church, in so far as it is a visible organization, claims in some degree a power of the keys, that is, the right to admit or exclude members — to determine fellowship. But the antithesis so emphatically expressed in the text between Heaven and Earth proves that the kingdom of Heaven there spoken of is more comprehensive than the visible Church of Christ. It is proclaimed that the power of binding and loosing on earth bestowed upon the apostles and their successors, is ratified in its every act by the supreme tribunal of God in the Church triumphant. In accordance with a well-known principle of Catholic exegesis, the best interpretation of a text of Sacred Scripture is furnished by the universal tradition of the Church from the age of the Apostles to the present time.

St Paul, in his epistles to the Corinthians, describes how he imposed punishment on the incestuous Corinthian and how he subsequently remitted it. The penalty was not merely an ecclesiastical censure of excommunication inflicted primarily for the purpose of safeguarding the flock of Christ. The Apostle expressly states that the chief motive which actuated him was anxiety for the individual salvation of the transgressor. Nor could it have been (as has been already shown) a mere disciplinary measure to impress upon the sinner the gravity of his crime or to test the sincerity of his repentance. Having no organic relation to confession, whether public or private, and no expressed or implied connection with perfect contrition, it was not a part of any conceivable Christian ordinance for the remission of the guilt and eternal punishment of sin. According to Catholic reasoning, it was therefore an exercise of the power of the keys by the Apostle to remit a temporal debt due to God for the offense; and since, according to universal Jewish and Christian belief, the Divine Justice rigorously demanded either direct or vicarious satisfaction, the Apostle could only concede that "indulgence" by appropriating to the individual sinner the superabundant merits of Christ and the Saints out of the treasury of the Church.

It will be observed that the Apostle of the Gentiles granted the first recorded indulgence in the form of an absolution. Indulgences usually took this form in the primitive Church. The early Fathers frequently refer to their being thus conceded by bishops on the presentation of a "Libellus Supplex" given to the penitent by some Christian martyr on the eve of suffering an heroic death for Christ. It is interesting to note that the present practice of never granting those favors except to persons who are in full communion with the Church, and who have received the Sacrament of Penance, was substantially insisted upon by St. Cyprian. He demands that the martyrs should not grant "Libelli" except to persons who had abandoned their sinful career and given ample evidence of heartfelt contrition and sincere conversion. Indulgences in the first centuries of the Church having implied a diminution of the period of canonical punishment (the name by which this act of leniency was then known was φιλανθρωπία.) (vide Conc. Ancyra, can. 5; Cfr:Hefele, Conciliengeschichte), such expressions as an indulgence of seven years and seven quarantines came into use. An indulgence of seven years means the condonation of as much of the temporal debt due to God for sin as canonical punishment extending over seven years would atone for. Likewise an indulgence of seven quarantines connotes a canonical punishment extending over seven Lents.

We find in the writings of St. Augustine reference to the remission, in return for almsgiving, of temporal penalties imposed for minor ecclesiastical offenses. Thus there gradually grew up the custom of granting indulgences under the form of commutation. Under this form they were especially conspicuous during the period of the Crusades. Every person who confessed his sins in a sincere and contrite spirit, received Holy Communion and joined the Crusade for liberating the holy places from the infidels was declared to need no other penance. "*Iter illud pro omni Poenitentia reputetur*" was one of the decrees of the Council of Clermont, held under Urban II. in the year 1095. The system of commutation for almsgiving afforded opportunity for abuse, as was evident in the practice of "farming out" to laymen the collection of alms in return for indulgence. Thus, for example, in the case of the famous indulgence granted by Leo. X., in 1517, to the Catholic faithful on condition that they would contribute to the completion of St. Peter's basilica in Rome, the right of collecting the money was conferred, in the first instance, on Albert, bishop of Maintz, and then sold by him to an Augsburg banker. Circumstances like these gave occasion to the Protestant party to charge the Church with the "sale of indulgences." Cardinal Pallavicini, the celebrated Jesuit historian of the Council of Trent, does not hesitate to say that if Leo X. had been surrounded by able theologians and enlightened by their counsels he would have proceeded more cautiously in dispensing indulgences. However, it should in justice be recognized that the erection of St. Peter's in Rome, the ancient capital of the Christian world, was an enterprise of the deepest interest to every member of the faithful. Together with the incidental abuses connected with commutations, other circumstances combined to inspire disaffection for the Holy See in the minds of European rulers and their dependents; and, as in the case of every revolution fed by prolonged and deeply-rooted discontent in the minds of those who control public opinion, a spark sufficed to start the conflagration. The life of Luther recently published by the Rev. Heinrich Denifle, O.P., and the abundant controversial literature which it has called forth from the ablest Protestant historians and theologians of Germany, have proved that the first Apostle of the Protestant Reformation was an epoch-maker by reason of conditions, not because he possessed in any high degree the qualities of the *Uebermensch*. Yet the nailing of his ninety-five theses on the doors of the castle church of Wittenburg in protest against the indulgence granted by Leo X., and preached by Tetzel, sub-delegate of Albert, bishop of Maintz, set all Europe aflame and destroyed the dogmatic unity of Catholic christendom.

Opposition to the doctrine of indulgences arose at different times, not because of their alleged novelty or repugnance to the religious sense of the Christian people, but because they did not always approve of the object for which alms were obtained by the preaching of indulgences, or because of the personal defects of those entrusted with their promulgation. It should be distinctly noted that these purposes were not always strictly religious. They were frequently philanthropic, such as the construction of bridges, the erection of hospitals, etc., and in such cases received the unqualified approval of princes and people. In order to comprehend the outburst which Luther was able to evoke against the indulgence granted by Leo X. we must bear in mind, besides the questionable motives that are alleged to have partly inspired the action of that pontiff, also the bitter memories that tarried in the minds of European monarchs after their defeat on the question of investitures, and the death-blow dealt thereby to the feudal system. The entire antipathy aroused, for this and other reasons, against the Holy See in the time of Leo X. found vent in the attack initiated by Luther on indulgences.

An Indulgence may be acquired directly by the living and applied by them, with the consent of the Church, to the souls of the faithful departed. All Catholic theologians are unanimous in the opinion that an indulgence should not be granted without grave and substantial reasons, since the ordinary Christian economy demands that each individual should make personal reparation for the temporal debt due for his sins. Moreover, in order to participate fruitfully in an indulgence, certain conditions and dispositions are necessary on the part of the subject. He must be in the state of grace, have a genuine desire to gain the indulgence, and perform certain acts prescribed by the Holy See.

The application of indulgences to the dead is not a juridical act of the Church, whose jurisdiction is limited to the members of the militant or visible Church on earth. Remission of the temporal debt due to God for sin by the suffering members of Christ's mystical body in Purgatory is communicated to them by the Church by way of suffrage or supplication. In other words, she authorizes the living to join their petitions with hers that God may graciously accept the indulgences which they gain and in the measure in which they gain them, in behalf of the souls of the faithful departed. Indulgences are now dispensed partly by way of absolution and partly by way of commutation. The well-known distinction between partial and plenary indulgences should be understood in an objective sense. The degree in which any indulgence is actually gained or subjectively appropriated by the individual depends on his subjective disposition, according to the theological maxim: whatever is received is received according to the measure of the recipient. The most solemn of all plenary indulgences is that which is granted on the occasion of a jubilee such as that which was proclaimed for 1904 by His Holiness Pius X to mark the 50th anniversary of the definition of the Immaculate Conception by Pius IX.

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Indulgence, Declaration of, the proclamation issued in 1687 by James II. of England by which he sought to relieve his subjects from observing laws opposed to their consciences. As the persons then suffering most from the laws were Roman Catholics, and as the laws would leave them free to worship according to their consciences, the proclamation was opposed by many king's subjects. Seven bishops of the Church of England refused to order their clergy to read the king's proclamation. Charles II. issued two similar indulgences in 1662 and 1672, both of which were unpopular with the people outside the Roman Catholic Church.

In'dus (Sanskrit, *Sindhu*), the chief stream of the northwest of India, and one of the great rivers of the world. It has a length of about 1,900 miles, and drains an area of more than 300,000 square miles. It rises in Tibet on the north of the Himalaya Mountains, nearly 100 miles northwest from the sources of the upper Brahmaputra (q.v.), on the north side of the mountain mass of Kailas, 18,000 feet above sea-level. In the upper part of its course it takes a northwesterly direction along the northern foot of the main Himalayan range, enters the Kashmir territories, passes through Ladak, below the capital of which, Leh, it receives the Zanskar, farther on the Dras, after which it enters Baltistan. Here it receives, on the right, the Gilgit, from a glacier of the Karakoram, the largest tributary that joins it in the Himalayan regions, and takes the name of Indus or Sind. About 100 miles below this it takes a sudden bend toward the southwest, and after a course of about 180 miles more in this direction it leaves the loftier regions. At the British fortress of Attock in the Panjab — where it is crossed by a great railway bridge carrying the line to Peshawar — it is joined by the Kabul from Afghanistan, and here, 950 feet above the level of the sea, it is nearly 800 feet wide and from 30 to 60 feet deep according to the season. For the rest of its course (about 900 miles) it continues its southwesterly direction till it enters the Indian Ocean. At Kalabagh, 110 miles below Attock, it has a breadth of over 1,400 feet. Arriving in the low-lying country, its waters become charged with mud, and in the rainy season, and by the melting of the snow in the mountains, it overflows its banks. Near Mithankot it receives on the east the Panjnad, or united stream of the Five Rivers of the Panjab. Below the confluence it has a width of over 1,900 yards when the water is low. In Sind it gives off several extensive arms or canals, which are of great value for irrigation; and below Hyderabad it divides into a number of shifting mouths or estuaries, the most navigable of which is at present the Yatho mouth. The delta, formed by the enormous amount of alluvium brought down by the river, has a coast-line of about 130 miles, and the point or head of it at Tatta is 70 miles from the sea. The tide rises to this distance. The Indus loses much water from passing through dry and desert regions, and much is also drawn off for irrigation; accordingly it brings down much less water to the sea than the Ganges. Vessels drawing more than seven feet of water cannot generally enter any of its mouths; but steamers of light draft ascend from Hyderabad to Multan. A railway ascends the valley of the Indus from the important port of Karachi to Peshawar.

Industrial Commission, a non-partisan body authorized by Congress on 18 June 1898, to investigate the subjects of "immigration, labor, agriculture, manufactures, and business" in the United States, with the utmost fairness to both capital and labor, and report to Congress with suggested legislation, as a basis not only for national law and administration, but for uniformity of State laws. It was empowered to administer oaths in order to obtain sworn testimony, and send for persons and papers, as well as (by a supplementary act) to purchase relevant literature up to $1,500 a year. The members were to be five Senators appointed by its president, five Representatives appointed by the Speaker, and nine private gentlemen appointed by the President and Senate, fairly representing different industries and branches of national life. Originally appointed for two years, the term was extended to 15 Dec. 1901, and then to 15 Feb. 1902, the last report being dated the 10th. The actual work was done by the private members, who employed 27 experts on the various lines, and examined nearly 700 witnesses; making a report in 19 volumes, of the highest value from the unmatched thoroughness and authoritativeness of the view on every side of our industrial system brought out, and the competence of the witnesses, who represented all grades, from heads of trusts to presidents of colleges, and from lawyers to heads of trade unions, leaving no field untouched. The commission also digested a vast amount of facts from judicial decisions and official documents. The private commissioners were A. L. Harris, S. N. D. North (successor Albert H. Clarke), Ellison A. Smyth (successor D. A. Tompkins), J. M. Farquhar, E. D. Conger, T. W. Phillips, C. J. Harris, M. D. Ratchford (successor C. H. Litchman), J. L. Kennedy. The experts were on warehouse and grain inspection laws, immigration (two, statistics and labor questions), agriculture (four, distribution, labor, speculation, and taxation), labor organizations, prison labor (two), railroad labor, Asiatic labor, strikes, and arbitration, trusts, transportation (two), railroad legislation, taxation of corporations (two), domestic service, pure-food legislation, mining industries, mining labor legislation, tobacco industries, mechanical progress, besides advisory counsel and expert indexing.

Indus'trial Corporations in the United States, include the large number of trusts, or industrial combinations formed between 1890 and 1903. As the individual or private business firm gradually gave way to the limited partnership, so the limited partnership in turn practically yielded to the general corporate form of doing business, especially in respect to manufacturing which followed the general tendency of business toward consolidation. This was a natural result of the rapid growth of capital, which consolidated for its own benefit. In this development some of the earlier and larger trusts undoubtedly played a very prominent part, creating a precedent, setting an example, as it were, notably the Standard Oil trust and the Sugar trust, both of which have been in corporate form for some years. They were the pioneers in consolidation of manufacturing interests, but compared with the more recent United States Steel Corporation, with its capital of more than a billion dollars, they are but pigmies. The great majority of these combinations have capitalizations in excess of $5,000,000 each, while only a very few are capitalized at less than $1,000,000. Many of these manufacturing combinations practically control a very large proportion of the entire business of the country in their particular lines and are ever extending that control to other countries.

The most notable feature in the increase in the industrial growth of the United States from 1883 to 1903 is in the iron and steel industry, in which the production is nearly six times greater than it was at the beginning of that period. The total quantity of pig iron and steel produced in 1882 was 5,360,015 tons. In 1892 the quantity was 14,084,581 tons, and in 1902 it had increased to 31,255,595 tons. The increase in the production of pig iron in 1892 over 1882 was 98.99 per cent; and in 1902 over 1892 it was 49.18 per cent. The increase in the annual production of steel, however, was much greater in proportion. In 1892 it was 183.38 per cent greater than in 1882, and in 1902 it was 174.34 per cent greater than in 1892. Among the advantages of the corporate form over individual ownership which so largely tend to the advantage of consolidations of capital and the supplying of the demand for greater facilities for its employment in industrial fields is the fact that, while stockholders die, the corporation can go on forever. The ownership of these corporations is divided among hundred of thousands of individual stockholders, who are liable only for the amount of their stock, and which can be transferred without affecting the corporation or its liability and without any trouble. The number of stockholders of four of the largest corporations, for instance — namely, the United States Steel Corporation, the American Sugar Refining Company, the Amalgamated Copper Company and the Standard Oil Company — number about 100,000 persons.

The census of 1900 gave the statistics of industrial corporations (first table below):

In 1902 these figures had materially increased, there being 213 industrial combinations or trusts with a capital of $6,639,019,304, but even these figures are far from the estimates made in 1903 by Moody (Manual of Corporate Securities) who places the total capital at $9,000,000,000, and who states that the railroad consolidations would increase this to $15,000,000,000.

The United States Steel Corporation, the largest of the trusts, and its competition are marvelous examples of the "combination" plan of capital. The following are the figures for 1902 (see second table below):

Industrial Education. — The industrial growth of the country created a demand for higher instruction in commercial subjects which soon led to the establishment of separate institutions devoted exclusively to such instruction. For details see AGRICULTURAL EDUCATION; ARCHITECTURE, EDUCATION IN; COMMERCIAL EDUCATION; CORRESPONDENCE SCHOOLS; EDUCATION: ENGINEERING; INDUSTRIAL; PROFESSIONAL, IN AMERICA; SCIENTIFIC AND TECHNICAL; ENGINEERING, CIVIL; ENGINEERING, MECHANICAL; INDUSTRIAL TERMS; LAW, AMERICAN SCHOOLS OF; MANUAL TRAINING; MEDICAL EDUCATION; PAINTING, EDUCATION IN; SCULPTURE, EDUCATION IN; TECHNICAL EDUCATION; TECHNOLOGY, SCHOOLS OF; TRADE SCHOOLS; ETC.

No. of Co.'s.	INDUSTRIES	No. of plants controlled	Capital issued	
			Stocks	Bonds
40	Iron and steel companies	489	$763,806,295	$20,614,000
21	Food and allied products	277	277,618,300	12,725,900
14	Chemical products	295	278,357,295	9,294,000
11	Metals other than iron	113	203,505,600	8,565,000
28	Liquors and beverages	258	193,301,158	55,529,142
6	Vehicles (land)	72	189,680,000	10,300,000
4	Tobacco	41	197,184,628	....
8	Textiles	72	109,514,175	36,944,000
5	Leather	108	184,015,200	13,805,000
7	Paper and printing	119	130,006,500	42,461,217
15	Clay, glass and stone, etc.	203	63,896,858	5,567,500
8	Lumber, etc.	59	39,534,400	275,000
16	Miscellaneous industries	97	238,367,700	332,000
183	Total	2,203	$2,268,788,109	$216,412,759

SUMMARY	Capital Authorized	Capital Outstanding
United States Steel Corporation proper	$1,404,000,000	$1,319,560,000
Underlying securities of 26 controlled properties	90,435,656	68,478,656
Securities of 3 companies controlled in the interest of the United States Steel Corporation	139,250,000	131,250,000
Securities of 4 companies operated in harmony with United States Steel Corporation	118,686,200	86,661,000
Grand total	$1,752,371,856	$1,605,949,856
Securities of 32 of larger competitors of United States Steel Corporation	452,164,600	385,740,100

Industrial Terms. The following list embraces many of the important terms that are used technically in the several commercial industries. Such terms as are usually regarded as self explanatory, as well as those that have no general application, have been omitted. Those that are of more than ordinary importance will be found defined more fully under their appropriate heading.

Abandonment.— A term used in marine insurance to denote that all property saved has been relinquished to the underwriters in order that the insured may claim indemnification for a total loss.

Abb.— In wool-sorting the quality of the wool is denoted by the terms: "fine abb," and "coarse abb."

Abordage.— A term used in marine insurance. If a collision between two vessels happens on the open sea and the damaged ship was insured the persons insuring her must pay the loss, although they are entitled to relief at civil law against the party causing the damage.

Acceptance.— A term usually used, in marine insurance, in cases of abandonment. It is this process which perfects the rights of the insured in the recovery of his loss.

Actuary.— An officer of an insurance company whose skill in the application of the doctrine of chance to financial affairs enables him to make the computations necessary to determine the valuation of contingent liabilities, as shown in the compilation of tables, the computation of risks, etc.

Agreement.— In insurance the contract issued prior to the delivery of the official policy is known as the "agreement."

Annealing.— The process of treating substances by heat to remove their brittleness and yet make them tough and inclined to be elastic.

Annuity.— A fixed amount paid each year, whether in one sum, or periodically, in installments. When an annuity is continued for a specific number of years it is termed a "certain" annuity. If the period of its continuance is uncertain it is called a "contingent" annuity. When payment has already commenced it is an "annuity in possession," but when such payment does not begin until a specified period has elapsed, or a definite event has taken place it becomes known as a "reversionary" or "deferred" annuity.

Amount of Loss.— An insurance term denoting the diminution or destruction of the values of, or of the charge upon, the insured by the direct consequence of the operation of the risk incurred, according to its value in the policy.

Assessment.— In insurance, an assessment is made (1) as an apportionment in general average upon the articles at risk for contribution for damage and sacrifices purposely made for escape from impending peril, and (2) also upon premium notes given by members of mutual companies as a substitute for the investment of the paid-up stock.

Atichlor.— A term used in bleaching to denote the method employed to remove or neutralize the injurious effects of the free chlorine left in some bleached materials.

Arch.— When a portion of a lode is left standing, in mining, because it is too poor to work or is needed as a support, it is called an "arch."

Asterism.— A term in printing, denoting the 3 asterisks sometimes placed before a sentence to call attention to it.

Attemperation.— Regulating the temperature of the beer-worts in brewing.

Attenuation.— The decrease in density of the beer-worts in brewing is termed "attenuation."

Avivage.— A process for clearing and brightening the colors in dyeing.

Average Bond.— A bond in marine insurance under which the consignees of cargo subject to general average, guarantee payment of their contribution as soon as ascertained in order that their goods may be delivered at once.

Back.— (a) In metal-mining, the portion of the lode that lies between the level and the one next above; (b) in coal-mining, the inner end of a heading where work is being conducted; (c) the thickest and best hides are termed "backs" in the leather trade.

Back-casing.— A wall of dry brick sunken through sand or gravel in mining.

Back-lash.— A term denoting the backward suction after an explosion of fire-damp.

Back-stay.— In printing, the leather strap used to check the carriage of the press.

Balk.— When a bed of coal suddenly thins out it is termed a "balk."

Band.— A layer of rock that is interstratified with coal.

Barney.— A small car used in mining to push the mine-car up a slope; the pit from which it runs is termed the "barney-pit."

Barratry.— In marine insurance, the commission of any fraudulent act in the management of a ship, or its cargo, by which the owners, consignors, or insurers are subject to injury.

Barrel-work.— Pieces of native copper too small to be handled as mass-copper, but large enough to be shipped in barrels.

Bastard.— (a) An impure brown sugar made from the refuse of previous boilings; (b) the large mold into which the sugar is drained is also called a "bastard;" (c) in printing, any type whose face is out of proportion to the size of its body is termed "bastard" type.

Bating.— The process of steeping hides and skins to render them soft and fit for tanning.

Battery.— The timber structure that is used to prevent coal from sliding down a shute.

Bay.— In mining, an open space for waste in a long-wall working.

Beaming.— (a) Winding the warp-yarn on a loom in the manufacture of cloth; (b) working hides with a slicker over a beam in the leather trade.

Beater.— (a) A machine used in cotton manufacturing to open and clean the cotton before it passes to the carder; (b) a knife used for breaking flax or hemp; (c) the lathe or batten of the loom used in weaving.

Benching.— A term applied to the process used in getting the coal after it is holed.

Black-liquor.— A crude acetate of iron used, in dyeing, as a mordant.

Bleed.— (a) In bookbinding, to trim the margin too closely; (b) in dyeing, extracting the coloring matter.

Bleu-de-roi.— The term used to denote the cobalt-blue color in European porcelain.

Blick.— The iridescence appearing on gold and silver at the end of the refining process.

Blue-cap.— In mining, the bluish or brownish halo which, when it appears around the flame of the safety lamp, indicates a dangerous quantity of fire-damp, is termed the "blue-cap."

Boards.— The hard paper-stock inserted between the printed sheets in a press to remove an indentation of impression; often called "press-boards."

Bone.— The term used to define the slaty portions in a coal mine.

Bonnet.— The shield used to protect a mine shaft from substance which might otherwise fall into it.

Border.— The rim fixed about the bed-plate used in milling to prevent the meal from falling off before it reaches the proper opening.

Branning.— A term that is applied both to the process of steeping cloth before or after it is dyed, and to the steeping of skins before tanning.

Brood.— The term applied in mining to all heterogeneous mixtures found with copper or tin ore.

Brush.— An instrument constructed of several small trees, like the birch, and used by farmers instead of a harrow in covering grain, or small seed after sowing.

Buck.— The breaking of ore into small pieces for jigging.

Buddle.— In mining, to wash ore free from earthy matter the water is run over an inclined hutch which is termed a "buddle."

Bullocks' Hides.— The trade name given to the raw hides of cattle.

Bully-head.— The name by which the sledge-hammer used by miners is popularly known.

Bultow.— In the fishing industry, the practice of stringing many hooks on one line, used in fishing for cod off the Banks.

Bunchy.— Used in mining to denote that the ore is irregularly distributed through the lode in small masses, or "pockets."

Bundle.— (a) In paper-making, 2 reams of printing, or brown paper; (b) in spinning, 20 hanks, or 6,000 yards of linen yarn.

Buntons.— The timbers put across a mining shaft to divide it into compartments.

Butt.— A hide of sole leather in which the belly and shoulders have been cut off.

Cade.— A term of measurement in the fishing trade, denoting either 500 herrings, or 1,000 sprats.

Cage-seat.— The framework at the bottom of a shaft, so arranged as to reduce the jar when the cage drops upon it.

Calf.— A term applied to a bookbinding in calf-skin. This binding is of several grades: Divinity calf, a dark-brown binding, with blind stamping and no gilding; half-calf, in which the backs and corners only are of calf-skin, mottled calf, a calf binding of pale color in which the decorations have been made by the sprinkling of acid; smooth calf, or plain, undecorative leather; tree calf, a bright, brown calf binding stained by acid to imitate the trunk and branches of a tree.

Canch.— A term used to denote that part of a floor or roof of a gangway that is removed to equalize the grade because of a fault, or break in the strata.

Cannel.— A form of weaving that produces a corded or rep tissue.

Cap.— A term denoting certain sizes and shapes in paper: Double cap, 17x28 in.; exchange cap, a fine quality paper, used in printing bills of exchange; flat cap, or full cap, 14x17 in.; foolscap, usually 12x15 in.; legal, or pot cap, 13x16 in., etc.

Carding.— The disentangling of wool, cotton, or other fibres preparatory to spinning.

Carrot.— In the fur trade, to dress a pelt to preserve it from insects.

Carrots.— Rolls of tobacco after they have been so prepared that they require only to be ground and sifted to be made into snuff.

Case.— (a) A shallow wooden tray, the partitions making the small boxes in which the various characters of type required by printers are kept in order for the use of compositors. (b) A book cover that has been made separately from the book for which it is intended.

Casse-paper.— The wrinkled, broken, or otherwise imperfect paper rejected by the trade.

Cassette.— The utensil in which chinaware is baked; sometimes called the "coffin."

Cast.— (a) The water used in the preparation of beer. The quantity that is first placed in the mash-tub is termed the "first cast;" that which is subsequently added, the "second cast," "third cast," etc. (b) In bee culture, an after swarm led by a maiden queen.

Certosina Work.— A term used to denote the inlay of certain light materials — like ivory or satinwood — upon dark woods like walnut.

Chop.— (a) In milling the product of the first crushing of the wheat; (b) also used to denote the brand and quality of tea imported from China, as "first chop," etc.

Clicker.— The workman who cuts the uppers and soles for boots and shoes.

Clog.— The short pieces of timber used in mines to prop the roof.

Closing-machine.— (a) A machine that sews heavy cloth or leather with a lock-stitch, alike on both sides; (b) apparatus used in rope-making to twist the already made strands into rope.

Cobbing.— In mining, a process of breaking the ore that the better parts may be sorted out.

Cockle.— (a) A large stove used in the making of porcelain, to dry the biscuit-ware after its glazing preparatory to burning; (b) the kiln used for drying hops.

Color.— In gold mining, the particles of gold that are shown when auriferous sand is washed out.

Chase.— In printing, a square, open framework of iron into which the type forms are fastened to facilitate moving and working in the press.

Commercial.— A term used to denote the shape and size of paper: Commercial letter, 11x17 in.; unfolded commercial letter, small, 10½x16½ in.; commercial note, 8x10 in., unfolded.

Companionship.— In printing, a number of compositors employed in setting up a quantity of copy under the direction of one leader.

Compost.— A mixture of various manuring substances used by agriculturists in fertilizing land.

Concentrator.— A machine used, chiefly in mining in the United States, to separate the ore from the rock with which it was associated in the lode.

Constructive Total Loss.— A term used in marine insurance when the thing insured and damaged, while not entirely a total loss, is so nearly so that it is practically beyond recovery or repair. In such cases a notice of abandonment is served upon the insurers by the owners, after which the "constructive total loss" may be recovered.

Cord.— (a) In fancy weaving, the interval between two vertical lines of the design is termed a "cord;" (b) the same term is used in bookbinding when a book is tied firmly between two boards to assure its drying smoothly. The term "Maitland cord" is used in weaving to denote the cord which extends along the wooden shafts of leaves to which the heddles are secured.

Cording.— The term denoting the arrangement of the treadles in a loom by which they are made to move in such clusters and time as the production of the pattern may necessitate.

Core-piece.— The yarn running through the centre of a rope to assure its solidity.

Corner.— The tool used in bookbinding to decorate the corners of a book.

Couch.— (a) The operation, in brewing, of spreading the steeped grain upon the floor to convert it into malt; (b) in paper-making, the act of removing the paper from the mold upon which it has been formed that it may be placed upon the felt.

Counter-lode.— A term used in mining to denote a lode running in such a direction in relation to the main lodes that it crosses or intersects them.

Coursing.— The method of regulating the ventilation of a mine by conducting the air through various doors, stopings, etc.

Cram.— In weaving, a warp that has more than two threads in each split of the reed.

Crazing.— In the pottery industry, when the glaze separates from the body and forms blisters.

Creaser.— A tool used in bookbinding to define the width of the bands of a book, and to fix the position of the lines on the backs and sides.

Creep.— If the pillars of a mine are not sufficiently large, or the roof is not fully supported the pressure of the superincumbent strata sometimes causes an apparent rising of the under-clay. Collieries have been entirely destroyed by these "creep."

Crop.— An untrimmed hide, struck for sole-leather, is termed a "crop," or "crop-hide" in the trade.

Crutch.— A term used in soap-making to denote the perforated instrument with which the various ingredients are stirred together.

Cut.— The block upon which a picture is engraved and from which it is impressed in printing.

Cutter.— Usually applied, in mining, to a joint or crack which crosses a better defined system of cracks in the same rock. In coal-mining "cutting" is the work done in getting the coal into a condition where it may be broken down.

Dabber.— The use of the "dabber" by printers has largely ceased since the introduction of the ink-roller, but the same term is now applied to instruments used by etchers and stereotypers. The former is used to ink the surface of engraved blocks or plates; the latter to dab the back of the damp paper used in the papier-mache process of stereotyping, in order that it may be driven into the interstices of the type.

Dabbing.— The term applied to the process in stone-working by which the surface of the stone is covered with small indentations, after having been made uniform.

Dam.— The term applied to the underground wall frequently constructed to hold back water, air, or gas.

Damping.— A process used in bleaching to add a certain amount of moisture to a fabric, after it has been starched, that it may be properly finished.

Dandy.— The running-out fire for the melting of pig-iron in tin-plate manufacturing.

Dandy-roller.— The wire-gauze cylinder beneath which the web of water-pulp is passed in paper-making to drain it partially of water.

Dash-wheel.— The partially submerged wheel used in cotton manufacturing to wash and rinse calico in the piece.

Deck.— Used in mining to denote the loading or unloading of cars upon the cage.

Deckle-strap.— The contrivance used in paper-making to define the width of the sheet by regulating the flow of pulp.

Decrement.— A term used in insurance, usually in the sense of the "equal decrement of life," or the doctrine of annuities upon which assurance companies base their existence. It is the theory that in a given number of lives there should be an equal number of deaths within a given period.

Dele.— A term used in proofreading to direct the compositor or printer to remove a letter, word, or phrase.

Deviation.— A term used in marine insurance to denote the voluntary departure of a vessel, without necessity or reasonable cause, from the usual course of the voyage for which she was insured. All unreasonable delays are also involved in the same law, which releases the underwriter from all risks.

Devil.— An errand-boy employed in a printing-office.

Dipping.— A process in ceramics by which a coarse clay body is coated with fine enamel by being plunged into the liquid which constitutes the coating.

Discharge.— The term used in dyeing to denote the process by which white patterns are produced on colored grounds.

Discovery Claim.— In mining law, the portion of ground held by reason of the first discovery of its mineral deposits.

Distribute.— A term used in printing for the process of returning dead matter (type no longer required) to the cases; "throw-in" is another term used to define this process.

DOCTOR.— (a) A term in wine-making, used to indicate that the character of the wine has been changed by the addition of another liquor; (b) to alter any commodity for purpose of deception.

DOFF.— A term that has several distinctions in the textile manufacture: (a) The process of stripping the cotton or wool from the cards preparatory to spinning; (b) the act of mending broken threads; (c) the removal of full bobbins to give place to the empty ones.

DOSSIL.— The roll of cloth used to clean the ink from an engraved plate prior to printing.

DOUBLE.— A term used to denote the size and quality of paper: Double medium, a printing paper, 24x38 in.; double royal, a printing paper, 26x40 in.

DOUBLE-DYEING.— A method of dyeing mixed goods by which the wool and cotton are dyed separately with colors that have no affinity for each other.

DOUBLE INSURANCE.— A term used among insurance companies as a synonym for over-insurance. Thus, where divers insurances are made upon the same interests against the same risks in favor of the same assured, in proportions exceeding the value of the subject, the party insured may sue upon all the policies although he is entitled to but one satisfaction.

DOUBLE-MILLED.— A term applied to denote that cloth has been fulled twice to make it finer in quality.

DOUBLER.— (a) A machine for doubling and drawing silk; (b) a still made to intercept and redistill the vapors of distillation; (c) a felting placed between the fabric and the press before printing.

DOWNCAST.— A term used to denote the system of ventilation used in mining, the shaft down which the air passes into the mine being called the "downcast."

DRAFT.— Used in weaving to describe the cording of a loom or the arrangement of the heddles.

DRAG.— (a) A light iron-rod tool with a tapering spiral end, used by miners in cleaning out bore-holes before introducing the charge; (b) the device that guides wood to the saw in saw-milling; (c) also applied in printing to denote the thickened impression on one side of the letters produced by the scraping of the sheet on the type.

DRAWING-PAPER.— A term used commercially to describe a variety of stout papers manufactured expressly for use in drawing. The regular sizes are as follows: Cap, 13x16 in.; demy, 15½x19½ in.; medium, 18x22 in.; royal, 19x24 in.; super-royal, 19x27 in.; imperial, 21½x29 in.; elephant, 22¾x27¾ in.; columbier, 23x33¾ in.; atlas, 26x33 in.; theorem, 28x34 in.; double elephant, 26x40 in.; antiquarian, 31x52 in.; emperor, 40x60 in.; Uncle Sam, 48x120 in.

DRAWING-ROLLS.— The rolls used in spinning machinery. As they are set in pairs, each of which turns more rapidly than any previous pair, the sliver passes through them in succession.

DRAW-BOY.— Formerly the weaver's assistant; now, a mechanical device used in drawing the heddles to form the pattern of the cloth to be woven. The machine upon which this figure-weaving is done is known as the "draw loom."

DRAWING.— A term denoting the method of freeing substances from all particles of iron and steel by use of a magnet.

DRESSER.— (a) The workman employed in type-foundries to remove all defects from the types in preparing them for sale; (b) the tool, or machine employed to cut and dress the furrows on a millstone; (c) a mallet used by plumbers in closing joints in sheet-lead; (d) one of the picks used in mining.

DRIFT.— A term used in mining to describe the nearly horizontal excavations that are frequently made in working a mine; sometimes called a "drive."

DRILL.— In agriculture, when a field is not sown broadcast, but in rows, it is said to be in "drills."

DRIP-JOINT.— When two sheets of metal used in roofing have been so united that the joint forms a water conductor the arrangement is known, in plumbing, as a "drip-joint."

DROP-BAR.— A term applied to the bar or roller on a printing-press that regulates the passage of the paper sheets to impression.

DROP-DRILL.— The term denoting an agricultural instrument that is employed to drop the seed and fertilizer into the ground simultaneously.

DROP-FINGER.— In some cylinder printing-presses the rods that are employed to hold the sheets in place until they can be seized by the grippers are termed the "drop-fingers."

DROPPER.— A term used in mining to denote a branch or spur that connects with the main load but that does not materially enrich it.

DROPPING.— A term used to denote a defect in the product of the glassmaker. It is caused by the accidental dropping of the crude glass into the molten glass in the melting vessel.

DROP-ROLLER.— Used in printing to denote the roller that drops at specified intervals to supply the printing ink for distribution.

DROVING AND STRIPING.— A process in stone-cutting by which the shallow parallel grooves are made along the length of the rough-hewn stone.

DRYING-OFF.— A term denoting the process by which an amalgam of gold is evaporated.

DRYING-PLATES.— Used in brewing to denote the series of frames in the malt kiln. They are placed one over the other, and, being covered with woven wire, the hot air ascends through them in such manner as to dry the malt.

DUMP.— Used in printing to denote the act of removing types from the stick to place them on a galley.

DUNG-BATH.— In some processes of dyeing and calico-printing the cloth is subjected to a "dung-bath," composed of warm water, animal's dung, etc., for the purpose of removing the superfluous mordant.

EGG-SHELL.— A term used commercially to denote the thinnest and most translucent of china or porcelain.

ELBOW-PLATE.— A term used in paper-making when the cutter of the rag-cutting machine has been bent to something like an angle in the middle.

ELECTROPLATING.— The process of coating articles with silver or other metal by means of electrolysis.

ELECTROTYPING.— The process of making plate copies of any engraved or molded surface by means of electrical deposition.

ENDOWMENT.— A term used in life insurance to describe a policy in which the face value, with accrued earnings, is payable to the insured at, or after a stated period, or in which the face of the policy is paid to his representatives should he die prior to the expiration of that time.

ENSILAGE.— An agricultural term used to denote the process of preserving fodder, etc., in a green state by storing the materials in silos or pits dug in the ground.

FACE.— In coal-mining, the working, or portion of the seam that is being mined.

FASCET.— A rod, or basket of wire used in carrying the bottle from the mold to the leer in glass-manufacture.

FAT-WORK.— In printing, when copy is particularly profitable to the compositor owing to the fact that it has much open space that may be filled with leads, or that in other ways favors rapid execution, is termed fat-work. To beat, or ink "fat" in printing means that a form of type has been given an excess of ink.

FEEDING.— In printing, a term denoting the method of placing the sheets of paper in such position that they are ready to meet the requirements of the press.

FILATURE.— In silk-culture, a reel by which the silk is drawn from the cocoons.

FILLET.— (a) In weaving, a strip of card-clothing; (b) in dairying, a perforated curb used to confine the cheese-curds; (c) a wheel-shaped tool used in book-binding to impress a line, or decoration upon the covers of books; (d) in printing, a rule fixed with lines that may be used as a border.

FILLING.— The term by which the woof or weft thread of a woven fabric is known.

FILLING CAN.— Used in rope-making to denote the can in which the sliver is condensed and wound after coming from the doublers.

FINE-DRAWING.— The term applied to the finishing process in cloth manufacture. By exposing the cloth to a strong light all the minute holes due to breaks are discovered so that they may be repaired with a needle, by the introduction of sound yarns in the place of those that have proved defective.

FINING-ROLLER.— A cylindrical sieve of wire cloth used in paper-making to retain the coarse fibres and knots so that they cannot pass through with the finely ground stuff.

FIRE-GILDING.— A process of gilding by which the mercury is driven from the amalgam by the heat of a muffle, leaving a fine film of gold.

FIXING BATH.— In tanning, the catechu-bath is followed by another known as the "fixing" bath. It consists of water sufficient to cover the skins, acidified with nitric acid, modified with a little glycerin.

FLESHER.— The tool used in leather manufacture for the purpose of fleshing hides.

FLOAT.— A term used in weaving to denote the passage of the shuttle crosswise above or below the threads but without intersecting them.

FLONG.— The combination of moist tissue paper and paste used in stereotyping by the papier-mache process to form the mold or matrix from composed types or engraved surfaces.

FLOOR.— In brewing, each steeping is known as a "floor" or "piece."

FLOORING.— Used in brewing to denote the operation of spreading the grain on the malt-floor, that it may be kept at an even temperature, to check germination.

FLOW.— A term used in ceramics to denote the flux that is used to make the colors run and blend in firing.

FLURRY.— A term used in calico printing to denote the condition of frothiness which is sometimes developed by the colors during the process of printing.

FLY.— (a) One of the arms of a spinning-frame which revolves around the bobbin to twist the yarn as it is wound upon it; (b) in cotton-spinning, the term is applied to the waste cotton; (c) in weaving, a shuttle with wheels driven through the shed by a jerk; (d) in printing, the mechanism which receives and delivers the separate sheets as they are printed on the press; (e) in piano making, the hinged board with which the keys are covered when not in use.

FOLIO.— While the word "folio" is used to denote the size of a book it is also applied as a descriptive term for several sizes of paper, each of which is designated by a specific name: Pot folio, 7½x12½ in.; foolscap folio, about 8x12½ in.; flat-cap folio, 8½x14 in.; crown, or post folio, 9½x15 in.; demy folio, 10½x16 in.; medium folio, 12x19 in.; royal folio, 12½x20 in.; superroyal folio, 14x22 in.; imperial folio, 16x22 in.; elephant folio, 14x23 in.; atlas folio, 16½x26 in.; columbier folio, 17¼x24 in.; double elephant folio, 20x27 in.; antiquarian folio, 26½x31 in.

FOOLSCAP.— A term applied to a writing paper varying in size from 12x15 to 12½x16 inches. The term was derived from the water-mark, a fool's cap, which formerly appeared upon all the papers that bore this name.

FOOTLINE.— A term used in printing to denote the last line of a page of type. It is usually left blank, although it sometimes contains the number of the page or the signature on the sheets.

FORWARDER.— A term used in bookbinding to designate the workman whose duty it is to receive the sewed book, put on its back, cover, etc., and prepare it for the finisher.

FULL-FACED.— A term used in printing to describe a type with the thick lines that make it print extremely black.

FURNITURE.— The term "furniture" in printing denotes the pieces of wood or metal that are placed around the pages of type, not only to keep them the necessary distance apart but to assist in fastening them securely in the chases. When the furniture has been systematically cut into various lengths and widths, so that they may be easily combined, the pieces are known as "labor-saving furniture."

FUSTIAN.— The term applied to a short twilled cotton fabric, usually a cloth having a short nap, like corduroy, velveteen, etc.

GAGING-THREAD.— In weaving, a thread introduced temporarily to stop the weft-thread at a specified point.

GALLEY.— An oblong, shallow tray, now usually made of brass, but sometimes of wood, used in printing by compositors as a place to deposit the type they have set. Galleys in which the type may be locked are known as proof-galleys. Standing galleys are inclined frames fitted with cleats on which the type galleys rest. A proof taken from types being held on galleys is termed a "galley-proof."

CASUALTY.— A term frequently used in insurance as a synonym for accident.

CO-INSURANCE.— A form of insurance in which the insured, in view of a reduced rate of premium agrees to maintain insurance upon a certain specified percentage of the total value of his property, failing which he becomes his own insurer for the difference, a fact which makes him jointly responsible with the assuring company in case of partial loss.

GATHERING.— Used in glass-making to describe the method of coiling the molten glass on the end of an iron tube preparatory to the work of blowing.

GIGGERING.— A process in bookbinding by which the burnished lines are rubbed upon the covers decorated in antique fashion.

GIGGING.— The process of finishing cloth by drawing the loose ends of wool in a fabric to the surface to form a nap. After the work of napping is completed the fabric is ready to be finished by shearing.

GILLING.— A term denoting a process for making all fibres level and even in the manufacture of woolen yarns or worsted.

GINGERBREAD-WORK.— A phrase used, somewhat as a term of contempt, in describing the fanciful shapes of the ornamental wood-work and carvings seen upon furniture, etc.

GLANCE.— A term used in mining to designate those ores in which a peculiar lustre and color indicates that they are of metalliferous combination.

GLOSSING.— A term denoting the operation of twisting the hanks of silk, in silk-manufacture, after they have been dyed and dried. This process is sometimes termed "stringing."

GOTHIC.— A term used by American printers to describe a style of square cut printing type very similar in appearance to the old Roman mural letter. In England this type is known as the "grotesque."

GRAVEL.— Used in brewing to denote the appearance of the beer when yeast cells are floating about in it in the form of fine "gravel."

GRIZZLIES.— An arrangement in the mine sluice to receive and cast aside all the large stones brought down by the current during the process of washing the auriferous gravel.

GRAVEYARD INSURANCE.— A term used to designate a method of swindling insurance companies by the substitution of a person of robust health for the bad risk actually insured. Also used to describe other kinds of insurance swindling, or crimes committed in the collection of insurance moneys.

HACKLING.— In flax-manufacture "hackling" is the process of preparing the flax for spinning by the removal of all foreign substances and smoothing and equalizing all the lengths of fibre.

HALF-TONE.— A term used to designate a photographic process in which a screen made either of netting or ruled glass, is interposed between the lens and the sensitized plate, and from the image thus produced, a positive image is made upon the prepared metal plate. This is etched into relief by the use of acids.

HALL-MARK.— A term used industrially to designate any official stamp that has been placed upon an object of trade to denote genuineness.

HARD-CURED.— A term used in the fishing industry to designate that the fish specified has been cured by being thoroughly dried in the sun after salting, a process by which all the moisture has been evaporated.

HARDENING.— A process used in hat-manufacturing, by which the bodies of the hats are rubbed and pressed hard for the purpose of felting the material as well as to diminish the size and render them more dense. A hardening-kiln is a kiln in which the transfer printing process in pottery is completed: The pottery being relieved from all superfluous oils by exposure to a low heat.

HARNESS.— The term applied to the apparatus in a loom by the operation of which the warp-threads are shifted alternately to form the shed.

HARROWING.— A term used in agriculture to describe the process of dragging a many metal-teethed instrument over plowed land, either to level it and break the clods, or to cover seed that has been sown. A "chain harrow" consists of a congeries of iron rings, instead of the metal teeth, and is employed to separate weeds from the earth and to cover grass seed. In a "revolving harrow" the teeth are arranged on radiating arms that have been pivoted to the draft-gear in such a manner that, by their horizontal rotation, they add greatly to the raking or tearing power of the teeth.

HESSIAN.— A coarse cloth made of a combination of hemp, and jute and used for bagging is known as "Hessian" by the trade.

HIGH-PROOF.— Commercially all highly rectified spirits are termed "high-proof."

HOLLAND.— A term which, while formerly applied only to linens imported from the Netherlands, is now used to designate the glazed and unglazed linen cloths that are made in many places. "Brown Holland" is a cloth that maintains much of the original color of the retted flax fibre, it having been subjected to but little bleaching or boiling.

HONEYCOMBING.— In cloth-manufacture, a term applied to designate a thin fabric in which the stitches, running diagonally across the material, have been drawn up in such a manner that the spaces between them are puffed or in relief.

HOP-JACK.— A term applied to a vat with a false bottom used in brewing. It is so arranged that it retains the solid substances in the mash-tubs, but allows the wort to flow away after it has been boiled and the hops have been added.

HOPPER.— Used, in milling, to denote the inverted-cone-shaped trough through which the grain passes on its way to the shaking-shoe.

HORSE-POWER.— A term used as a unit of measurement in every industry in which power machinery is used. Although several values are assigned to this unit the prevailing value, both in America and England, is Watt's horse-power, which places it at 7.460 megaergs per second, or about three-quarters of the actual power of a horse.

IMPOSITION.— The act of laying pages of type, etc., upon a smooth stone slab to secure them in the chases and prepare them for the press.

INDENTION.— A term used in printing to denote that a certain amount of blank space has been left before the line, or a specified number of lines of type. An indenting of every line after the first, with an increasing blank constantly shortening on both sides is termed "diamond" indention. An indenting of every line except the first, that being of full width and so overhanging the others, is termed "hanging" indention.

INFUSION.— A term used in brewing to denote the process of preparing the mash by treating the bruised malt with water at a temperature of from 7 ° to 75°.

INSURABLE INTEREST.— It is essential to the insurance contract that the insured should have a legal interest in the object for which the insurance was taken. In France the laws annul all policies that exceed the insurable interest of the assured at the time of the subscription.

INSURANCE.— A term used to describe a contract whereby for an agreed premium one party undertakes to compensate another party for loss in a specified subject by specified perils. There are several kinds of insurance companies in operation, but nearly all are either "stock" or "mutual" companies, while the risks covered include, life, accident, fire, health, marine, burglary, live-stock, plate-glass, etc.

JAPANNING.— The process of coating the surface of metal, wood, etc., with varnish which is immediately hardened by exposure to high temperature.

KERFING.— (a) The process of preparing wood for bending without breaking by making a series of small cuts in it with a sawing-machine, (b) in cloth manufacture, the process of removing the wool by passing it through a shearing-machine.

KIPPERING.— In the fish trade, the process of curing fish by cleansing them, dressing them with pepper and salt, and curing them, either by drying them in the open air, or, artificially, by subjecting them to the smoke of some prepared substances.

LANDROLLING.— A term used in agriculture to denote the process of crushing clods, to make the earth friable, by means of a heavy roller.

LAYER.— The vat in which hides are left to lie in a strong solution of tannin towards the end of the tanning process.

LAYING.— The term is applied to two distinct stages in rope-making: (1) the twisting of three or more yarns to form a strand; (2) the twisting of three strands to form a rope. The machine that performs this operation is termed a "laying machine," the wooden cone placed between the strands to prevent a slack twist is termed a "laying-to ."

MANIFOLDING.— A term used in business circles to denote the process of making several impressions of a single letter or document by one operation, as by means of a manifolding-machine, or by the use of carbon paper.

MASH.— Used in brewing and distilling to describe the mixture of ground grain that has been infused in warm water.

MILLING.— (a) The process of manufacturing cereals into flour or meal. There are two methods of milling: (1) low milling in which the grain is ground but once before being bolted, and (2) high milling, in which it is ground repeatedly; (b) in pottery, the operation of grinding and mixing the slip; (c) the process resorted to in tanning to open and soften the pores of hides; (d) in cloth manufacture, the process of felting cloth to thicken it, etc.

PIECE-GOODS.— The trade name for fabrics that have been woven in lengths suitable for retail sale by linear measure.

POINT.— The unit of measurement in types, each point being about one seventy-second of an inch. The various types in use in the United States and their relative sizes in "points" are as follows: Excelsior, 3 points; brilliant, 3½; semi-brevier, 4; diamond, 4½; pearl, 5; agate, 5½; nonpareil, 6; minion, 7; brevier, 8; bourgeois, 9; long primer, 10; small pica, 11; pica, 12; English, 14; two-line brevier, 16; great primer, 18; paragon, 20; two-line small pica, 22; two-line pica, 24; two-line English, 28; four-line brevier, 32, three-line pica, 36; double paragon, 40; four-line small pica, 44, and four line pica, 48 points.

OPEN POLICY.— In insurance, a policy in which the value of the subject insured has not been fixed, but has been left to be determined in case of loss, or because it has been left open to permit of the addition of other things whenever occasion demands.

QUARTER-PLATE.— A term used in photography to denote the size of a plate. Thus, a quarter-plate measures 3¼x4¼ in.; a half-plate, 4¾x5½ in.; a whole plate, 6½x8½ in.

RECTIFY.— The term applied to the process of removing impurities from alcoholic distillations and to raise its strength to the required proof.

SALT A MINE, TO.— A swindling operation by which a mine is made to seem more valuable than it really is by the surreptitious introduction of ores obtained elsewhere.

SHELLS.— Those parts of the lay in weaving in the grooves of which the reed fits. They are of two classes and are termed "upper" and "under" shells.

SURRENDER.— A term in insurance to denote that the party insured has abandoned all right in his policy in consideration of having received a portion of the premiums already paid to the company. The percentage of premiums returned is known as the "surrender value" of the policy.

TOUTER.— Industrially, a person who makes it his business to solicit trade for a shop.

TONTINE POLICY.— In insurance, a policy in which the insured agrees that no money shall be received by him from the insuring party, either in the form of dividends, return-premiums, or surrender-value, for a specified term of years, but that, instead, the entire surplus shall be permitted to accumulate until the end of that period when it may be divided between those who have kept their policy in force.

TOTAL LOSS.— In marine insurance, total loss may mean that the subject insured has been absolutely destroyed by the peril against which it was protected, or it may mean that the loss by damage, seizure, or other causes has been so great as to be practically absolute. In the latter case it is often termed a "constructive total loss."

VALUED POLICY.— A term used in insurance to show that a policy is one in which the value has already been set upon the subject insured, the insertion of which fact in the policy with the amount agreed upon, makes proof of damages in case of loss unnecessary.

WAGER-POLICY.— In insurance, a policy in which the insured has no insurable interest, and, being generally regarded as a form of gambling, such policies are not valid except in places where the validity of a wager may be recognized.

WALKING DELEGATE.— A person selected by a trade union or other labor organization to visit similar bodies of workingmen, to interest them in the order, voice their demands upon their employers, direct them in their strikes, etc.

WALL.— Used in mining to denote the surfaces of the rock between which the ore is inclosed. If the vein is inclined at such an angle that the ore is over the miner's head it is termed a "hanging" wall; if it is beneath him it is called a "foot" wall.

WARP.— (a) In agriculture, the operation of fertilizing a poor piece of land by artificial inundation from waters which have large quantities of earthy matter; (b) in weaving, the threads that extend lengthwise in a loom. The roller upon which the threads are wound is termed the "warp-beam;" the machine which treats them with size before they are wound is the "warp-dresser," while the machine which draws the warp threads through the dye beck is termed the "warp-dyer."

WASH.— Used in mining to denote the process of separating the ore from earthy and other matter by the employment of water. The fermented wort from which the spirit is extracted in distilling is also termed the "wash."

WINNING.— The work of developing a mine preparatory to the work of mining is termed "winning" in the United States.

WOOF.— In weaving, the thread that is woven into the warp is also termed the "weft."

Inebri'ety. See ALCOHOLISM.

Iner'tia, a term introduced by Kepler to signify that property of matter in virtue of which it is "inert," so that when a body is at rest, or in a state of uniform motion in a straight line, it preserves its state of rest or of uniform rectilinear motion, unless some agency external to the body acts upon it in such a way as to modify that state. We gain our first conception of inertia by the attempts that we make to move bodies that are at rest, or to stop those that are in motion. Even if they are suspended freely, so that frictional forces are negligible, we find that their state of rest or motion cannot be modified without the exercise of a certain amount of muscular force; and by abstracting our own personality in the case, we gradually come to the conception of inertia as a physical property inherent in all bodies. Inertia has been popularly described as a "passive resistance" to change of motion; but this expression is objectionable because it is entirely inaccurate. Freely suspended bodies (that is, bodies that are free from frictional forces,) cannot be said to "resist" forces that are applied to them. On the contrary, they yield instantly to the smallest force; but a small force, when exerted upon a given body, for a given length of time, does not produce as great a change of motion as would be produced by a large force acting upon the same body for the same length of time. The conception of inertia shades insensibly into that of "mass"; the mass of a given body being proportional (by definition) to the velocity that is communicated to the body by a force of standard intensity, acting upon it for a standard length of time. (See MASS; MATTER; MOLECULAR THEORY.)

Infallibil'ity, exemption from the possibility of error. The word is used as applied to arguments, statements, reasoning, or the formation of judgments, and does not include impeccability, or exemption from the error of sin. The infallibility of the Church as believed by Roman Catholics means that "the Church can neither deceive nor be deceived in matters of faith and morals"; and she is limited to the definition of truths already contained in Scripture and tradition. The seat of infallibility rests in the Pope as successor of Saint Peter (Matt. XVI 18), and in the bishops in communion with the See of Rome, whether dispersed or united in a General Council (q.v.). In the acts of the Vatican Council, held in Rome in 1870, the following is the text defining the nature of the infallibility of the Pope: "The Roman Pontiff, when he speaks *ex cathedra*, that is to say, when in the exercise of his office of pastor and teacher of all Christians; he, in virtue of his supreme apostolic authority defines that a doctrine on faith and morals is to be held by the whole Church, by the assistance of God promised to him in the person of blessed Peter, has that infallibility with which it was the will of our Divine Redeemer that His Church should be furnished in defining a doctrine on faith or morals, and that therefore these definitions of the Roman Pontiff, of themselves and not through the consent of the Church, are irreformable." The Greek Church, the Church of England, and the Protestant Episcopal Church which is its representative and in communion with it in the United States, believe that infallibility resides in the universal Church in accordance with Christ's promise of the Spirit that should guide His followers unto all truth. Consult: Allies, 'See of Saint Peter'; Ballerine, 'De Primatu'; 'De Potestate Summ. Pontif.'

In'famy and Infamous Crimes, in common law the first means disqualification from giving legal evidence as a result of having committed the second, the theory being that a person capable of such crimes is incapable of speaking the truth. Both in Great Britain and generally in the United States this disqualification has been abolished by statute, and previous convictions for crime have been considered to affect a person's credibility without impairing his legal capacity to give evidence. Infamous crimes are strictly those which entailed infamous punishments. The fifth amendment to the Federal Constitution speaks of "capital or otherwise infamous crime" and we read in 2 Dane, Abridgement, 569, 570: "Punishments clearly infamous are death, gallows, pillory, branding, whipping, confinement to hard labor and cropping." Infamous punishments include imprisonment in State prison, or penitentiary with or without hard labor, and crimes which entail such punishments are undoubtedly to be considered infamous crimes, in the sense implied in the fifth amendment to the Constitution.

Infancy. The term infancy is used variously by different writers to include a shorter or longer period of the earliest stage of human existence. By most writers it is limited to the first 12 or 14 months, extending to the time when the baby begins to walk and to talk, and so is synonymous with a "babe in arms"; many medical authors would make it include the whole period of the first dentition, or up to about two and a half years. The characteristics of the period are utter helplessness, rapid growth of body, gradual development of muscular functions and great impressibility of the nervous system. In mankind this helplessness is more marked and the period of dependence is longer than in any other of the higher animals. It has been pointed out by John Fiske that the present elevation of man above other animals is due largely if not entirely to this lengthened period of plasticity,— to his prolonged immaturity. Man is born with only a few of the lowest vegetative capacities fully developed, such as digestion, respiration, and circulation; the muscular and nervous functions are latent and only gradually develop; while the higher functions of the mind go on evolving until the fifth decade of life. A long infancy or period of immaturity means a great capacity for development.

Birth and Heredity.— The infant comes into the world with a fixed sum total of vital force, along with certain hereditary tendencies in development toward health and, perhaps, toward disease. These hereditary tendencies are all modified by the physical, social, intellectual and moral status of the child's family and surroundings: in a word, they are vastly influenced by the child's environment. Heredity was formerly regarded as the most important factor in the child's life; but heredity is really only one of three great factors,— the others being the nutrition of the child, and his physical, intellectual and moral environment. During the plastic years of infancy, childhood and adolescence, a bad heredity can frequently be overcome by proper management: on the other hand, the capital of a good heredity can be squandered. Nature always tends toward the normal or healthy, so that there is always the possibility for a bad heredity to be obliterated if only the natural tendency is assisted. More then depends on the nutrition and environment of the infant than upon its heredity.

Nutrition: Breast-Feeding.—The best method of nourishing the infant is nature's way — to have it nursed by the mother. But for various reasons this is often impossible. Modern life — and especially city life — has in some way rendered a large proportion of women incapable of producing breast milk for their offspring. And the number of these mothers who desire to nurse their infants but cannot is increasing each year. Again, in not a few instances, the infant does not thrive upon the breast-milk, even though it may be abundant. In both these classes of cases some form of artificial or substitute feeding is a necessity. Good wet nurses are so difficult to procure in the United States that artificial feeding is generally preferable unless the baby is premature or feeble and failing: then the services of a wet nurse may be needed to save the infant's life.

Artificial or Substitute Feeding.— The best available substitute for human milk is an adaptation of fresh, clean unadulterated cow's milk. The milk should be diluted and otherwise modified to suit the infant's feeble digestive powers, and it should be given preferably, without being scalded or sterilized. In summer, or when there is any doubt as to the freshness of the milk, the cleanliness of the dairy or the careful handling of the milk, "Pasteurization," or heating the food to a temperature of 155° F. is advisable. Details as to milk modification and Pasteurization can be found in any book on "Infant Feeding." Ready-made infant foods,— the canned or bottled proprietary foods — do not contain the right ingredients for properly nourishing the infant, and their prolonged exclusive use is nearly always followed by some form of malnutrition — especially scurvy and rickets. These proprietary foods contain large proportions of sugar or starch, and so make fat babies, but such infants are generally pale, have feeble powers of resistance, and are prone to succumb to disease of the lungs or of the digestive tract. When the prepared infant foods are used as additions to milk they are less objectionable, and may at times be of advantage.

Weight and Development.— The infant that has been properly nourished before birth and is born at full term weighs on the average about 7½ pounds — boys being somewhat heavier than girls.

During the first few days, while the nourishment from the mother is insufficient, the baby regularly loses from six to eight ounces; but it soon begins to gain, and if the nutrition is normal and the infant remains well, there will be a steady increase in weight throughout the first two years. The gain during the first year is more regular, however, as well as more rapid than that during the second year. During the first three months the increase in weight each week is about half a pound: from the third to the sixth month the weekly gain is somewhat less, from four to six ounces: from the sixth to the ninth month about four ounces, and after the ninth month a little more, usually a weekly increase in weight of from four to six or even eight ounces. By the end of the fifth month the baby that has been perfectly well and is being properly nourished should have doubled its birth-weight and weigh about 15 pounds: at the end of the 15th month it should weigh three times its weight at birth. In many instances the baby will treble its original weight by the end of the first year; but 21 pounds may be considered the average weight for the end of the 12th month. Infants that were very large at birth do not increase so rapidly: while small or premature babies are apt to make a gain that is greater in proportion to their original weight. "Hand-fed" or "bottle" babies should weigh on the average about the same as breast-fed babies,— provided that they have had no disturbance of their digestion; the food must, however, have been perfectly adapted to the infant, and this is often a very difficult problem.

Height and Other Measurements.— At birth the length of the average baby is about 20 inches: during the first six months there is an increase of four to six inches, and during the second six months from three to four inches more; by the end of the second year the height is 32½ inches, a growth of over a foot since birth. By the end of the third year the stature is one half of the adult height. The head grows very rapidly during infancy and early childhood. The circumference of the head at birth is from 13 to 14½ inches; by the end of the sixth month it is 16½ or 17 inches: at the end of the first year 18 inches, and at the end of the second year it is 19 inches. By seven or eight years the circumference of the head almost equals the adult size of 21 inches. This is visible evidence that during the first months and years of life the brain is increasing in volume more rapidly than any other organ in the body,— the head or brain-box expanding to conform to the enlarging brain. The soft spot or "fontanel" usually closes between the 15th and the 20th months. The chest is smaller than the head at birth (13 inches), but its circumference increases rapidly, so that at 18 months that of the chest and the head are equal. After this the chest grows steadily but gradually until puberty, when there is a very rapid increase for four or five years. Aside from the regular increase in weight and measurement, the healthy infant shows other signs of well-being. The baby's flesh is firm, and the skin is satiny and elastic: the color is pink, and the body and extremities are well rounded. Very fat babies are not necessarily stronger or healthier than those that weigh less: as has already been noted they are apt to be pale, flabby and of weak resistance to disease. The healthy baby is happy and playful when awake, and sleeps from 16 to 20 hours out of the 24,— longer the younger the baby. It is desirable that the growing child have a nap during the day up to the time when kindergarten work is begun; with nervous or poorly nourished children the practice should be continued until the seventh or eighth year.

Muscular and Mental Development.— These begin with the entrance of the infant into the world, but are slow in unfolding. At first the grosser movements performed by the muscles working over the larger joints, next more complex movements, and during later childhood and early adolescence the finer movements requiring nice adjustment and delicate co-ordination. Hence it is that occupations or accomplishments requiring great manual dexterity, such as violin or piano-playing, should be taken up early,— "before the hand gets stiff," as the phrase is. The first movements are those of the legs, arms, and neck: they are not purposeful but merely reflex. By the sixth week the infant can hold up its head, when the back is supported, but very unsteadily until about three months old. At some time in the third or fourth month the infant makes its first voluntary movement, grasping at some object in the range of vision. Within a month or two later the baby can co-ordinate the muscles of the eyes, arm and hand sufficiently to take firm hold. Sitting alone is an accomplishment of the seventh or eighth month, and creeping also begins at about this time, if the baby is ever to creep at all. During the eighth or ninth month the baby begins to stand, having made the attempt for many weeks before; at ten or eleven months the infant can stand alone, and shortly after the twelfth month the first tottering steps are taken. It is some months before the baby is secure upon the feet, the maintenance of the equilibrium requiring nice control of many groups of muscles. Healthy infants differ greatly as to the time when they can walk alone, some walking at as early as ten months, while others may not walk until eighteen months. Very fat babies walk late but, in some instances, an excess of caution seems to be a factor. If a child is far behind in performing any of these muscular functions, a physician should be consulted so that careful examination may be made for signs of rickets or of disease of the brain or of the spinal cord.

Development of Special Senses.— For the first few days the newly-born infant avoids the light, and for many weeks cannot endure a direct bright light. Perception of light soon develops, the color first attracting attention being red. Clear perception of objects comes during the fifth month. Hearing is in abeyance for several days, a baby at birth being practically deaf; but after a week or ten days this function begins, and later hearing becomes very acute, the infant being able to recognize the mother's voice or a footstep at about three months. Loud sounds cause the baby actual pain, so severe are their impressions on the delicate auditory apparatus. The sense of touch (contact) is early developed, especially in the tongue and lips; but sensitiveness to pain is very dull during infancy. Heat and cold are recognized from an early period, the variation of a few degrees in the temperature of the food causing the baby to refuse it. Taste and smell also are present at birth, taste being very discriminating.

Development of Speech.— Speech is very closely related to the higher functions of the brain, and is therefore the last of the simple functions to develop. Usually a baby begins to say "Mamma" and "Papa," with clear knowledge of the meaning, toward the end of the first year. Next names of objects and persons are learned and soon two words are put together. Then verbs are used, and about the end of the second year little sentences are made. Pronouns are regularly the last of all the parts of speech to be used. During the third year speech develops very rapidly, the baby bringing out some new term or expression almost daily. There are great variations in the time when children begin to talk; and for this there are many reasons. Girls generally talk earlier than boys by two or three months: babies that associate in the nursery with other children talk earlier than only children. If, however, a young child reaches the age of two years without attempting to talk, mental backwardness or organic brain disease is apt to be the cause. Tongue-tie is seldom the cause of backwardness in talking, although it does produce imperfect articulation.

Dentition — Teething.— The first teeth appear about the sixth or seventh month, but a perfectly healthy baby may have no teeth until 10 or 11 months old, or on the other hand may cut the first tooth at four months. The regular order is as follows: lower central incisors, upper central incisors, upper lateral incisors, lower lateral incisors — each pair coming at intervals of three to six weeks: at about the fourteenth month the front double teeth (anterior molars) appear in the two jaws, and four or five months later the canines, known popularly as the "eye and stomach teeth." Finally, the last four molars appear sometime between the twenty-fourth and the thirtieth month, and these complete the twenty teeth of the first dentition. Teething babies are apt to be fretful, they have a reduced resistance against disease, and they are prone to slight disturbances of digestion. To attribute most of the ills of infancy to the process of teething is a great mistake; usually some other and better cause for the disturbance can be found if the baby is carefully examined. During the time when the successive pairs of teeth are coming through the gums, the usual food should be largely diluted, so as to prevent any serious indigestion.

Fever.— Sudden high temperature is readily produced in young children by slight causes, inasmuch as the heat-regulating centre in the brain is but poorly developed. Again, the temperature in disease is erratic, and is apt to be higher than in adults suffering from the same ailment. Only persistent high temperature need cause anxiety.

Convulsions.— A characteristic of infancy is the easy excitability of the motor side of the nervous system. Hence convulsions or spasms are much more frequent and less serious than in adults. The immediate cause of the motor explosion may be an overloaded stomach, fright or mental excitement, or the fever of an oncoming disease. Severe earache, intestinal worms or a paroxysm of whooping cough may also serve as an exciting cause. Underlying or predisposing causes are a nervous heredity, malnutrition, or rickets; or there may be organic disease of the brain or the kidneys. The spasm usually begins with a turning of the eyes to one side and twitchings or grimaces of the face: there may be frothing at the mouth; then the arms and legs are rapidly contracted and relaxed: later the body stiffens out, the breathing becomes noisy and labored, the face, — especially the lips — becomes livid. Shortly afterward the body relaxes, the breathing becomes easy, and spasm ceases for the time being — having lasted anywhere from five to thirty minutes. Until the physician arrives certain simple measures are of value. The infant should be undressed, wholly or partially, and put into a warm bath (not warmer than 105° F.) to which a handful of mustard flour has been added, and the baby should be rubbed all over while in the tub for about five minutes. Then remove from the bath and lay between blankets, putting a warm bottle at the feet and an ice cap or cold compress on the head. If the baby can swallow, a full dose of castor oil should be given. Most convulsions are due to the presence of decomposing food-remains in the alimentary tract, and the spasms usually cease when the stomach and bowels have been thoroughly evacuated.

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In'fant, in law. By the common law persons come to majority at the age of 21 years, until which time they are called in law *infants,* but by common usage in the United States the word minor prevails. Infants cannot, in general, bind themselves by contracts, as they are supposed not to have sufficient discretion and ability for this purpose. But this is their privilege, and their contracts are accordingly held in general not to be void, but only voidable at their election; and they may elect to avoid their contracts during their minority, except such as they may have entered into for necessaries suited to their condition in life, but they cannot confirm them so as to be bound by them until their majority. Infants may possess property, but it must be under the management and control of a guardian. They have not the right of citizens as to voting, and discharging other political functions. But in regard to crimes and punishments, and trespasses and private wrongs, their conduct is regulated by the same laws as that of the other members of the community, in case of their being of sufficient age and discretion to understand their duties and obligations. And for this purpose no general limit can be assigned, as some children are much more intelligent than others of the same age; and it will again depend, in some degree, upon the nature of the offense committed, or the wrong done, whether a child of any given age can be considered legally guilty of it, since some offenses and wrongs can be more easily understood to be such than others. The law, in general, has a tender regard to youth, and does not permit them to be convicted and punished for offenses and trespasses unless it appears clearly that they have sufficient knowledge and discretion to distinguish them to be such. There are exceptions to the incapacities of minors as to contracting, and these exceptions are made for their benefit. Thus an infant not sufficiently furnished with necessary clothes, food, or instruction, by his parent or guardian, and not being under the immediate superintendence of the parent or guardian, may make a valid contract, in respect to those subjects, and such contract may be enforced against him. Infants require the consent of parents or guardians to marry. The jurisdiction in respect to infants is generally vested in either probate or orphans' courts. These courts appoint guardians to take charge of the property of infants, and, in case of the decease of the father, to take charge of their persons; but during the life of the father he has the guardianship and control of the persons of his children until they are 21 years of age.

Blackstone thus defines infant: «Infants have various privileges, and various disabilities: but their very disabilities are privileges, in order to secure them from hurting themselves by their own improvident acts. An infant cannot be sued but under the protection, and joining the name of his guardian, for he is to defend him against all attacks as well by law as otherwise: but he may sue either by his guardian, or by his prochein amy, or alone for wages in the county courts. In criminal cases an infant of the age of 14 years may be capitally punished, but under the age of 7 he cannot. The period between 7 and 14 is subject to much uncertainty: for the infant shall, generally speaking, be judged *prima facie* innocent: yet if he was *doli capax,* and could discern between good and evil at the time of the offense committed, he may be convicted, and undergo judgment and execution of death, though he has not attained to years of puberty or discretion.»

Infant Jesus, Daughters of the Congregation of the, is an order in the Roman Catholic Church. It owes its origin to Anna Maroni, a native of Lucca, who having come to Rome entirely destitute, succeeded by her industry in securing a competency. In more advanced years, her charitable feelings prompted her to establish an institution where poor girls should be instructed in such work as would enable them to earn a livelihood. The clergy approved of her plan, and afforded her much assistance, and it was finally established as a regular institution, and in 1673 Pope Clement X. acknowledged the existence of the society, gave it by-laws, and endowed it with sundry privileges, under the appellation of «Daughters of the Infant Jesus.» The number of the «Daughters» allotted to each convent was fixed at 33, in commemoration of the number of years Jesus lived upon earth. The novitiate lasts three years; the sisters make vows of poverty, chastity and obedience. Such as may wish to leave the convent are allowed to do so before taking the vows, but, in that case, they are to leave to the convent all they brought to it at their admission. Prayers and fasts are strictly enforced. The regular habit of the order consists of a wide, dark brown dress, and a white hood.

Infanta, ēn-fān'tä, Philippines, a former Spanish commandancia of the island of Luzon, consisting of a narrow strip of territory on the Pacific coast with Nueva Ecija on the north and Tayabas on the south. In 1902 it was made a sub-province of Tayabas, «the inhabitants to enjoy the same rights and privileges as if the said territory had been originally incorporated in the province of Tayabas.» The surface is very rough and mountainous and the construction of roads impossible except at heavy cost; several trails lead over the mountains to the central provinces. The forests are valuable, among the trees most important to commerce is the balate, which produces the balate gum. The agricultural methods are most primitive; the chief crops are rice, cocoanut, chocolate and coffee; the most important industry is the manufacture of nipa wine; there was formerly a large manufacture of cocoanut oil in Infanta, but this industry was paralyzed by the hurricane of 1882. Pop. 10,800

Infant'icide, the murder of a child born alive, is a crime of frequent occurrence. The main cause of the crime is shame, induced by a dread of the social disgrace attaching to mothers of illegitimate children; though in many instances infanticide has been the result of violence produced by puerperal insanity. The morbid disposition to kill the newly born has also been observed in certain of the lower animals. The sanctity of human life, from its beginning to its close, is a maxim of modern civilization, and the law treats as a murderer whoever wilfully terminates it at any stage. According to the law of England every woman who employs means to procure criminal abortion is guilty of felony, and liable to penal servitude for life, or not less than three years; and severe penalties are inflicted on those who aid women to procure miscarriage. The concealment of birth is a misdemeanor, and may be punished with imprisonment for two years. In the United States, when a child's death is occasioned by an illegal act, such act is considered either murder or manslaughter according to the circumstances. The crime, however, is rarely punished, and in large cities many cases occur each year which are never reported to the authorities.

Infanticide was prevalent in Greece and Rome. In modern times many barbarous peoples are guilty of wholesale child-murder. Among some of the Pacific Islanders and aboriginal Australians there is a great destruction of infant life. The Hindus used to destroy female children without compunction. In China infanticide is said to be very common.

Infantry («the juveniles,» probably at first the knights' pages), foot soldiery, as distinguished at once from cavalry and artillery. In all ages this has naturally formed the numerical bulk of armies, but its tactical importance has varied greatly with circumstances. The name cannot be given to the mere unorganized fighters of barbarian *mêlées;* it implies some organization, and at least the rudiments of tactics. The first large armies were the Egyptian and Assyrian, continued by the Persian: the social system was aristocratic, and the large plains ideal for the utility of cavalry; hence the infantry was rather an auxiliary, to complete a rout after the mounted lords and the chariots had broken the ranks, than the main fighting body. The first development of infantry as the chief reliance was naturally in the small Greek states, whose independence rested on their citizen soldiery, and whose rough territory made cavalry evolutions difficult. Cavalry was therefore used mainly to guard flanks and to skirmish; the Spartans for a long time would not use it at all. The infantry was divided into classes according to armor; hoplites (with heavy defensive armor, long spear and dagger), psiloi and peltasts (very little armor, light barbed javelins to throw), and gymnetes (sharpshooters, light-armored and with slings or bows). The battle formation was the famous phalanx, whose one basic principle was the value of mass and momentum, and which was irresistible either for attack or defense against barbarians who lacked firmness in the ranks. It was commonly a rectangular block eight ranks deep, so that only the first two or three could use their spears at the same time, the rear ranks serving only for instant reinforcement and for impact; the men were from 18 inches to 6 feet apart, according to conditions of defense or attack; the phalanx had usually 2,000 to 4,000 men, but sometimes as high as 10,000 or more. Sometimes the formation was the triangular wedge. The first great improvement was by Epaminondas, who made the ranks 50 deep, and by the enormous impact crushed the Spartan phalanx at Leuctra. This was the Napoleonic principle of concentration at the critical point, most of the Spartan army being allies with no heart in the fighting, and kept at bay by a few skirmishers. Nevertheless, the step was backward except for immediate necessities, as it increased the main vice of the phalanx — its immobility, which made it break up dangerously on bad ground, and gave little power to change front or execute flanking movements. In later tactics the larger ones were subdivided into companies of 120 with a distance equal to the front, forming an approach to the legion; and the latter was copied also in the formation by lines, increasing rapidity of movement and flexibility on difficult ground, as well as power of extension and so of flanking. The Macedonian *sarissa* or long pike doubled the number of ranks which could thrust at once over each other's shoulders. But the whole system went down before the Roman legion, which essentially maintained its position till the Empire too went down. It consisted normally of 1,200 each of hastati (spearmen), principes (veterans), and velites (light troops), 600 pilani (veteran reserves), and 300 equites or cavalry. It was divided into three lines and 30 maniples or companies, and combined solidity with ease of maneuvering.

In the Middle Ages, till the general use of gunpowder, the feudal system insured the degradation of the infantry, as it depended on the fighting power of the knight, and consequently lavished all the care and expense on perfecting his armament. But even without this, the same result would have come, for without good field artillery, and with only bows and arrows at their best, the heavily armed man was invulnerable, as the Spanish conquests in the New World amply prove. Hence the logical result was the extension of defensive armor till some new missile force came in. But the cost of this was so great — a full suit of steel armor cost about $2,000 — that only the richer even of the knights could afford them, no king could raise money to equip a standing army, and the aristocracy would combine to refuse him money for such a purpose; and the rank and file were scattered and slaughtered in face of a charge of a small number of mailed knights. The defeat of the French knights by the English bowmen was that of a disorderly and insubordinate mob, by a splendid archery which slew their horses and pierced the cheaper armor. But gunpowder at once changed the whole situation. A serf with a $10 hackbut could stand out of reach and kill a knight with his costly armor; and a sovereign could collect and arm a great force of these and use them to put down his unruly vassals. Hence armored knights and horses began to decrease, and standing bodies of foot soldiery with firearms to increase. The change in battle array was correspondent: theretofore, even the ablest commanders had maintained the great depth of 10 ranks, traditional from classic times. Gustavus

Adolphus reduced this to six, deploying to three under fire; while Tilly and Wallenstein and the other imperial commanders kept to the old phalanx formation. Breitenfeld (1631) and Lutzen (1632) were won by this and Gustavus' light artillery. The introduction of the bayonet about 1650 led to a reduction to four ranks. But the greatest single improvement was due to Leopold of Dessau early in the 18th century: he instituted the chief reforms usually credited to Frederick the Great, and formed the armies with which Frederick won his victories. He reduced the ranks to three, making it possible for all to fire, trained them to maneuver with great precision, and wrote the drill-book which is still the basis of all European and American manuals. Frederick's infantry organization, in regiments of two or three battalions, each 500 to 600 strong, was copied by all the other nations: and the general principle of open order, made necessary from the destructiveness of artillery on close masses of men, and possible by the confidence in each other bred by civilization, is still retained. Broadly, the difference between ancient and modern infantry is that between mass and mobility.

For obvious reasons — cheapness of maintenance, universal availability of men untrained in horsemanship, ability to march and maneuver on all sorts of ground, less liability to be crippled by loss of the animals, etc.— all modern armies consist mainly of infantry; and the nominal horse troops are most often dragoons, or soldiers mounted merely for quickness of movement, but who fight on foot. The quantities of other arms, as cavalry, artillery, engineer corps, etc., are based on the infantry numbers. The proportions vary in different armies and in different functions of the same army, according to nature of service: more or less cavalry and artillery being used according to need of concentration, or action in dispersed bodies. Forces like the United States Western troops a generation ago, for instance, in small squads on detached duty, would have different proportions from a great Continental army in the midst of a campaign. While there is no one system of infantry tactics which can be universally applied, the same cause which has made the change just spoken of has thus far continued to act with steadily increasing force. Artillery continues to grow in power and in range; the danger-line grows ever farther from the enemy; it is nearly impossible, and would be murderously losing, to charge in close column across the 2,000 yards which is now the average range. The system adopted is called "extended order," which means a considerable space between the men, and small bodies acting separately in a charge; each making a rush for some cover not so far off that they will be blown in reaching it, or will be decimated in the attempt. A certain relation between companies and regiments is kept up, to avoid destruction in detail and enable combined action, but precise parade alignment is not attempted. This involves not only the mutual confidence of civilized men, but some of the independent judgment of those who have not had initiative crushed out of them by red tape: the greatest of modern tacticians and commanders have expressed a preference for intellectual quality over mere numbers, even in the rank and file. In the United States, the extended order was first introduced in the Revolution.

For the organization of the line in this country, see ARMY OF THE UNITED STATES. In addition to this, a few facts may be given: The general orders of 19 May 1877 fixed the strength of the infantry at 9,575 men, in 25 regiments. The pay ranges from $3,500 a year for the colonel to $13 a month for the private. The appointments are made from the United States Military Academy, from the ranks after two years' service and severe examinations, or from civil life if there are no eligibles in the others. The arms are the Krag-Jorgensen and the new Springfield magazine rifle, with knife-bayonet. The equipment is knapsack, haversack with implements for meals, canteen, blanket wrapped in piece of shelter tent, and waist-belt with cartridges.

Infec'tion, the introduction of disease-producing micro-organisms in the body. Infection may result in a number of different ways. Micro-organisms may be introduced by means of direct injury. When a person falls and cuts the hand, the bacteria of pus-production or of tetanus may be so introduced, and blood-poisoning or tetanus may develop. Many infections come by means of the intestinal tract. Thus typhoid is commonly obtained from milk or drinking-water. The intestinal worms, tapeworm, roundworm, are contracted in this manner, and a number of other parasites, particularly the trichina, may come from infected food taken into the alimentary canal. Infection may also occur by means of the air-passages. The bacillus of tuberculosis is most often taken into the body in this way, and finding suitable soil, it causes the development of the dread disease. The bubonic plague is frequently contracted through the disease-germ entering the air-passages. At the present time it is deemed not unlikely that a number of infectious diseases, notably influenza, diphtheria, scarlet fever, measles, whooping-cough, are contracted through the respiratory tract by infection with the exciting cause. Occasionally direct contact seems necessary for infection, as in gonorrhœa and syphilis. In malaria, and probably in yellow fever, the active agent that causes the disease is introduced into the body by the bite of an insect, the mosquito. In malaria one particular genus (*Anopheles*) serves as an intermediate host in the developmental history of the parasite, in a manner analogous to the history of the development of a number of the intestinal worms. It is not unlikely that a large number of diseases may be disseminated by the bites of insects of one kind or another. In all the infectious diseases the element of a real, live, and active contagion should never be overlooked. Infectious diseases do not spring out of nothing. There must be some sort of contact in order that a person become infected. A most important part of the treatment of all infectious diseases is the protection of other people by proper care of all one's own excretions during sickness. The doctrine so frequently taught by some that sickness is ignorance is an important half-truth. But for the ignorance of people concerning the proper care of those afflicted with infectious diseases with reference to the protection of others, measles, diphtheria, scarlet fever, whooping-cough, typhoid fever, consumption, and a number of other maladies would be entirely eradicated from civilized communities.

In'fidel, in modern parlance, one who deliberately rejects the Christian faith after obtaining knowledge of it. In former times a man might be an infidel who had never heard of Christianity. *Infidelis* in ecclesiastical language means "unbelieving," and is applied to unevangelized heathen as well as doubters and apostates. Thus in the Roman Catholic Church a bishop *in partibus infidelium* merely means a bishop whose diocese is set in heathen countries.

In'finite, a term in metaphysics, which means a reality which has no limit or boundary, in time or space. The idea of the infinite is as old as the Ionian philosophy, when Anaximander (610 B.C.) declared that the one in the many, the basis of being in Nature, was το ἄπειρον, the infinite. The reality of infinitude has been the source of much controversy, and the tendency of many modern philosophers is to deny it. "An infinite number," says Bosanquet, "would be a number which is no particular number, for every particular number is finite. It follows from this that infinite number is unreal." On the other hand F. H. Bradley states the contrary, in the clearest terms, "We may be asked whether Nature is finite, or infinite. . . . if Nature is infinite, we have the absurdity of a something which exists; and still does not exist. For actual existence is, obviously, all finite. But, on the other hand, if Nature is finite, then Nature must have an end, and this again is impossible. For a limit of extension must be relative to an extension beyond. And to fall back on empty space will not help us at all. For this (itself a mere absurdity) repeats the dilemma in an aggravated form. But we cannot escape the conclusion that Nature is infinite. And this will be true not of our physical system alone, but of every other extended world that can possibly exist. . . . Every physical world is, essentially and necessarily, infinite."

It seems as if Aristotle had a clearer and more logical view of infinity, το ἄπειρον than many modern Positivists, such as Bosanquet. He says, λειπεται οὖν δυνάμει εἶναι το ἄπειρον. He means of course, that, with regard to finite human intelligence, the infinite remains unrealized, although logically it could be realized, and of course, when we speak of infinite time, or infinite creative change in nature, we speak of something which potentially exists, but is only gradually becoming actual.

Infinity is also applied to the divisibility of matter. This is termed "infinite fission." If an atom is divided into two parts, and each of these is again divided into two parts, the mind cannot conceive of any individual fragment resulting from this division as incapable of being divided.

Professor Royce of Harvard has undertaken the task of vindicating the concept of the actual Infinite against the charge of self-contradiction. He is controverting Mr. F. H. Bradley of Oxford, who while he admits "we cannot escape the conclusion that Nature is infinite," expresses also his belief that such an assertion is a contradiction in terms. Professor Royce accomplishes this vindication by proving the following theses:

1. The true Infinite, both in multitude and in organization, although in one sense endless, and so incapable in that sense of being completely grasped, is in another, and precise sense, something perfectly determinate. Nor is it a mere monotonous repetition of the same, over and over. Each of its determinations has individuality, uniqueness, and novelty about its own nature.

2. This determinateness is a character which, indeed, includes and involves the endlessness of an infinite series; but the mere endlessness of the series is not its primary character, but simply a negatively stated result of the self-representative character of the whole system.

3. The endlessness of the series means that by no merely successive process of counting, in God or in man, is its wholeness ever exhausted.

4. In consequence, the whole endless series, in so far as it is a reality, must be present, as a determinate order, but also all at once, to the absolute experience. It is the process of successive counting, as such, that remains, to the end, incomplete, so as to imply that its own possibilities are not yet realized. Hence, the recurrent processes of thought reveal eternal truth about the infinite constitution of real Being,— their everlastingly pursued Other; but themselves,— as mere processes in time — they are not that Other. The true Other is, therefore, that self-representative system of which they are at once portions, imitations and expressions.

5. The Reality is such a self-represented and infinite system. And herein lies the basis of its very union, within itself of the one and the many. For the one purpose of self-representation demands an infinite multiplicity to express it; while no multiplicity is reducible to unity except through processes involving self-representation.

6. Nevertheless, the Real is exclusive as well as inclusive. On the side of its thought the Absolute does conceive a barely possible infinity, other than the real infinity, a possible world, whose characters, as universal characters, are present to the Absolute, and are known by virtue of the fact the Absolute thinks.

This brings metaphysics face to face with the notion of a Supreme Being, who is infinite or absolute. With the mystics God is infinite love, joy and wisdom to his human children. The Hindus taught that God was the infinite universe, the Other, the reality. "That (that is, the Universe) art thou," was their dictum. Christianity teaches that "God is of infinite power, wisdom and goodness," of which qualities the best of men have but a finite endowment.

The term "infinite" was introduced into geometry by Kepler in his 'Nova Stereometria Doliorum: accessit Stereometriæ Archimedeæ Supplementum.' Thus he considered a circle as formed by an "infinite" number of triangles, having their vertices at the centre, and their bases at the circumference. A cone likewise, he taught, was composed of an "infinite" number of pyramids, having their vertices at the vertex, and standing on an "infinite" number of triangular bases, bounded by the circular base of the cone. In this sense infinite means incommensurable, not to be expressed by a finite mathematical formula. Consult: Bradley, 'Appearance and

Reality'; Royce, 'The World and the Individual'; Bosanquet, 'Logic'; Couturat, 'L'Infini mathematique.'

Infin'itive, the indefinite mode in which the verb is represented without a subject. As the verb expresses an action, or a state, it generally belongs to a subject whose action or state is expressed; but if we wish to express the mere idea of this action or state we use the infinitive, which, therefore, in many languages is employed without further chance as a substantive — for instance, in Greek and German — only preceded by the neuter article; but as the verb expresses an action or state under certain conditions of time, the infinitive can also express the action or state in the present, past, or future, though these conditions are not expressed in all languages by peculiar forms. Some languages express it by some grammatical contrivance, as is the case in English, where it is denoted by *to* prefixed to the general uninflected form of the verb, as *to love* = Latin *amare; to have loved* = Latin *amavisse*. The infinitive may be regarded as the point of transition from a verb to a substantive, and is often used as the subject of a proposition.

Infinitesimal Calculus. See CALCULUS, INFINITESIMAL.

Infin'ity, and the Infinitesimal. See INFINITE.

Inflammation, a term long used to indicate the phenomena that follow mechanical, chemical, or physical injuries to living tissues. These changes have been described for centuries as rubor (redness), calor (heat), dolor (pain), and tumor (swelling), which are the phenomena particularly seen on surface inflammations. At the present time the idea is becoming fixed that inflammation is a conservative process, the phenomena attending nature's effort to rid the tissue of harmful substances. In the normal process of repair of an injury there are changes which closely resemble the milder types of inflammation; but when to a mechanical, chemical, or physical injury there is added a growth of micro-organisms, the reply on the part of the body-cells differs from the ordinary repair of injury. The changes witnessed depend upon the strength and kind of invading micro-organism and the particular tissue invaded. The first change is *hyperæmia,* a suffusion of the part with blood from capillary dilatation; following this the liquid part of the blood, the serum, is poured out into the tissues and offers its resisting powers to the poisonous substance. If these measures be insufficient, the white blood-cells called phagocytes congregate in the tissues, destroying the invading organisms, by actually consuming them and neutralizing their toxic products. During this struggle there is more or less death of the cells, called «degeneration»; large masses «slough»; the remnants of the cells and the phagocytes killed form the thick fluid called pus. When an inflammation goes on to the formation of pus, it is spoken of as *purulent* or *suppurative*. Certain poisons cause a peculiar reaction on the part of the tissues, characterized by the formation of new tissue that is unable to carry on the function of the part. This tissue is the same as the connective tissues, and the process is called *productive inflammation*. The poisons that continue to act for a long time are particularly apt to cause this reaction, and the inflammation is called *chronic* because of its permanency. Catarrhal inflammations are these same processes when they occur in mucous membranes; the appearance of these catarrhs, however, is different, owing to the peculiar structure of mucous membrane and to the fact of the epithelial covering offering excellent resistance to invasion. When death of cells occurs they can readily be cast off. Croupous inflammation is the term used to describe those in which there is considerable destruction of the superficial layers of the mucous membrane, which, with the fibrin of the blood, forms a coating or «false membrane» on the surface. Granulation tissue (q.v.) is the name applied to the tissue formed during the repair of an injury. Names are given to certain types of inflammation having a characteristic appearance to the naked eye, but microscopically there is nothing absolutely distinctive in these except their arrangement. Particular examples of these are tubercular and syphilitic inflammations.

The majority of the diseases of the body that we recognize as entities are due to inflammation in some tissue or organ, but the picture depends on the various changes in the functions of different parts of the body. The kind and virulence of the generated poison, together with the reaction on the part of the body-tissues, makes the complete picture that we seek to recognize. The treatment of inflammation is, in large part, the practice of medicine and surgery. Efforts to help the tissues combat against invasion are made with more success as knowledge is gathered of the peculiar invading forces and the natural modes of defense. It is not that we wish to combat the inflammation *per se,* but rather to make it unnecessary by helping it to a successful issue. The actual destruction of the bacteria by drugs introduced into the body is of little use, for they would be apt to cause as much destruction of the body-cells as of the invading cells; but their toxines, which cause the actual damage, we are learning to neutralize by the administration of artificially prepared antitoxins, and by placing the body and its special tissues under the most favorable conditions for developing its natural forces of resistance.

In exposed parts of the body, where antiseptics may be applied, the toxic germs may be killed, and various measures that change the blood-supply may be advantageous. Where death of tissue takes place, nature may require help in its removal. It has long been the rule to evacuate pus wherever it is formed, unless its escape from the tissues is easy.

The treatment of chronic inflammation is entirely different, as this is a process where actual structure is changed beyond repair in many instances. The all-important question is whether the tissue can carry on its proper functions; for if it can, the body need not suffer. The inflammatory process is arrested in its progress by the removal of the irritating cause, by improving the blood-supply of the part and the vitality of the body generally. These constitute the measures in general applied for the cure of chronic inflammations, it being understood that the endeavor is to place the tissues in such a condition that they may carry on their functions for the good of the whole organism; and the failure of these measures shows either that they are at fault or that the tissue-change has gone too far. Inflammation of any part is indicated by adding the suffix "itis" to the name of the organ or tissue. See BRONCHITIS, COLITIS, LARYNGITIS, MENINGITIS; etc.

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Inflexion (Latin, *inflexio*, a bending), that process in grammar which modifies words when placed in relation to other words in a sentence. Pronominal and predicative roots are combined to form one word in the Semitic and Aryan tongues, which are therefore called inflexional, a process impossible in monosyllabic languages like the Chinese or in languages of the agglutinate order like those of the Turanian family. In grammar, cases, numbers, persons, tenses, etc., are known as inflexions, and in many instances the original affixes can be readily recognized. The Semitic and Aryan families of languages, which admit of phonetic corruption both in the root and the terminations, are called organic or amalgamating languages. The pronominal termination varies according to the person or number. Thus the Sanskrit *mi, si, ti,* the endings of the three persons singular of the present of the verb, are perhaps from the personal pronouns *ma, sva, ta,* and the persons of the plural indicate the plural number by the form of the pronominal affixes. The plural of masculine and feminine Greek and Latin nouns of the third declension is probably a contraction of the duplication of *sa*, the pronoun of the third person. The verbs *i*, to go, *as* and *fu*, to be, supply the inflexions of certain tenses of the verb, there being also a pronominal termination varying according to the person. In English the common auxiliary verbs am, do, have, shall, will, may, can, asserting respectively existence, action, possession, obligation, volition, liberty, power, assume the function of inflexions, and are themselves inflected to denote past time. In French the same inflexional law exists, the connection between the auxiliary and the root being closer than in English. *Aimer-ai,* I have to love, that is, I shall love, is compounded of the infinitive *aimer*, to love, and *ai*, I have, the first person present indicative of *avoir*. The same is the case in Italian and Spanish.

Inflores'cence, Infructescence, botanical terms referring respectively to methods of flowering and fruit-bearing. The flowering shoot, says Strasburger, frequently bears only a single flower, which may then be either axillary or terminal. In many cases, however, the metamorphosis of the generative region, which results in the production of flowers, has led to the formation of a special system of fertile shoots termed an inflorescence or, after the fruit is formed, an infructescence. (See FLOWERS; FRUIT.) Such inflorescences are wanting or ill developed among the Gymnosperms, while in the Angiosperms they are often well differentiated, constituting unities of a higher order. The modifications exhibited by the fertile shoots of such an inflorescence are due, partly to a difference in their mode of branching, partly to the reduction or the metamorphosis of their leaves. These changes are the result of an adaption to pollination, in the endeavor to aggregate the flowers and at the same time render them more conspicuous by the reduction of the foliage-leaves. Sometimes the whole system of fertile shoots is converted into an attractive apparatus, as in the *Araceæ*, where the axis and the subtending leaf of the inflorescence have assumed the function, usually exercised by the perianth, of enticing insects. Viewed from a purely morphological standpoint, two types of inflorescences may be distinguished, the Botryose (racemose, monopodial) and the Cymose (sympodial).

Influenza, la grippe; an epidemic catarrhal fever, now believed to be due to a very minute bacillus that can be found in the various secretions. Epidemics of this disease have been traced back as far as the beginning of the 16th century, and since 1741 many such epidemics spreading over portions of Europe have been described. There are so many different types of the disease, and so many parts of the body may be distinctly attacked by it that it somewhat baffles close definition. The epidemics vary much in severity as well as in type. During the last decade it has become almost constantly present over portions of the United States, in some years being much worse than in others.

So great is the variation of its symptomatology that no standard description can be given, and the types are classified according to prominent features. After one to four days of incubation, the disease usually sets in abruptly with chilliness or true rigor: this is followed by a fever (which may be constantly low or may run very high), headache and general aching, and a degree of prostration out of proportion to any discoverable cause. The respiratory form is characterized by inflammation of the nasal, the pharyngeal, the laryngeal, the tracheal, and the bronchial membranes. Starting in the nasal mucous membrane, the inflammation is apt to involve the other membranes in the order given. It is quite common for the lungs to show small spots of bronchopneumonia. There is frequently nothing to distinguish such an influenza from similar acute catarrhs of the respiratory passages except the known presence of an epidemic and the disproportionate prostration. The gastro-intestinal form is characterized by nausea, vomiting, abdominal pain and profuse watery discharge, with prostration sometimes amounting to collapse. The typhoid form is characterized by the sudden development of rather high fever (with or without severe aches and pains), general apathy, or even a low muttering delirium. The fever runs from a few days to two weeks, and may very closely resemble typhoid. The nervous form is characterized by severe pains throughout the entire body, prostration, moderate fever, but no definite affection of any part or organ. The meningeal form is characterized by headache, fear of light, pain and stiffness of the muscles of the back of the neck.

Complications and extension of the inflammation to other parts are common. Pneumonia complicating influenza is rather apt to be very severe, and in some epidemics the mortality rises very high. Pleurisy is quite common. Great disturbance of the heart's action is seen in some cases, and the poison may actually attack the lining membrane of its chambers. Less commonly there is inflammation of the eye, ear, brain, liver, intestine, or kidneys. The skin is sometimes affected, showing a general blushing rash, herpes (small painful itchy blisters), or bloody patches. A very common sequel is great nervous depression, either an inability to make bodily or mental exertion or "low spirits," even amounting to true melancholia. Unless influenza is epidemic, differential diagnosis may be very difficult, but hasty refuge in a diagnosis of "grippe" is far too common; in doubtful cases search should be made for the specific bacillus and considerable reliance placed on the presence or absence of the characteristic symptom, extreme weakness.

For the disease there is no specific treatment; the infecting organism must continue to grow until the natural defenses of the body overcome it; as yet no means has been discovered of killing the bacillus in the body or overcoming its poisons by an antitoxin. Careful isolation of the affected individual will prevent the spread of the disease to other members of the family, and much can be done for the patient's relief. Useful measures consist in securing thorough action of the bowels, keeping up the nutrition by simple, easily digested foods, and the administration of drugs such as phenacetin, acetanilid, caffeine, and bromides to relieve the distressing pains or nervous tension. The nervous exhaustion which is apt to follow is best treated by a period of mental rest, nourishing diet, and little or no bodily exertion.

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Infor'mer, a person who sues for a penalty against those who have infringed any law or penal statute. To encourage the apprehending of certain felons, guilty of offenses not so much criminal as bordering on criminality, many English statutes, from 1692 downward, granted rewards to such as should prosecute to conviction. The penalty in whole or in part inflicted in the case of a successful conviction, and immunity from certain troublesome parish offices, were the inducements held out to informers. In many cases this practice has been resorted to in modern statutes. In the United States one who informs the government of the whereabouts of smuggled goods, counterfeit money, etc., is rewarded by a fee of ten per cent of the net value of the confiscated goods. In criminal law an informer is said to turn state's evidence (q.v.).

Infu'sion, in pharmacy, an aqueous solution of a medicinal substance obtained by treating with water, usually without the aid of boiling. The water may be either hot or cold, varying with the object to be obtained. According to the directions of the United States Pharmacopœia, infusions are generally prepared by pouring boiling water upon the drug and macerating in a tightly closed vessel until the liquid cools. The active principles are in this manner extracted more rapidly and, as a rule, in much larger portions than if the solution is colder. Heat is not advisable if the active principles are volatile. If an infusion is desired of a greater degree of concentration than that obtained by the process of maceration, it is frequently prepared by percolation, in which operation the drug is sliced or broken up into small fragments, packed in a percolator, and the water, either hot or cold, is passed through. Infusions are sometimes made with the aid of other liquids than water, but this is the exception rather than the rule. Infusions do not keep well, and therefore they should be made extemporaneously and in small quantities. In household medicine, infusions are very widely employed. These may be made at home or made by the pharmacist. It is essential to remember that if they are made in hot weather in large quantities they must be sterilized.

Infusion of saline solution into the blood-vessels is a very important procedure in medicine. It is employed largely in the treatment of shock, and in severe hemorrhage, especially following operations or childbirth. The solution that is used is known as a normal salt-solution, and consists of about one teaspoonful of common salt to a pint of water. This solution should be boiled carefully for one half to three quarters of an hour, the amount of evaporating water being made up as the boiling proceeds, and after being made it should be kept in large bottles provided with cotton plugs for stoppers. In severe cases of hemorrhage, infusion has often saved life, as it provides a body of fluid on which the heart and blood-vessels can act. The salt-solution is usually introduced into one of the large veins of the arm at a temperature of one to two degrees above that of the body-temperature. See BLOOD; TRANSFUSION.

Infuso'ria, Protozoa of the classes *Flagellata* and *Ciliata,* originally so-called from abounding in organic infusions. While the term is now restricted to the ciliate protozoans, it often includes the flagellate protozoans as well. The latter are represented by the monads. These are exceedingly minute round or pear-shaped animals, which move by one or two lash-like processes called flagella. They contain a nucleus and contractile vesicles. Some of them are fixed by a stalk, and are provided with a collar, as in *Codosiga,* out of which the flagellum projects. One of the simplest monads (*Heteromita*) is obtained by placing a cod's head in water at a temperature of about 70° F. In a few days the water will swarm with these monads. The young germs will live in boiling water, but perish at a temperature of from 212° to 268° F., while the adults are destroyed at 142° F.

In the ciliate infusoria the body is more or less flattened and covered with cilia (*Paramecium,* etc.). They have on the under side of the body a slightly defined mouth (or cytostome), which is permanently open, and the food is swept into it by the action of the cilia around it. The mouth leads into a funnel-shaped throat or cytopharynx, which ends in the protoplasm of the body. The food-particles swept into this throat and pressed into the protoplasm form a small enlargement which finally sinks farther in forming the "food vacuole," which, by the flow of the protoplasm, is carried about the body, while the digestible portions are absorbed and the waste matter is cast out at a fixed point,— a sort of vent (cytopyge). The fresh-water forms have contractile vesicles, and in certain species the animal possesses so-called stinging rods (trichocysts), which are very minute and are placed vertically to the surface of the cortex: by some students they are supposed to be tactile rather than stinging structures. What correspond to the muscular fibres of the higher animals, cause the quick convulsive movements observed in these creatures. Two important organs are present in all ciliate infusoria, that is the nuclei. The larger nucleus (macronucleus) is an oval, rod-like or spiral body, which appears to control the processes of feeding and motion. The other nucleus (micronucleus) is much smaller and is concerned with reproduction. Reproduction occurs usually by self-division, and more rarely the infusorians contract into a ball and divide into spores, which grow to become adults. The periods of fission are at times interrupted by the process of conjugation, which only differs from sexual reproduction in the fact that two individual infusorians meet and fuse together and then separate, the result being a process of fertilization which leads to a complete new formation of the nucleus, and thus to a new organization of the animal. (For a more detailed account see Hertwig-Kingsley's 'Zoology' 1903.)

The more specialized infusoria are *Stentor* and *Vorticella*. The former is large enough to be seen without a lens. It is purplish, and under the microscope shows itself to be a beautiful creature. It is trumpet-shaped, with a spiral tract of thicker cilia around the mouth-end. The most highly organized infusoria are the bell-animalcules (*carchesium*, etc.), which are compound bell-shaped forms, forming colonies with forked branched stalks. The nucleus is sausage-shaped, and near it is the micronucleus. They form a white mass like mold on the stems and leaves of aquatic plants. Some of the infusoria are parasitic in the digestive and circulatory organs of the higher animals. Consult: Stein, 'Organismus der Infusions-Thiere' (1859–83); Saville Kent, 'Manual of the Infusoria' (1880–2); M. Hartog, 'Protozoa' (Vol. I., Cambridge Natural History, 1903); Ray Lankester, 'Treatise on Zoology' (1902); Hertwig-Kingsley 'Zoology' (1903).

In'galls, John James, American lawyer: b. Middleton, Mass., 29 Dec. 1833; d. Las Vegas, New Mexico 16 Aug. 1900. He was graduated from Williams College in 1855, and was admitted to the bar in 1857. In 1858 he moved to Kansas and established a law practice there. He was secretary of the territorial council in 1860, and of the State senate in 1861, and in 1862 was elected a member of the senate. In 1873 he became a member of the United States Senate, and was re-elected in 1879 and 1885. He was president pro tem. of the Senate from 1887–91. In 1891 he was again a candidate for senator, but was defeated by the Farmers' Alliance. From that time till his death he devoted himself chiefly to lecturing and writing.

Ingalls, Rufus, American soldier: b. Denmark, Maine, 23 Aug. 1820; d. 15 Jan. 1893. He was graduated from West Point in 1843, fought in the Mexican War and in 1854–5 was a member of Steptoe's expedition to the Northwest. At the outbreak of the Civil War he defended Fort Pickens, then became quartermaster of the Army of the Potomac, and was present at many of the important engagements, and at the close of the war had attained the rank of major-general. In 1867 he became quartermaster of the military division of the Atlantic, quartermaster-general of the United States army in 1882 and was retired in 1883.

Ingelow, ĭn'jĕ-lō, **Jean,** English poet and novelist: b. Boston, Lincolnshire, 1820; d. Kensington, London, 20 July 1897. Her first published work appeared anonymously in 1850 under the title 'Rhyming Chronicle of Incidents and Feelings.' It was followed by 'Allerton and Dreux: or the War of Opinion' (1851), a story, and 'Tales of Orris' (1860); but not till the publication of 'Poems,' in 1863, did Miss Ingelow become famous. This volume won the enthusiastic praise of critics and the instant approval of the public, and passed through 23 editions. The most widely appreciated poems in it are 'The High Tide on the Coast of Lincolnshire'; 'Songs of Seven'; 'Divided'; and 'Supper at the Mill.' Later volumes were: 'Studies for Stories' (1864); 'Stories told to a Child' (1865); 'A Story of Doom, and Other Poems' (1867); 'Mopsa the Fairy' (1869); 'Off the Skelligs' (1872), her first long story; 'The Little Wonder Horn' (1872), a new series of stories told to a child; 'Fated to be Free' (1875); 'Sarah de Berenger' (1880); 'Don John' (1881); and 'John Jerome' (1886). A third volume of verse, 'Monitions of the Unseen' was published in 1885. Her works have been even more popular in America than in her native country.

Ingeman, Bernhard Severin, Danish poet and novelist: b. Torkildstrup, on the island of Falster, 28 May 1789; d. Soro 24 Feb. 1862. He was educated at the University of Copenhagen, and it was while a student there that he published his first 'Poems' (1811–12), of a dreamy, melancholy nature, showing the influence of German romanticism, and displaying the unhealthy state of his body and mind. In 1814 he published a long allegorical poem, 'The Black Knights,' which showed a marked advance. The next six works which he produced were plays, the tragedy 'Blanca,' brought out in 1815, being the most popular and successful, though 'The Miraculous Child Reinald' (1816) was undoubtedly the best. 'The Subterranean Ones, a Story of Bornholm,' his first prose work, was written in 1817, and the following year he started on a tour of the Continent, returning in 1819. On his return he wrote his 'Stories and Miraculous Tales,' which was published in 1820, followed in 1821 by a comedy, 'Magnetism in a Barber's Shop,' which, however, was unsuccessful, and thereafter he confined himself to prose work. In 1822 he accepted the chair of Danish language and literature at the Academy of Sorö, and then began his voluminous writings on historical subjects, his novels probably being inspired and copied from the Waverley novels, by Scott. The subjects and characters were taken from Danish history, and, while they were to a great extent inaccurate, were possessed of such strong nationality that they became of great interest. Among these historical romances were 'Valdemar the Victorious' (1826); 'Erik Menved's Childhood' (1828); 'King Erik and the Outlaws' (1833); 'Prince Otto of Denmark and his Time' (1835). From 1837–9 he wrote a collection of 'Evening and Morning Songs,' which became very popular on account of their great beauty of religious expression. From this time until his death his writings were mainly religious, and the last of his works, 'The Apple of Gold,' was published in 1856. His collected works in 41 volumes were published in Copenhagen (1843–65).

Ingenhousz, Jan, Dutch physician and scientist: b. Breda, Holland, 1730; d. Bowood, the seat of the Marquis of Lansdowne, England, 7 Sept. 1779. He studied medicine, and after practising in his own country for several years removed to London in 1767. In 1769 he was appointed aulic councilor and body physician to the Austrian Empress, Maria Theresa, and to Joseph II. After serving for 10 years in that capacity he returned to London, where he began his scientific researches, later becoming a fellow of the Royal Society, and publishing in their 'Transactions' several treatises and essays. Among these were 'Experiments on Vegetables, Discovering Their Great Power of Purifying the Common Air in Sunshine, but Injuring it in the Shade, or at Night' (1779); 'Anfangsgründe der Electricität' (1781); 'Essay on the Food of Plants and the Renovation of Soils' (1796). Dr. Ingenhousz is credited with being the discoverer of the use of carbonic acid for medicinal purposes, and he also invented the plate electrical machine.

Ingersoll, ing'gėr-sŏl, **Charles Jared,** American statesman, lawyer, and author; son of Jared Ingersoll (q.v.): b. Philadelphia 3 Oct. 1782; d. there 14 May 1862. After finishing his collegiate course he studied law, was admitted to practice, traveled in Europe, and became attached to the American embassy to France. In 1812 he was elected to Congress, taking his seat in May 1813. In 1815 he was appointed United States district attorney for Pennsylvania, an office which he held until 1829. Shortly after he was elected to the legislature of Pennsylvania. He was a member of Congress 1841–7 as representative of one of the districts of which the county of Philadelphia was then composed. He was the author of the poems 'Chiomara' (1800), and 'Julian' (1831); and of 'Inchiquin — the Jesuit's Letters on American Literature and Politics' (1810); 'Historical Sketch of the Second War between the United States and Great Britain' (1845–52); etc. Consult Meigs, 'Charles Jared Ingersoll' (1896).

Ingersoll, Ernest, American naturalist: b. Monroe, Mich., 13 March 1852. He studied at Oberlin College and in the Lawrence Scientific School and Museum of Comparative Zoology of Harvard University, where he was a pupil of Agassiz, and in 1874 and 1877 was connected as naturalist with the Hayden survey. He was also an expert on the United States fish commission, and later became known as a popular writer and lecturer on scientific subjects. In 1901 he was lecturer in zoology at the University of Chicago. Among his works are: 'Nests and Eggs of North American Birds' (1880–1); 'Oyster Industries of the United States' (1881); 'Knocking 'Round the Rockies' (1883); 'Country Cousins' (1884); 'The Crest of the Continent' (1884); 'Down East Latch-Strings' (1887); 'Wild Neighbors' (1897); 'The Book of the Ocean' (1898); 'Nature's Calendar' (1900); 'Wild Life of Orchard and Field' (1902); and also 'The Ice Queen,' and several other popular juvenile tales.

Ingersoll, Jared, American politician: b. Milford, Conn., 1722; d. 1781. Upon the passage of the Stamp Act he was appointed, in 1765, a stamp agent in Connecticut, and accepted the post by the advice of Franklin. This subjected him to the personal abuse and insults from which all colonial stamp agents suffered, and finally he was forced to resign, later, in 1770, becoming an admiralty judge. He wrote and published a pamphlet called 'The Stamp Act' (1776).

Ingersoll, Jared, American lawyer: b. Connecticut 1749; d. Philadelphia 21 Oct. 1822. Having been graduated at Yale College in 1766, he went to London, was entered of the Middle Temple, and passed five years in the study of law. The American Revolution breaking out while he was still in London, he espoused the cause of the colonies, although the son of a loyalist. He went from London to Paris, where he remained for 18 months, making the acquaintance of Franklin. Returning home, he took up his residence in Philadelphia, where he won almost immediately a prominent position as a lawyer. In 1787 he was chosen one of the representatives of Pennsylvania in the convention which framed the United States Constitution. Twice attorney-general of the State, he was United States district attorney for Pennsylvania, and was in 1812 the federal candidate for Vice-President of the United States.

Ingersoll, Joseph Reed, American lawyer and politician: b. Philadelphia, Pa., 14 June 1786; d. there 20 Feb. 1868. After graduating from Princeton in 1804, he took up the practice of law in Philadelphia. He was a Whig member of Congress from 1835–7, and again from 1842–9. In 1852 President Fillmore appointed him minister to England, a post which he held for only a year. He wrote 'Secession a Folly and a Crime,' which appeared just previous to the outbreak of the Civil War; also a 'Memoir of Samuel Breck' (1863).

Ingersoll, Robert Green, American lawyer, lecturer and author: b. Dresden, N. Y., 11 Aug. 1833; d. Dobb's Ferry, N. Y., 21 July 1899. He received a common school education and was admitted to the bar in 1854. He soon became prominent in the courts and in Democratic politics. In the Civil War he recruited the 11th Illinois cavalry and entered the army as its colonel. On 29 Nov. 1862, while trying with a force of 600 men to intercept a Confederate raiding party, he was captured by a force of 10,000 men, but was soon paroled and given command of a camp in Saint Louis. He soon afterward resigned. After the war he became a Republican, and was made attorney-general of Illinois in 1866. He was a delegate to the Republican National Convention in 1876 and placed in nomination for President James G. Blaine, whom he termed "the plumed knight." His nominating speech gave him national reputation as an orator, and he afterward lectured frequently. He was an agnostic, and in his lectures attacked the Bible and the beliefs of the Christian religion. He was prominent in politics for several years, and had he not given such frequent expressions to his agnostic views he would doubtless have been honored with high offices. He took up his permanent residence in New York city in 1882 and practised law there till his death. His most famous lectures include 'Some Mistakes of Moses'; 'The Family'; 'The Liberty of Man, Woman, and Child'; 'The Gods'; and 'Ghosts.' His publications include 'Lectures Complete' (1886); 'Prose, Poems and Selections' (1888); and 'Great Speeches' (1887). A complete collection of his works was published in 1900.

Ingersoll, Canada, town in Oxford County, Ontario, on the Thames River and the Grand Trunk railway, 19 miles northeast of London. It is the marketing centre for a rich grain and fruit-producing section, and has an important trade in lumber, grain, cheese, and general country produce. It has manufactures of iron products, machinery, agricultural implements, woolen goods, woodenware, lumber, and creamery products; banks, and weekly newspapers. Pop. (1901) 4,573.

Ingham, Benjamin, English evangelistic leader: b. Ossett, Yorkshire, 11 June 1712; d. Aberford 1772. He received his education at Batley School and at Queen's College, Oxford, whence he graduated B.A. in 1733. In 1735 he was ordained, and, becoming associated with John Wesley, went with him to Georgia, remaining two years. In 1737 he went with the Wesleys on a visit to the Moravians in Germany, and became so strongly attached to their doctrines that he broke with the Wesleys and founded in Yorkshire several congregations of what were known as «Moravian Methodists,» but more commonly as «Inghamites.» He endeavored to unite in this organization the chief doctrines of the Moravians and Methodists, and so successful was he as bishop or general overseer that in a few years there were 84 of these congregations in England. He moved to Aberford about the time of his marriage with a sister of the Earl of Huntingdon in 1741, and succeeded in converting the whole surrounding neighborhood to his faith. In 1759, however, the greater part of his followers deserted him and went over to Sandeman, and in 1760 Ingham himself joined the Sandemanians and the Inghamites disappeared.

Ingham, Charles Cromwell, American painter: b. Dublin, Ireland, 1797; d. New York 10 Dec. 1863. He was a pupil of William Cunning at the Dublin Academy, came to New York in 1817, was there a founder of the National Academy of Design (1826), and its vice-president in 1845–50. De Witt Clinton and Lafayette were among his subjects. His works include: 'Day Dreams'; 'The White Plume'; 'The Death of Cleopatra.'

Ingham, Samuel Delucenna, American politician: b. Bucks County, Pa., 16 Sept. 1779; d. Trenton, N. J., 5 June 1860. He was for some time in the Pennsylvania legislature, and was then sent to Congress, 1813–18, and again 1822–9. In the interim he was appointed prothonotary of the courts of Bucks County, but resigned in 1819 to become secretary to Gov. Finley. On 6 March 1829 President Jackson appointed him secretary of the treasury, a position he continued to hold till 1 Aug. 1831.

Ingleby, Clement Mansfield, English author and Shakespearean critic: b. Edgbaston, near Birmingham, 29 Oct. 1823; d. Ilford, Essex, 26 Sept. 1886. After graduating from Trinity College, Cambridge (B.A. 1847; M.A. 1850) he entered into partnership with his father, but in 1859 gave up his law practice and moved to Ilford, where he began writing for the magazines on scientific and metaphysical subjects. His best known works are his Shakespearean studies, among which are 'The Shakespere Fabrications' (1859); 'Shakespere Controversy' (1861); 'Shakespeare's Centurie of Prayse, etc.' (1874); 'The Still Lion' (1874; new edition 1875, entitled 'Shakespere's Hermeneutics'); 'Shakespere: the Man and the Book' (1877–8). He also wrote 'Outlines of Theoretical Logic' (1856); 'An Introduction to Metaphysics' (1864–9); etc.

Inglis, ĭng'lz, **Charles,** American Anglican bishop: b. New York 1734; d. Halifax, Nova Scotia, 1816. He was ordained priest in England, and in 1765 became assistant minister at Trinity Church, New York. A stout loyalist, he refused to omit from the service the prayer for the king and royal family, and upon the occupation of New York by Washington retired for a time to Long Island. In 1777 he was chosen to the rectorship of Trinity, and in 1783, at the evacuation of New York by the British, went to Halifax in the emigration of the United Empire loyalists. He was consecrated in 1787 bishop of Nova Scotia (with jurisdiction over the other North American provinces), and was the first missionary bishop of the Church of England. He published sermons and pamphlets.

In'got, a small bar of metal formed by casting it in molds. The term is chiefly applied to the bars of gold and silver intended for coining.

Ingraham, ĭng'gra-am, **Duncan Nathaniel,** American naval officer: b. Charleston, S. C., 6 Dec. 1802; d. there 16 Oct. 1891. He entered the navy as midshipman in 1812, and became a captain in 1855. While in command of the sloop-of-war St. Louis he arrived at Smyrna 22 June 1853, and was informed that Martin Koszta, Hungarian by birth, but entitled to the protection of the United States, was a prisoner on board the Austrian brig of war Hussar, then lying near the St. Louis. Ingraham went on board the Hussar, had an interview with Koszta, and learned that he had resided a year and 11 months in New York, where he took the usual oath of allegiance to the United States in July 1852, and was in possession of a legalized copy of a declaration of his intention to become an American citizen; that he had come to Smyrna from New York on business; that on the afternoon of 21 June he was seized by a party of armed Greeks, employed by the Austrian consul-general, carried on board the Hussar, where he was held in close confinement. Ingraham accordingly, on 2 July, at 8 A.M., demanded of the Austrian commander the release of Koszta by 4 P.M., declaring that he would otherwise take him by force. At 11 o'clock the Austrian consul-general proposed to deliver Koszta into the hands of the French consul, to be held by him subject to the disposition of the consuls of the United States and Austria, and not to be delivered without their joint order. As this proposition gave sufficient assurance of the personal safety of Koszta Ingraham accepted it, and the Hungarian was set at liberty. The conduct of Ingraham was fully approved by the government, and Congress by joint resolution, 4 Aug. 1854, requested the President to present a medal to him for his conduct on this occasion. In 1860 he resigned from the United States navy, entered the Confederate service and became a commodore.

Ingraham, Joseph Holt, American novelist: b. Portland, Maine, 1809; d. Holly Springs, Miss., December 1866. After a brief experience of mercantile life he became teacher in Washington College, Natchez, Miss., and in 1836 published his first book, 'The South-West, by a Yankee.' Thenceforth he produced in rapid succession 'Lafitte'; 'Burton, or the Sieges'; 'Captain Kyd'; 'The Dancing Feather'; and other romances of small literary merit, some of which attained a large circulation. He subsequently entered the Episcopal ministry and was rector of a parish and of St. Thomas's Hall, an academy for boys, in Holly Springs, Miss. He still continued to write, publishing 'Prince of the House of David' (1855) and the 'Pillar of Fire' (1859); 'The Throne of David,' which were widely popular, but nearly worthless from a literary point of view.

Ingraham, Prentiss, American soldier and author: b. Adams County, Miss., 22 Dec. 1843. He was educated at Jefferson College (Miss.), also studied medicine at the Mobile Medical College, entered the army of the Confederate States in 1861, fought later with Juarez in Mexico, with the Austrian army in the war with Prussia, and in the ten-years' war for independence in Cuba. Subsequently he entered a literary career, and published a great quantity of fiction, including: 'Without Heart' (1878); 'Zuleikah' (1887); 'Red Rovers on Blue Waters' (1890); 'The Vagabond' (1891); and 'The Wandering Jew of the Sea' (1891).

In'gram, John Kells, English educator and author: b. County Donegal, Ireland, 7 July 1823; d. Dublin 1 May 1907. He was educated at Trinity College, Dublin, and was appointed professor of oratory and English literature there in 1852, Regius professor of Greek in 1866, and librarian in 1879. At one time he was vice-provost of the college, and also held the presidency of the Royal Irish Academy. His 'History of Political Economy,' originally printed in the 9th edition of the 'Encyclopædia Britannica,' was separately published in 1888 and widely translated. He further wrote: 'A History of Slavery and Serfdom' (1895); 'Sonnets and other Poems' (1900); 'Human Nature and Morals according to Auguste Comte' (1901), etc.

Ingres, Jean Dominique Auguste, zhŏṅ dō-mē-nēk ō-güst ăṅg-r, French historical painter: b. Montauban 15 Sept. 1781; d. Paris 14 Jan. 1814. Placed in the school of David he made such rapid progress that at 20 he had gained in two successive years the first and second prizes of the Academy of Fine Arts. In 1806 he departed for Italy, where he passed nearly 20 years, abandoning, under the influence of a close study of Raphael and the old masters, the dry, classic style acquired from David His works are numerous, and comprise generally serious historical and classical subjects; in the great exhibition of 1855 at Paris an entire salon was appropriated to them. Many are in the Louvre, on the ceiling of one of the apartments of which is painted his 'Apotheosis of Homer.' He painted the portraits of many distinguished personages, from Napoleon I. downward. The art of Ingres is adjudged to hold a middle place between the classic and the romantic schools.

Inhala'tion, in medicine, a mode of applying remedies directly to the respiratory tract. Either steam alone, steam charged with drug-vapors, or drugs finely subdivided in sprays, are breathed into the air-passages as deeply as possible. This method of medication is useful only in relieving inflammations of the upper air-passages and possibly the trachea and larger bronchi. The air in the smaller bronchi is not changed by breathing, but by the diffusion of gases, so that substances in aërial suspension are deposited on the surface before reaching the smaller divisions of the bronchial tubes. Steam does not penetrate far, but is cooled, and deposits moisture as far as the trachea. The old-fashioned croup-kettle and many devices for carrying out the same idea are used for the first stages of laryngitis. Many substances, such as tincture of benzoin, etc., are added to the boiling water, but render it no more efficacious. Instead of conducting the steam directly to the mouth and nose by a funnel or tube, it may be well to place the patient in a simply enclosed tent, formed of bedclothes, and to allow the steam to charge the confined air. This method is particularly advisable for infants and older children.

Inher'itance, in law, a perpetual or continuing right to an estate invested in a person and his heirs. There are nine «canons of inheritance»: three may be quoted: (1) That inheritance shall, in the first place, descend to the issue of the last purchaser in *infinitum;* (2) That the male issue shall be admitted before the female; (3) That where two or more of the male sex are in equal degree of consanguinity to the purchaser, the eldest only shall inherit, but the females all together.

Inheritance Tax, an assessment laid upon those made heirs of property, either by distribution or descent. Sometimes this assessment is confined to collateral heirs, when it is called collateral inheritance tax. The raising of public funds in this way has been sanctioned by legislation from the beginning of Roman law, and in England and other countries is a large and steady source of revenue, although such taxes have been stigmatized by certain economists as «death duties.» During the Civil War taxes of this kind were made part of the internal revenue system of the United States, but abolished soon after the struggle ended. The rate and method of assessment vary in different countries, and in different States of the Union. The English inheritance tax ranges from a 1 to a 10 per cent assessment, in accordance with the amount of the inheritance and the degree of relationship of heirs. In the United States lineal, collateral and succession inheritance taxes have been instituted in several States, as a source of domestic revenue. In Connecticut the assessment on inherited property is 5 per cent on all sums and values above $1,000. In Delaware the assessment ranges from 1 to 5 per cent, according to the amount of property left, and the degree of relationship. In Illinois, 1 per cent on values over $20,000 to lineal descendants; 2 per cent to 5 per cent on all amounts to collateral relations. In Maryland, 2½ per cent on all legacies and successions. In New York, 1 per cent on all property over the amount of $10,000 to lineal heirs, 5 per cent on all amounts over $500 to collateral relatives. In Ohio, 5 per cent on all values over $500. In

Virginia, 5 per cent in every case. Several States leave untaxed the property descending or distributed to the lineal descendants, and place assessments of varying percentage on the amount or value of the legacy which falls to collateral heirs. These are California, Maine, Massachusetts, Minnesota, New Jersey, Tennessee, West Virginia. Inheritance laws have in the United States occasioned much discussion and litigation, but their justice and utility have been testified to by experience and the decision of the law courts. The economists of the present and other periods have seen the scientific propriety of such legal provisions, and have noted the uniformity with which they deal with all classes of the financial community.

In'ia, a genus of toothed cetaceans similar to dolphins, but placed on structural grounds in the allied family *Platanistidæ*, with the freshwater dolphins of the Ganges and the La Plata. The single species (*I. groffrensis*) is called bouto and tucuxi, and is found in some of the upper tributaries of the Amazon, and in the lakes near the Cordilleras. It measures about eight feet in length, has a long cylindrical snout with stiff hairs, and a very slight dorsal fin. It feeds chiefly on fish, and is hunted for the sake of its oil.

Initiative. See Referendum.

Injunc'tion, a writ issued by a court of equity, bidding, or forbidding, a person or persons to do a certain thing. The injunction originated in Roman law, and was anciently known as an interdict, a name it still bears in Scottish practice. It was introduced as a remedy for some of the abuses of common law, and as a preventive, when evasion of common law provisions seemed possible. It is to-day one of the most potent of the legal remedies of an equitable character which stand on the statute books.

There are three main divisions in the purposes for which a writ of injunction is issued. A writ may be prohibitive, protective, or restorative. In the first place it may forbid the commission of certain acts of a civil nature which are charged with injustice. Second, it may be so framed as to protect such civil rights of an individual or a corporation as seem to be threatened. Third, it may order the restitution or restoration of such rights as have unlawfully been taken away from an individual or a corporation. These characters of the writ have been clearly expounded by Blackstone, as follows:

"This writ may be had to stay proceedings at law, whatever stage they may have reached; to restrain alienations of property *pendente lite*, and tenants for life and others having limited interest from committing waste. It may be granted to restrain the negotiation of bills of exchange, the sailing of a ship, the transfer of stock, or the alienation of a specific chattel, to prohibit assignees from making a dividend, to prevent parties from removing out of the jurisdiction, or from marrying, or having any intercourse, which the court disapproves of, with a ward. The infringement of a copyright or a patent frequently calls for the exercise of this beneficial process; which may also be had to restrain the fraudulent use of trade marks, or of the names, labels, or other indiciæ of the makers or vendors of goods and merchandise, and in a large class of cases, far too numerous to be mentioned here."

The first two kinds of injunction are most commonly used, and a familiar example of the prohibitory writ is that which orders the abatement of a nuisance. A railroad which lays tracks without first gaining the right of way may be compelled by injunction to remove them. By such a writ patent rights, copyrights and trade marks are secured from infringement, or proceedings in a court of law are stayed. Sometimes a court of equity issues an injunction prohibiting litigants within its own jurisdiction from prosecuting a suit in another jurisdiction; for example, a United States court may restrain creditors for suing in State courts for the enforcement of their claims against a bankrupt, and reserve the disposition of his estate to its own jurisdiction. A court of equity only issues a writ of injunction when a remedy of law appears inadequate to give the wronged party the complete relief to which he is entitled. Thus in recent cases the courts have issued writs forbidding labor agitators and others from inducing or coercing workingmen, in such a way as to bring on a strike to the injury and damage of employers, who might thus be induced to sacrifice their rights in order to escape ruin or irreparable loss.

An injunction in the United States may be preliminary or perpetual. A preliminary writ is sometimes styled interlocutory, as it is issued *pendente lite*. The preliminary writ may be made perpetual, if, after arguments made and heard, the court decides that the grounds advanced for the continuance are valid, and have been so proved by evidence. Failure to obey an injunction is punishable as a contempt of court (q.v.) Consult Beach, 'Treatise on the Law of Injunctions' (1895).

Injunction, Government by. See Government by Injunction.

Injunction, Theatrical, a term applied to a mandate issued by a court of equity, to compel or prevent the performance of some act for which money damages would not properly compensate the injured party. Relief by injunction in matters pertaining to theatricals is probably more frequently sought than in any other business or profession, and precedents in law established in this class of cases has become of considerable importance. At first, courts of this country and England refused to grant injunctions against actors for the purpose of compelling them to perform their contracts, a learned justice saying: "The Court could not regard as law the old adage that 'a bird that can sing and will not sing must be made to sing.'" But latterly, when the service of an actor became recognized and it was made to clearly appear that an actor or singer, by intelligence, education and other artistic accomplishments and talents, was of extreme importance to one who had invested money in the production of a play or opera, it was held that a court of equity would by injunction enforce a covenant in a contract. But this has simply gone to the extent of compelling a fulfilment of the contract, or forcing the artist to remain idle during its term. The services of every actor will not be enjoined. He must actually possess some exceptional merit, so that his services may be termed special, unique and extraordinary, and it must be shown they cannot be fulfilled by any other person without injury to the employer. In the case of Lumley *v.* Wagner, the courts of England enjoined Johanna Wagner, a prominent prima donna of the early 50's from appearing at Covent Garden Opera House, London, in violation of her contract with Lumley; and then for the first time the British courts asserted their authority over contracts of actors, and granted an injunction forbidding her rendering professional services for any but her original employer.

In the United States, the Federal courts recognized the right of a manager to have the exclusive services of his employee, and in McCall *v.* Braham an injunction was granted which prevented Lillian Russell from violating her contract. In the State courts, the case of Augustin Daly *v.* Fanny Morant Smith (49 How. Pr. 150), Superior Court Justice Freedman also appreciated the fact that the ancient rule had been abrogated and the modern one compelling actors to live up to their agreements, as other individuals, was there enforced. The contract must unquestionably be fair. The rights of both parties to it must be equal. In other words, if the contract gives the manager the right to terminate it by giving notice before the expiration of the contract, a like right of termination must also be given the actor; and as stated before, the actor's services must be special, unique and extraordinary. In this latter connection, it seems uncertain where to draw the line. In the case of Carter *v.* Ferguson the court refused to grant an injunction to Mrs. Leslie Carter against William J. Ferguson, an actor, saying that his services were not so special and unique as to warrant a court of equity's interference. In Charles Hoyt *v.* Loie Fuller, the court granted an injunction against the dancer, holding that a serpentine dance in the performance of which she became famous, warranted the court's interference by injunction. In George Edwardes, the London manager, *v.* Cissie Fitzgerald, the New York Supreme Court granted an injunction against Miss Fitzgerald, on the theory that a certain wink of her eye used in a play was of special merit, and a drawing card. In Harris *v.* Sparks, an injunction was granted against John Sparks, the Irish comedian, the ground being that his portrayal of an Irish character was special, unique and extraordinary. While in the still later case of Shubert Brothers *v.* Aimee Angeles, imitations given by the performer were considered so special, unique and extraordinary as to warrant the granting of an injunction. Each case, however, must be determined by its own peculiar circumstances. In the most recent case — Harrison Grey Fiske *v.* Tyrone Power— the court refused to grant an injunction against Tyrone Power, although his ability as an actor was exploited in the newspapers; on the ground that his services were not so special, unique and extraordinary, as to justify an injunction. But in guarding the rights of an actor, the courts will see that no advantage has been taken of him by the manager, and that the manager for whom he is to perform is of such financial responsibility as to insure the salary of the actor. In the case of Rice *v.* D'Arville, Edward E. Rice, the theatrical manager, sought to restrain Camille D'Arville from performing for others; but on the defense that Rice was insolvent and indebted to her on a previous contract, Justice Oliver Wendell Holmes, then of the Massachusetts Supreme Court, would not compel her to perform for Rice.

Injunctions in the theatrical profession are not confined to actors and actresses, but are often invoked to prevent the piracy of a play or the use of a name. Where a play, or a scene from a play, has been copyrighted, the Federal courts alone have jurisdiction of the matter, and will by injunction prevent anybody from performing or producing it as their own. When there has been no copyright the common law protects the work, so well as its title; and the use of a similar name, or a name which is apt to deceive the public into the belief that it is the one already used by an author, will likewise be enjoined. A recent instance is the case of Charles Frohman *v.* Arthur Fraser, where the use of the title "Sherlock Holmes" was enjoined, this name having been adapted by William Gillette as the title of a play, notwithstanding the name had been used by A. Conan Doyle as the title of his novel. In that case the court held that Mr. Gillette having first used the name in connection with a theatrical production was entitled to all emoluments arising from it. Notwithstanding the numerous attempts to avoid the principles of law applicable to this class of cases, it matters not whether it is the actor who is involved or the theatrical manager, the American courts are humane, equitable, just and careful, and invariably zealously guard the interests of those engaged in the theatrical profession, so well as those engaged in any commercial business. See INJUNCTION; GOVERNMENT BY INJUNCTION; COURT; EQUITY; CHANCERY; CONTEMPT; LAW; etc.

Ink, a colored liquid used for writing and printing. They are of various classes, as writing and copying, black or colored, India, printing and lithographing inks.

For long ages past the best black writing-ink has been made by mixing together solutions of nutgalls and of ferrous sulphate of iron, known as green vitriol, and holding in colloidal suspension, by aid of a gum, the colored substance produced. The gallo-tannic acid present in a freshly prepared solution of galls, upon exposure to the air, changes gradually largely into gallic acid, and the protoxide of iron changes into peroxide. The color of this changed product is much deeper than that of the original mixture. It has been found that the permanency of the writing is greater if the ink is used before this conversion is fully completed. The change is held in check by having present in the ink a slight amount of some free volatile acid such as hydrochloric. The trace of acid also serves to hold the iron color in the state of colloidal suspension or solution. The moulding to which such an ink is liable is checked by adding to it a trace of some antiseptic, such as carbolic acid. All known commercial substitutes hitherto used for nutgalls in black writing-ink produce a fluid somewhat inferior to that from nutgalls.

An exhaustive scientific investigation of the chemistry of ink to determine the best ingredients and the proportions to be used of the same for the producing of the most permanent black writing-ink has been made in Germany by Osw. Schluttig and Dr. G. S. Neumann, and published in their work on 'Die Eisengallustinten,' issued by Zahn & Jaensch of Dresden in 1890. Their conclusions were followed in preparing the specifications for the official "Standard Record Ink" required under the laws of Massachusetts to be used on all the public records in that state. The same specifications have since been adopted by the U. S. Treasury for the ink used in that department. This ink has also been adopted by the Danish government for its official records. The specifications, which were prepared by Dr. Bennett F. Davenport of Boston, as ink expert for the State of Massachusetts, it is to be noted are for the required quality of the ink, and not for the compounding of it. The specifications are as follows:

It must be a gallo-tannate of iron ink, not inferior in any essential quality to a typical standard for comparison which has been properly prepared after the following formula, in which all the ingredients are of the quality prescribed by the United States Pharmacopœia, and the per cent of true acid present in the sample of tannic acid used has been determined by the Loewenthal and Schroeder method.

Take of pure, dry Tannic Acid, 23.4 parts by weight; crystal Gallic Acid, 7.7 parts; Ferrous Sulphate, 30.0 parts; Gum Arabic, 10.0 parts; diluted Hydrochloric Acid, 25.0 parts; Carbolic Acid, 1.0 part; Water, sufficient to make up the mixture at the temperature of 60° F. to the volume of 1000. parts by weight of water.

Inks submitted will be subjected to the following tests, as compared with the typical normal standard ink described above: (1) A fluid ounce allowed to stand at rest in a white glass vessel, freely exposed in diffused daylight for two weeks to the light and air, at a temperature of 50° to 60° F., protected against the entrance of dust, must remain as free from deposit upon the surface of the ink or on the bottom or sides of the vessel. (2) It must contain no less iron, and must have a specific gravity of 1.035 to 1.040 at 60° F. (3) It must develop its color as quickly. (4) After a week's exposure to diffused daylight the color must be as intense a black when used upon the standard record paper, and it must equally resist changes from exposure to light, air, water, or alcohol. (5) It must be as fluid, flow as well, strike no more through the paper, nor remain more sticky immediately after drying.

To such an ink a slight amount of some one of the water soluble coal-tar colors is usually added to give the desired initial color to the ink when used in writing.

Cheaper grades of black writing-ink are produced by substituting for the nutgalls other tannin containing substances, or by using logwood. In these other iron salts, or salts of other metals are sometimes used, as of copper, aluminum or chromium. For special purposes some of these have certain advantages. For copying, for instance, the ink made from logwood with alum cake and chromate has the highest efficiency known. This ink, however, fades out after a few years' exposure to the open air and daylight.

Within modern times colored liquid solutions have come much into general use as inks, made up with aniline and other dyestuff colors. They are easily and cheaply made, flow nicely from the pen, and allow of a great variety as to choice in coloring, but none of them have the permanency of the ancient nutgall iron ink on exposure to light and air.

The usual basis of commercial marking inks, for use on textile fabrics, is some salt of silver. The permanent color of this ink is developed through the action of light, heat or some chemical, after the ink has been applied. The usual basis of India ink is an exceedingly finely divided solid carbon, mixed with a size to hold it in suspension when the ink is prepared for use by being ground up with water. The usual base used for printers' ink is a linseed-oil varnish. To this the desirable color is imparted by the use of lampblack, or some other coloring substance.

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Ink'berry, or **Winterberry,** a shrub (*Ilex glabra*) of the holly family which grows upon the Atlantic coast of the United States. It is a fine evergreen, two to four feet high. Its stems are slender and flexible, and its leaves, about an inch in length, are lanceolate in form, of leathery texture, and present a shining upper surface. It bears small, very black berries. Formerly its bark and leaves were used medicinally, especially in fevers. For bouquets and decorative purposes it is much valued, and finds a ready market in large Eastern cities.

Inkerman, ĭnk-ĕr-män', Russia, a village on the site of a ruined town in the Crimea, at the head of the harbor of Sebastopol, 35 miles by rail southwest of Simferopol. It gives its name to the sanguinary battle fought on the heights overlooking the town, on 5 Nov. 1854, when the Russians unexpectedly attacking the British camp were repulsed with great slaughter, losing in killed 3,000 and in wounded 6,000, the loss of British and French allies being 850 killed and 3,500 wounded.

Inlay'ing is the art of ornamenting flat surfaces of one substance by inserting into them pieces of some other substance. Various kinds of metal or wood, or pearl, ivory, etc., are employed in this process, which is now applied chiefly to the production of ornamental articles of furniture. When wood of one color is inlaid with others of different colors, as in ornamental devices in flooring, it is generally called marquetry, the various pieces of wood being usually disposed in regular geometrical figures. The art of inlaying iron or steel with other metals, as gold or silver, is called damascening. Buhl and reisner work, once highly prized, have lost much of their celebrity. The former took its name from Buhl, an Italian resident in Paris in the reign of Louis XIV., and the latter was designated after Reisner, a German who not long after settled in the same city. Buhl for the most part inlaid brass on tortoise-shell, Reisner a dark wood on a tulipwood ground. The usual instrument for cutting out veneers for inlaying is a fine saw, mounted in a bow or arched handle, and worked in short quick movements. Three or four veneers are sometimes cut simultaneously in this way. Inlaying with stone, in which the Florentines have long excelled, is called *pietra dura*, and differs from mosaic in having the holes not cut through the ground, which is commonly of black marble, but only to a regulated depth.

The best work of this kind is now produced at St. Petersburg, the art being stimulated by encouragement from the Russian government. An Indian variety of inlaying, in which the inlaid metal occupies more of the surface than that which forms the ground, is called *Kuftgari;* and in another variety, *Tutenague* or *Bederywork,* small pieces of silver are hammered into spaces previously cut in the ground, which consist of one part of copper to four of pewter, and is thus both hard and easily cut. See MOSAIC.

In'man, Henry, American artist: b. Utica, N. Y., 20 Oct. 1801: d. New York 17 Jan. 1846. From early boyhood he manifested a taste for art, and in 1814 Jarvis, the portrait painter, offered to receive him as a pupil, and he was bound an apprentice for seven years. Upon the conclusion of his apprenticeship he devoted himself to portrait painting. Among his most characteristic portraits are those of Chief Justice Marshall and Bishop White. He painted also landscape, genre, and history. In 1844 he visited England, where he was the guest of Wordsworth, whose portrait he painted, and at whose suggestion he executed his 'Rydal Water,' near the poet's residence. During his residence in England he also painted portraits of Dr. Chalmers, Lord Chancellor Cottenham, and Macaulay.

Inn, a river of Europe which issues from a lake at the foot of the Rhætian Alps, flows northeast through the deep and narrow valley of the Engadine, in the Swiss canton of the Grisons, enters the Tyrol at Martinsbruck, passes Innsbruck, Hall, and Kuffstein, and shortly after enters Bavaria. At Mühldorf it turns east till it receives the Salza, where it begins to form the boundary between Austria and Bavaria, and joins the right bank of the Danube at Passau, after a course of over 300 miles.

Inn and Innkeeper. In Great Britain inns are houses where travelers are furnished, for the profit of the provider, with everything they have occasion for while on their journey, and may be set up without license by any person, provided he refrains from selling excisable liquors, which of course require a license. Hotels, public-houses, taverns, victualing-houses, and coffee-houses are all inns when the keepers of them make it their business to furnish travelers with food and lodging: otherwise they are not. In the United States there are no inns, but hotels in cities and taverns in rural districts. See HOTELS IN AMERICA; TAVERNS.

Innate Ideas, certain notions or conceptions declared by many philosophers to be given to the mind of man when he first receives conscious being. Their existence has been much disputed by philosophers. The term innate, as applied to ideas, was first used by Descartes. As his definition failed in precision, the doctrine of Descartes was assailed by Hobbes and Locke. As afterward more strictly stated by himself, his views were as follows: An innate idea is not one that presents itself always to our thought, for there could be no such idea; but we have within ourselves the faculty of producing it. He has nowhere given an enumeration of the ideas that he considers innate, though he attaches particular importance to that of infinity, which he makes the foundation of his proofs for the existence of God. What the followers of Descartes designate innate ideas, those of Cousin term universal, necessary and absolute. Some of the greatest names in European philosophy are associated with the discussion of this theory, or of cognate theories, as Clarke, Newton, Malebranche, Kant, etc.

Innes, ĭn'ĕs, Alexander Taylor, Scottish jurist: b. Tain, Ross and Cromarty, Scotland, 18 Dec. 1833. He was educated at Edinburgh University, was admitted to the Scottish bar in 1870, appointed advocate-depute in Scotland in 1881, and served under later Liberal governments. Among his works are: 'The Law of Creeds in Scotland' (1867): 'Church and State: A Historical Handbook' (1890); 'Studies in Scottish History' (1892): a life of Knox in the 'Famous Scots' series (1896): 'The Trial of Jesus Christ' (1899): and 'The Law of Creeds' (1902).

Inness, George, American painter: b. Newburg, N. Y., 1 May 1825; d. Bridge of Allan, Scotland, 3 Aug. 1894. His art education began in boyhood and when 16 years of age he learned map engraving. He first attempted nature sketching in 1843, when he showed such promise that he was admitted into the studio of Regis Gignoux, New York; but soon opened a studio for himself and through the liberality of a patron was enabled to visit Europe. After spending 15 months in Italy and one year (1850) in France he finally made his home at Eagleswood, near Perth Amboy, N. J. He is looked upon as the first among American landscape painters, and was not only a clever and imaginative interpreter of the scenery among which he lived, but a man of intellect, a thoughtful yet bold theorist on art subjects and an incisive critic. He had a keen appreciation of American scenery, and the sky and atmosphere of the eastern States were sympathetically portrayed with an earnestness that recalls the sentiment of the Fontainebleau-Barbizon school. His early paintings are distinguished by conscientious care for detail, vivid perception of color, and the panoramic breadth of a bold and unconventional originality. After 1878 his style had ripened, and his technique grew simpler and less highly elaborated. He was willing to sacrifice all cleverness of touch in handling detail for the sake of portraying the emotion, or transitory effect of light and cloud in a landscape, the perturbation of storm or wind, the pageant of sunset, or the magic calm of a moonlight scene. In such productions his command of color was very remarkable. His pictures are much prized by connoisseurs, and when offered for sale command high prices. Five of them are in the Metropolitan Museum of Art, New York. Among the finest are: 'Under the Greenwood'; 'Close of a Stormy Day'; 'Pine Groves of Barberini Villa'; 'An Autumn Morning'; 'Autumn Gold'; 'The Edge of the Forest'; 'Passing Storm'; 'Moonrise'; 'Winter Morning, Montclair, New Jersey.'

Inness, George, Jr., American painter: b. Paris, France, 5 Jan. 1854. He is the son of George Inness (q.v.), the landscape painter. He was a pupil of the elder Inness at Rome in 1870–4, of Bonnat at Paris in 1875, began to exhibit at the National Academy in 1877, and became a member of the National Academy of

Design in 1899. In 1899 he obtained a gold medal at the Paris Salon. His manner is forcible, and skilful in color. His work includes landscapes and animal subjects, among them: 'The Pride of the Dairy' (1878); 'Pasture at Chemung'; 'A Mild Day' (1887); and 'Morning on the River' (1902).

In'nocence. A wildflower. See HOUSTONIA.

In'nocent, the name of thirteen popes, as follows:

Innocent I., Saint: b. Albano; d. 12 March 417. He succeeded Anastasius I. as Bishop of Rome in 402. He supported Saint Chrysostom (q.v.) when the latter was driven from his see of Constantinople through the machinations of the Empress Eudoxia. Rome was pillaged by Alaric in 410, during his pontificate. He is commemorated by the Roman Catholic Church on 28 July.

Innocent II. (GREGORIO DE' PAPI, or PAPARESCHI, grā-gō-rē'ō dā pä-pē pä-pä-rĕs'-kē): b. Rome; d. 23 Sept. 1143. He was elected pope in 1130 by a part of the cardinals, while the others elected Peter of Leon, who took the name of Anacletus. Innocent fled to France, where he was acknowledged by the Council of Etampes, by Louis VI., and soon after by Henry II. of England; also by the Emperor Lothaire, who conducted him in 1133 to Rome, where he occupied the Lateran, while Anacletus occupied the Castle of Crescentius, the Church of St. Peter, and a large part of the city and maintained himself against Innocent until his death in 1138. He held the second Ecumenical Council in the Lateran, which condemned Arnold of Brescia and his heresy, declared all the decrees of Anacletus null, and excommunicated Roger of Sicily, who had supported the latter. Roger, however, obliged Innocent to acknowledge him as king, absolve him from excommunication, and invest him and his heirs with Apulia, Calabria, and Capua.

Innocent III. (GIOVANNI LOTHARIO CONTI, jō-vän'nē lō thä'rē ō kōn'tē): b. Anagni, Italy, 1161: d. Perugia, Italy, 16 July 1216. On the death of Celestine III. (1198) he was unanimously elected at the age of 37. Innocent, in the vigor of manhood, endowed by nature with all the talents of a ruler, possessed of an erudition uncommon at that time, and favored by circumstances, was better qualified than any of his predecessors to elevate the Papal power. By his clemency and prudence he gained over the inhabitants of Rome, obliged the imperial prefect to take the oath of allegiance to him, and directed his attention to every quarter where he believed that a Papal claim of property or of feudal rights existed. He concluded treaties with many cities of Tuscany for the mutual protection of their liberties and those of the Church, and soon obtained possession of the ecclesiastical states in their widest extent. He excommunicated Philip Augustus, king of France; laid the kingdom under an interdict in 1200 because Philip had repudiated his wife Ingeburga, and obliged the king to submit. He was still more decided in his treatment of John, king of England, who refused to confirm the election of Stephen Langton as Archbishop of Canterbury. Innocent laid the kingdom under an interdict, and in 1212 formally deposed him. John was finally obliged to submit, resigned his territories to Rome, and received them as a Papal fief from Innocent. All Christendom acknowledged the Pope's spiritual sovereignty; two Crusades were undertaken at his order, and his influence extended even to Constantinople. Innocent was one of the greatest Popes and rulers. It has been said of his rule, as of that of Gregory VII., whom he most resembles, that in those times the power of the Pope was salutary as a bond of union for Europe, in which the still firmer bond of a common civilization and knowledge did not, as at present, exist. In 1215 he held a council, the fourth Lateran and twelfth general which passed the decree making confession and communion obligatory at Paschal time. Frederick II. was acknowledged as German emperor, and the Franciscan and Dominican orders were confirmed.

Innocent IV. (SENIBALDI DI FIESCHI, sā-nē-bäl'dē dē fē ĕs kē): d. Naples 7 Dec. 1254. He became Pope in 1243 and was perpetually at feud with the German emperor Frederick and his successors.

Innocent V. (PIETRO DI TARENTASIA, pē-ā'trō dē tä-rĕn-tä'sē-ä): b. 1225; d. Rome 22 June 1276. His pontificate lasted only from 20 January to 22 June of the year 1276.

Innocent VI. (ETIENNE D'ALBERT, ā-tē-ĕn däl bār): b. Brissac, France; d. 12 Sept. 1362. His pontificate extended from 1352 to 1362, and during this period the Papal residence was at Avignon.

Innocent VII. (COSMO DE' MIGLIORATI, kōs'mō dā mē-glō-rē-ä'tē): b. Sulmona, Abruzzi, Italy, 1366; d. Rome 6 Nov. 1406. He was Pope from 1404 till his death, but was opposed by the antipope, Benedict XIII., who held his court at Avignon.

Innocent VIII. (GIOVANNI BATTISTA CIBO, jō-van'nē bät-tēs'tä chē'bō): b. Genoa 1432; d. 25 July 1492. He became Pope in 1484 and was for some time at war with Ferdinand of Naples and held the sultan Bajazet's brother Zelim a prisoner.

Innocent IX. (GIOVANNI ANTONIO FACCHINETTI, jō-vän'nē än-tō-nē'ō fä-chē-nĕt'tē): b. Bologna, Italy, 1519; d. 30 Dec. 1591. He occupied the papal chair only from the 29th of October preceding his death.

Innocent X. (GIOVANNI BATTISTA PAMFILI, jō-vän'nē bät-tēs'tä päm-fē'lē): b. Rome 7 May 1574; d. 6 Jan. 1655. In 1629 he was elevated to the cardinalate and became Pope in 1644. Under him the temporal and spiritual power of the papacy was greatly increased. In 1651 he condemned the Treaty of Westphalia and he formally condemned Jansenism in 1653.

Innocent XI. (BENEDETTO ODESCALCHI, bā-nā-dĕt'tō ā-dĕs-käl'kē): b. Como, Italy, 1611; d. 12 Aug. 1689. He served in his youth as a soldier in Germany and Poland, took orders later and rose through many important posts, until he was elected Pope in 1676, on the death of Clement X. He was eminent for his probity and austerity; zealously opposed nepotism and simony, and restrained luxury and excess. He condemned the New Testament of Mons and several other Jansenistic works. He also anathematized sixty-five propositions drawn from the works of modern Casuists and condemned

Molinos and the Quietists. He determined to abolish the right of asylum exercised in Rome by foreign ambassadors; but Louis XIV. would not yield to so just a claim, occupied Avignon, and imprisoned the papal nuncio in France; in consequence of which the authority of the Pope received a severe blow by the IV. Propositiones Cleri Gallicani in 1682. These disputes were highly favorable to the English Revolution, as it induced the Pope in 1689 to unite with the allies against James II., in order to lower the influence of Louis XIV.

Innocent XII. (ANTONIO PIGNATELLI, ān-tō-nē'ō pēn-yā-tĕl'lē): b. Naples 13 March 1615; d. 27 Sept. 1700. He became archbishop of Naples, a cardinal in 1681 and Pope in 1692. During his pontificate Louis XIV. and the French bishops revoked the Declaration of the French clergy, and submitted to the judgment of the Holy See in the matters in dispute during the pontificate of Innocent XI.

Innocent XIII. (MICHELANGELO CONTI, mē-kĕl-ān'jē-lō kōn'tē): b. Rome 15 May 1655; d. 7 March 1724. In 1695 he was made archbishop of Tarsus, and became a cardinal in 1707. He was also made bishop of Viterbo in 1712 and succeeded Clement XI. in the papal chair in 1721.

Innocents, Feast of Holy, variously styled Innocent's Day and Childermas, a festival generally observed on the 28th, but in the Eastern Church on 29 December, in commemoration of the massacre of the children at Bethlehem, «from two years old and under,» by the order of Herod, with the purpose of destroying among them the infant Saviour. The Church of England at the Reformation retained it in its ritual among its anniversary festivals. St. Cyprian refers to these children as martyrs, as does St. Augustine with still greater explicitness. It is to them that the hymn of Prudentius, 'Salvete Flores Martyrum,' is addressed.

Innocents Abroad, The, a famous book of travels by Samuel L. Clemens («Mark Twain»). In a vein of highly original humor this widely-read book records a pleasure excursion to Europe, the Holy Land, and Egypt, in the sixties. Descriptions of real events and the peoples and lands visited are enlivened by more or less fictitious dialogue and adventures.

In'novators, a name applied in Great Britain to educational reformers who, in the 19th century, succeeded in having corporal punishment abolished in public and private schools. The novels of Charles Dickens, particularly 'Nicholas Nickleby,' and 'Oliver Twist,' had much to do with the origin of the reform movement.

Inns of Court are certain societies in Great Britain exclusively invested with the right to call to the bar. The colleges of the English professors and students of common law are called inns, the old English word for the houses of noblemen, bishops, and others of extraordinary note, being of the same signification as the French *hôtel*. The opinion is, that societies of lawyers, which before the Conquest held their chief abodes for study in ecclesiastical houses, began to be collected into permanent residences, soon after the court of common pleas was directed to be held in a fixed place,— a stipulation which occurs in the great charters both of King John and Henry III. In these houses exercises were performed, lectures read, and degrees conferred. The inns of court are governed by masters, benchers, stewards, and other officers, and have public halls for dining, readings, etc. In London the four inns of court are: the Inner Temple and Middle Temple (formerly the dwelling of the Knights Templars, and purchased by some professors of law more than three centuries since); Lincoln's Inn and Gray's Inn (anciently belonging to the Earls of Lincoln and Gray). Each inn is self-governing, and all have equal privileges.

Innsbruck, ĭns'brook, or **Innspruck** (ancient ŒNIPONTUM; locally called SCHPRUCK), Austrian town and capital of the Tyrol, beautifully situated 59 miles north of Munich, on the banks of the Inn, near the confluence of the Sill, and almost in the centre of the valley of the Inn (Inntbal), the sides of which are enclosed by mountains several miles distant, but so lofty (7,000 to 8,500 feet) as apparently almost to overhang the town. In consists of the town proper, situated on the right bank of the river, and of five suburbs. It is for the most part well built. The houses are generally of a limestone breccia, and from four to five stories high, and built in the Italian style. The buildings most deserving of notice are the Hofkirche, containing the tomb of the Emperor Maximilian I., one of the most splendid monuments of the kind in Europe, though he himself is not interred in it; and the tomb of Hofer; the Church of St. James, with a painting by Lucas Cranach; the Jesuits' church, considered the handsomest in the town; the Capuchin church, with good paintings; the new palace, built by Maria Theresa, a very extensive edifice, with gardens which stretch along the side of the Inn, and form an excellent promenade; the old palace, in which the Archdukes of Tyrol and several of the German emperors used to reside; the university, founded in 1677, and re-established in 1826, well endowed, provided with a library, botanical garden, and cabinet of natural history, and attended by about 1,000 students; a gymnasium, and several other important educational establishments; and the museum, called Ferdinaudeum, rich in all the productions both of art and nature within the limits of the Tyrol. The manufactures include woolen, silk, and cotton tissues, gloves, glass, etc. As the capital of the Tyrol, Innsbruck is the place of assemblage for its states, and the seat of superior appeal, civil, and criminal courts, and of many important public offices. Many of the spots in the immediate vicinity have become memorable for the noble exploits which the Tyrolese peasantry performed in the war of Independence. Pop. (1890) 23,325.

Innuits, ĭn'ū-ĭts. See ESKIMOS.

I'no, daughter of Cadmus and Harmonia, second wife of Athamas, king of Thebes, drew upon herself the anger of Hera by nursing Dionysus, the son by Zeus of her sister Semele. In order to favor her own children she projected the murder of her stepchildren, Phryxus and Helle, who saved themselves by flight. Hera, still more highly incensed, made Athamas, the husband of Ino, mad, and he dashed his eldest son by Ino, against a rock. Ino fled with her youngest son, Melicertes, and threw herself with him into the sea. Ino and Melicertes were made sea deities at the prayer of Dionysus. Ino was worshipped under the name of Leucothea.

Inocarpus, ĭ-nō-kär'pŭs, a genus of leguminous plants, having unifoliate leaves and yellow flowers in axillary spikes. *I. edulis* is the South Sea chestnut, native of Tahiti. It is a large tree, with luxuriant foliage, the delicate evergreen leaves being six inches or more in length. It furnishes seeds or nuts much valued in the South Sea Islands, the inhabitants gathering them while green, and mashing them for food.

Inocula'tion. See INFECTION; VACCINATION.

In'osit ($C_6H_{12}O_6$), (from Greek *is, inos,* a nerve, a muscle), a saccharine substance found in the muscular tissues of the heart, as well as liver, brain, kidneys, etc. It appears both in health and, to an abnormal amount, in disease. It exists also in a number of plants, such as foxglove, potato, kidney-bean, acacia, asparagus, cabbage. See GLUCOSE.

Inouye Kaoru, kä-ō'roo ē-nō-oo'yā, **Count,** Japanese statesman: b. in Choshiu 1839, pupil of Yoshida Shoin. With Ito (q.v.), in 1862, he went secretly to Europe, and returning in 1864 became an unswerving exponent in Japan of the ideas lying at the root of Western civilization. Surviving the wounds made by reactionary assassins, he has, since 1868, served his country in various high positions, as the mikado's minister at home and as envoy abroad, especially in Korea. As minister of the interior he began the rebuilding of Tokyo from wood to brick. His famous memorial of 1873 called for moral improvement. For seven years, as head of the foreign office, he was active in treaty revision. He was created a peer in 1885, and again called to the office as minister of the interior in 1892, and retains the emperor's confidence as one of the surviving "elder statesmen," whose word in Japan is law. See KATSURA.

Inquiline, ĭn'kwĭ-lĭn, a term applied in zoology to animals which live as tenants within the nests or homes of other animals. The use of the term is almost entirely confined to entomology and then often restricted to the cases in which the rightful and the intruding tenants are closely related. Similar cases among other animals are commonly designated as commensalism (q.v.), but these and similar terms are used rather loosely. Examples of the inquiline relation occur among the termites, ants, and bees, but are known especially among the gall-flies (*Cynipidæ*); indeed, one entire division, comprising more than 500 species, is named *Inquilinæ*, because of the predominance of this mode of life. These insects differ but little in structure from the true gall-flies, but they lack the power to produce galls and consequently deposit their eggs within those of other species. They infest certain species of galls, as those of the blackberry and some oak-galls, in large numbers and sometimes more than one kind occur in a single gall. Perhaps the most remarkable feature of these inquilines is their frequent close resemblance to the insect which produces the gall which they infest.

Inquisi'tion, a tribunal or system of tribunals instituted by the Roman Catholic Church for the discovery, examination, and conviction of heretics and their punishment by the secular arm. Under the successors of Constantine in the Roman Empire the repression of heresy, or rather the enforcement of the decrees of church councils and synods, was a function of the imperial government, which inflicted temporal penalties upon the propagators of religious beliefs that contradicted the creeds approved by the State. When the reigning emperor was a favorer of Arianism or any other of the heterodox creeds, the orthodox bishops and their flocks were persecuted: when he was of the orthodox party the heterodox sects were put under the ban. In executing the decrees of the councils the imperial officials, called in the laws of Theodosius and Justinian "inquisitors" (*inquisitores*), were assisted by the bishops; but the tribunals were the ordinary secular courts, and judgment was rendered in the name of the State, not the Church. But in the 12th century, when the supremacy of the ecclesiastical power was universally recognized in western Europe, the initiative in the work of repressing heresy was taken by the Church as of course, and the discovery, trial and conviction of the offenders were functions of the ecclesiastical power solely: the secular power simply executed the judgments of the church tribunals. Boniface VIII.'s definition of the respective powers and the mutual relations of church and state was not proclaimed till the close of the 13th century; but had a similar definition been promulgated in the 12th century it would have expressed the universal sentiment of princes and peoples at the time. The celebrated bull, *Unam Sanctam*, defines that "Both swords, the spiritual and the temporal, are in the power of the Church; yet the one is to be wielded for the Church's behoof, but the other by the Church herself: the one by the hand of the priest, the other by that of the king and the soldier, though at the will and sufferance of the priest *ad nutum et patientiam sacerdotis*. And sword must be subordinate to sword — *oportet gladium esse sub gladio*, and the temporal authority subject to the spiritual power — *temporalem auctoritatem spirituali subjici potestati.*"

The first step toward the establishment of courts of inquisition would seem to have been taken in 1179 when the third council of the Lateran issued a decree of excommunication against the adherents of the heretical sects of southern France, who are charged not only with holding abominable heretical tenets but also with practising "unheard-of cruelties against the Catholics," demolishing the churches and massacring widows and orphans. The council grants "an indulgence of two years to those who shall make war on them." This decree was re-enforced by the Council of Verona (1184) over which Pope Lucius III. presided, and at which the Emperor Frederic I. assisted: the Council directs the bishops to bring to trial persons accused of heresy and to inflict fit punishment on the guilty. The fourth Council of the Lateran (1215), held in the reign of Innocent III., imposed on the bishops the duty of making a visitation of their dioceses twice or at least once a year either personally or by delegates to see that the Church's laws be enforced. Bishops are authorized to bind the inhabitants of a district by oath to search out heretics and bring them to trial. By the Council of Toulouse (1229) in the pontificate of Gregory IX. the search for heretics (*inquisitio hæreticæ pravitatis*) was systematized. The bishops are to name for each parish two or three respectable laymen who shall take oath zealously to search out heretics and to deliver them up to the *baillis*. Whosoever knowingly conceals a heretic loses all his goods. If heretics are discovered on the estate of a land-owner, he incurs the penalties: the house of the heretic shall be torn down. Heretics who recant have to seek a new abode, and must wear on their clothing two crosses of different colors until the Pope or his legate permits them to assume the ordinary garb. Whoever abstains from use of the sacraments is held suspect of heresy. A person convicted or suspect of heresy is debarred from the practice of medicine. Lest the ordinary church authorities should be remiss in carrying out this system Gregory IX. named (1232) as "pontifical inquisitors" monks or friars from outside, chiefly Dominicans; shortly after the pontifical inquisitors were chosen from the order of the Dominicans exclusively. Thus the duty of inquisition was taken out of the hands of the bishops and was discharged by officials responsible only to the Pope; from the judgments of the inquisitorial tribunals there was no appeal but only to the Holy See: in 1263 Urban IV. appointed an inquisitor-general for Provence, as a means of lowering the flood of appeals to Rome. The institution passed from southern France into the other provinces of that kingdom and into Italy, Germany and Poland. The Inquisition in England was directed by the metropolitans and their suffragans without being responsible to any inquisitor-general: but as long as Lollardism disturbed the peace of the Church the search for heretics was prosecuted rigorously: bishops and archdeacons were required twice a year to make inquisition of suspects: any man might be compelled under penalties to inform against persons suspected of heresy; the statute *de haeretico comburendo* was enacted by the Parliament in 1396.

In Spain the Inquisition, as set up in 1481 by Ferdinand and Isabella, was as much (or more) a political as an ecclesiastical institution: the officials from highest to lowest were appointed by the sovereigns and its action was directed by them without responsibility to the Holy See: Ranke calls the Spanish Inquisition "a royal tribunal furnished with spiritual weapons"; Llorente admits as much. The number of persons put to death under sentence of the Inquisition in Spain is put by Llorente at 31,000 from first to last, that is during 330 years. But Llorente made it impossible to check his statements by burning the original documents. Ranke impeaches his honesty; Prescott says that his estimates are "most improbable." Catholic historians call attention to the fact that not only heresy, but many other offenses against the laws were judged by the courts of inquisition in Spain, viz: polygamy, seduction, unnatural crimes, smuggling, witchcraft, sorcery, false personation, etc. At the time when the Inquisition flourished, persecution for heresy was a universal practice amongst all Christian peoples, and the methods of punishment inflicted were general throughout Europe. Protestant England persecuted as harshly and vigorously as Catholic Spain, and in both countries denial of the state religion was equivalent to treason.

Insane Asylums, Cottage System, or Village Plan. A form of construction for insane asylums and charitable institutions, much in vogue at the present time, in which large and imposing buildings are replaced by detached cottages. The cottages vary in size from those which will accommodate six to a dozen patients to larger ones which will accommodate 20 or more. They are usually constructed either in groups or along streets and avenues as a village. In the former, the several groups are given up to a particular industry as a farm group, where the patients are employed at farming, and others, as the garden, the brick yard, shop industries, etc., all of these being a part of one institution on a single large estate. In the village plan the institution is laid off in streets and avenues, and has the appearance of an ordinary village, each cottage having a flower garden in front, shade trees, etc. In either plan, there is conveniently located near the centre of the plant an administration building, a hospital for the sick and those requiring special care, a bakery, a laundry, and other utility buildings. The cottages may be constructed of wood or other material, and the cost of construction is small as compared with the old plan of asylum construction. It is, besides, more homelike, more convenient for administration and permits of indefinite expansion. Some of the best known institutions constructed on this plan are Alt-Scherbitz near Leipsic: Gabersee near Munich, Germany; the Saint Lawrence State Hospital at Ogdensburg, N. Y., and the Craig Colony for Epileptics at Sonyea, N. Y.

Insanity, a disease of the brain characterized by disorder or derangement of the mental faculties. This is its strictly pathological or scientific definition. Therefore, according to this definition, any disease of, or accident to, the brain whatsoever, provided such disease or accident caused any derangement of the mental faculties, howsoever trifling or temporary, would furnish an example of insanity. Thus a blow on the head causing unconsciousness, or a fever giving rise to delirium, is an example of an affection of the brain characterized by disorder of the mental faculties. Practically, however, the term insanity is limited to a group of affections of the brain which is more distinctly fixed, and the members of which it will be the object of this brief sketch to define.

Causes.— The causes of insanity are many and various, and the chief of these are the following: Heredity, infection, poisoning, traumatism or injury, overwork or exhaustion, and mental and moral shock or strain. Of importance also are age, sex, race, and nationality.

Of all these causes the most important undoubtedly is heredity. As Krafft-Ebing, the German alienist, has well said, there is no ground, except in tuberculosis, upon which heredity shows itself more distinctly than in the case of mental disease. Statistics have been compiled by various authors to show as nearly as possible the exact prevalence of heredity in insanity, but the results have not been altogether in harmony. In fact, it is extremely difficult to determine this factor in many cases in which it has been active, and this is so for two reasons: in the first place many patients and their friends conceal or deny a hereditary taint, and in the second place not a few patients and their friends, are really ignorant of their family histories beyond a generation or two. How many persons can tell accurately of what their grandparents died? The more this subject of heredity in insanity is investigated the more reason there is to believe that its importance has been underestimated rather than the reverse. And yet as a factor in causation it is much more common in some forms of insanity than in others — a fact which will be emphasized later in this article. Some authorities have limited heredity to the direct line of descent, ignoring collateral lines; but obviously this restriction cannot be maintained. And yet, if the attempt is made to trace a neurotic taint through collateral lines, the difficulty is greatly increased. the subject is vastly broadened, and, from the medico-legal standpoint, the inquiry becomes greatly involved. In mental heredity, moreover, it is not so much the particular disease that is passed on from parent to offspring, as it is the predisposition; and this predisposition, often called neurotic, is not the result entirely of insanity in the ancestry, but may be shown by a family history of other grave nervous disorders, such as epilepsy, hysteria, neurasthenia, and imbecility. This is a fact not sufficiently apprehended by the laity.

Infections of various kinds may act as causes of insanity. The most important of these is syphilis, and this acts especially to cause that form of insanity known as general paresis. The various infectious diseases, such as typhoid fever, septicæmia, smallpox, cerebro-spinal meningitis and, in minor degree, some others, may cause mental alienation. Post-febrile insanity may follow typhoid fever; and puerperal insanity may be due in part to a septic infection.

Poisons of various kinds may be very active causes of insanity. Chronic lead poisoning may give rise to a well-known form of delirium or mania; so in minor degree may mercury. But the most potent and most common of all poisons in the etiology of mental disease is undoubtedly alcohol. And this poison acts in two ways, for it may not only induce insanity in the individual, but it also is most active in causing that hereditary predisposition to insanity in the offspring to which reference has already been made. In fact, the subject of heredity is not a little involved with the subject of alcoholism in the progenitor.

Traumatism, or injury, may act as an exciting cause of insanity. This is true especially of injuries to the head. Trauma acts most readily in conjunction with other causes, such as alcoholism and syphilis. Injuries to other parts of the body, especially when associated with great shock, as in severe railroad accidents, may lead to various forms of mental alienation.

Overwork and exhaustion from any causes whatever may predispose to, or directly cause, a mental breakdown. This is true especially in cases in which the blood is depleted, the nutrition of the nervous system impaired, and the mind harassed with care and anxiety. These causes are most active in persons otherwise predisposed, as by alcoholism, syphilis or heredity.

Mental and moral shock and strain, such as sudden loss, grief, fright, mortification, intense religious and political excitement (as in the French Revolution), long continued anxiety, and the harassment of uncongenial surroundings, as in the home-life, may all act as causes of insanity.

The above are the chief categories of causes, but they do not exhaust the subject. It is in fact too extended for brief treatment. Finally, it must be borne in mind that in any individual case not one but a combination of several of the above causes has usually been active.

Classification.— Almost every alienist of repute has attempted a classification of the forms of insanity. The subject is one of peculiar difficulty, owing largely to the fact that our intimate knowledge of many of these various forms is far from complete. One of the most satisfactory schemes is the one by Krafft-Ebing, and is as follows, slightly abridged:

"A."

MENTAL DISEASES OF THE DEVELOPED BRAIN.

I. Diseases without Anatomical Lesions, or Functional Diseases.
  (1) Psychoneuroses, or diseases of a brain otherwise sound.
    1st. *Melancholia.*
      a. Simple Melancholia.
      b. Stuporous Melancholia.
    2d. *Mania.*
      a. Maniacal Exaltation.
      b. Frenzy.
    3d. Stupor, or Acute Dementia.
    4th. Hallucinatory Delirium.
      Note.— The above affections are primarily curable, but the worst of them may terminate in chronic incurable forms and in dementia.
  (2) Degenerative Insanities: Affections of a brain endowed with a morbid predisposition.
    1st. Constitutional Affective Insanity.
    2d. Paranoia.
      a. Congenital.
      b. Acquired. This form includes various subgroups according to the character of the delusions entertained by the patient.
    3d. Periodical Insanity.
    4th. Mental Affections arising from the constitutional neuroses.
      a. Neurasthenical.
      b. Epileptic.
      c. Hysterical.
      d. Hypochondriacal.

II. Organic Insanities or Mental Diseases with Recognizable Lesions in the Brain.
    1st. Acute Delirium.
    2d. General Paresis.
    3d. Cerebral Syphilis.
    4th. Senile Dementia.
      Note.— Chronic Alcoholic Insanity and Morphinism may yet have to be added to this group.

"B."

MENTAL AFFECTIONS OF THE UNDEVELOPED BRAIN.

Idiocy and Imbecility.

This scheme by Krafft-Ebing, while not without defects, is excellent for practical purposes and until someone can devise a better. Its great merit is that it is flexible: it readily admits new forms. Its defect is that it draws too sharp a distinction between the so-called functional and the organic insanities; and between the psychoneuroses and the constitutional forms. The truth is, all insanities are organic; and a constitutional taint may be present in the psychoneuroses.

Following this classification we note the following forms of insanity:

A. The whole group of insanities as distinct from idiocy is included under this head, and as a first great subdivision comes:

1. Mental Diseases without recognizable anatomical lesions: Functional Diseases. As

was inferred above, this whole group is only tentative in one sense, because as scientific knowledge advances it is found more and more that insanity in all its forms depends upon anatomical changes. For the present, however, this group may be allowed, with some reservation, to contain the following:

(1) The Psychoneuroses. In these forms the mental disease is such as can happen in a person with an otherwise perfectly normal brain. It is in a sense fortuitous, and not dependent necessarily upon a hereditary taint. Given the same causes, and it may be presumed that any person might develop a psychoneurosis, just as he might develop a fever. By this it is not implied, however, that heredity cannot act to predispose to these forms.

Melancholia is marked by depression. The affective or emotional, rather than the intellectual, faculties are involved. The patient has a sense of personal unworthiness; in other words, the depression centres about the patient's ego. He is not so much concerned about his misfortunes or his troubles, as about his unworthiness. Neither is he concerned about other persons: he is entirely self-centred. This may be said to be the keynote of melancholia. Delusions of a depressive character, as of having committed the unpardonable sin, may be present. The depression may become so profound and overwhelming that the patient passes into a stuporous or atonic state. (*Melancholia Attonita.*) In this state the physical functions, such as appetite, digestion, and nutrition, may be correspondingly depressed. Suicide may result. In some cases the patient is restless under the burden of his mental suffering (*Melancholia Agitata*).

Mania is marked by exaltation. The intellectual faculties are much more involved than in melancholia, and the patient is active, loquacious, sometimes destructive and combative, or else gay. He is somewhat incoherent, and his delusions are not well-defined, but fleeting and changeable in accord with his varying moods and disordered thoughts. The physical functions suffer as a result of exhaustion from over-activity. *Frenzy* is only a higher degree of mania, in which the mental functions are in entire disorder from over-excitation. Exhaustion is rapid.

Stupor, as its name indicates, is a psychosis in which the predominant tone is one of profound subversion of all the mental functions. *Acute Dementia* is another term for it. The patient may recover from a most unpromising state, especially in the case of young persons. *Dementia Præcox* is such a form, although the prognosis is not always good. *Primary* Dementia occurs without preceding acute stages.

Hallucinatory Delirium is a form of acute insanity marked by confusion and by the presence of hallucinations of sight and hearing. *Confusional* insanity is a term sometimes used, especially for the types which occur after acute infection, such as post-febrile insanity, and some forms following child-birth.

All these psychoneuroses may, in unfavorable cases, pass into chronic forms, and terminate in incurable dementia.

(2) The Degenerative Insanities.

In these forms mental deterioration is engrafted on a constitutional defect. Heredity plays a great part. The patients have been born with the neurotic predisposition. Their insanity is simply a logical evolution of a badly organized nervous system.

The great type of this form of insanity is *Paranoia.* The chief characteristic is the formation of systematized delusions. At first these may be of a persecutory tinge: the patient believes that he has enemies, who plot against his welfare or his life. He has hallucinations, especially of hearing. In a second stage, the delusions acquire a more expansive type: the patient believes that he is some great personage. As preliminary to all this, there is often a long career of moral and mental perversion: the patient has been noted as erratic, eccentric, visionary, and even immoral. He usually has displayed but little real brain power or steadiness, but often an intense egotism and a lack of common sense. Innumerable varieties and several stages occur. From this class are recruited in large part the criminal insane. These patients are the monomaniacs of the older writers, and they include also the moral lunatics, pyromaniacs and kleptomaniacs of more recent systematists. Among them are found also the victims of obsessions, morbid impulses and fixed ideas. The paranoiacs are the dangerous lunatics, and the prognosis is not favorable.

Periodical Insanity is a form of constitutional insanity in which, as the name indicates, there is a tendency to recurrence. This recurrence is sometimes in cycles (*Circular* Insanity), in which there is a period of maniacal exaltation, followed by one of melancholic depression, and then a somewhat prolonged period of apparent recovery, to be followed again by the morbid cycle. With every recurring cycle, however, the patient deteriorates somewhat, and may eventually degenerate into chronic insanity.

In the constitutional nervous diseases, such as Epilepsy, Hysteria, Hypochondria, and Neurasthenia, there are often mental changes of a morbid type, and these give rise to the forms of insanity named in accord with these respective neuroses. The symptoms vary widely in the several diseases.

II. In the organic insanities, so-called, the disease is marked by recognizable changes in the brain-structure.

Acute Delirium, or Bell's mania, is an acute infectious disease of the brain, of unknown origin, and of rapid progress, usually terminating fatally. It is marked by confusion and delirium, passing into coma and death. The changes in the brain are of an inflammatory kind.

General Paresis, or Dementia Paralytica, is caused by a progressive infectious or destructive process in the brain substance. Its dependence on syphilis is no doubt close, and it is further induced by alcoholism, dissipation and overwork. It is marked by change of character, erratic conduct and loss of mental and moral control, passing on into a stage of expansive delusions with progressive dementia. There are also characteristic speech defects, changes in the ocular muscles and in the gait, with increasing feebleness and paralysis. Various crises occur, such as maniacal, epileptoid and apoplectic, and in the last stage the patient is paralyzed and demented. Death is the inevitable result in the vast majority of cases.

In *Cerebral Syphilis* there is a characteristic inflammatory process beginning in the coats of the small blood-vessels. Mental symptoms occur in great variety, also many forms of paralysis.

Senile Dementia is a form of deterioration occurring in old age, and is dependent primarily on changes in the blood-vessels in the brain. Progressive failure of mental powers, with occasional delusions, is the chief feature. In some cases paralytic and epileptic crises occur.

B. Finally we have the great group in which the mental affections are the results of arrest of development of the brain. These are not included in insanity proper by systematic writers, but are regarded as a group apart. This group includes Imbecility and Idiocy, and is defined under the latter head.

No attempt has been made in the above classification to include various debatable forms. Among such forms are *Hebephrenia* (occurring in adolescence) and *Katatonia* (a psychoneurosis with both melancholic and confusional symptoms), and some others about which alienists are not yet agreed. The list must still remain open.

Pathology.— In the group of organic insanities it has been pointed out that these diseases rest upon a recognizable anatomical basis: thus in general paresis the structural changes in the blood-vessels and tissues of the brain are so marked and so well studied that this disease may be said to have as well known a morbid anatomy as pneumonia. But this is true of very few of the insanities, and the above classification is constructed largely on the distinction between forms of insanity with, and those without, well-defined anatomical changes. But while such changes cannot in many cases be detected even with the most powerful microscope, there is practically no doubt in the minds of most alienists that all insanities depend upon a physical or structural basis. In other words, they are but manifestations of morbid changes in the brain-cells. To detect these changes is still one of the great problems of psychiatry. The tendency of modern pathology is to seek for the anatomical changes of insanity mainly in two directions: first, in heredity; and, second, in infection or toxæmia. Heredity makes its impressions so invisibly upon the brain-cell that there may be wise doubts whether we shall ever be able to detect them; but its signs, or stigmata, on the body at large are not so difficult to distinguish. The main difficulty is to interpret them. By these stigmata are meant defects or peculiarities in the grosser parts of the body, as in the bones, especially of the head and face, the ears, eyes, teeth, etc. As to infection, and the marks of it as found in the brain-cells, the evidence accumulates more and more that in many forms of insanity, especially those called functional, the direct agent is often a poison circulating in the blood and interfering with the nutrition and functioning of the brain plasma. Syphilis and chronic alcoholic poisoning leave definite changes in the blood-vessels, tissues, and membranes of the brain.

Treatment.— The treatment of insanity resolves itself into the preventive and the curative. Modern practice is beginning to concern itself more and more with the former, while of course it does not in any way relax its attention to the latter. The prodromal, or initiative, symptoms of many forms of insanity, especially the psychoneuroses, are now so well understood, that it is often an easy matter to recognize the insidious changes that herald a mental breakdown, and to guard the patient from the dangers and misfortunes of a fully developed attack. Of first importance is to remove the patient from the exciting causes. Complete rest and isolation are therefore required and cannot be instituted too early. In order to secure these, hospital treatment is often essential. Very recently it has been proposed to treat these patients in general hospitals, in special wards, and not to hurry them into asylums under legal certification. In other words, they are to be regarded simply as other sick persons, and not to be immured merely as lunatics. The motive is thoroughly humane, and the practice is often successful in promising and selected cases. The indications are for rest, isolation and attention to the nutrition especially. There is no specific for insanity except in cases in which syphilis is active.

In very many cases, however, the nature and course of the disease render it imperative to commit the patient to special hospitals for the insane. This is not only for the good of the patient, but also for the welfare of society. These hospitals or asylums in all civilized countries are now among the very best of public institutions, and the prejudices once existing against them are no longer warranted. The indications for treatment vary according to the nature of the case. The weak and exhausted must be built up; the depressed must be encouraged and diverted; the violent and excited must be restrained; the chronic and demented must be cared for often as though they were children. The practice of to-day is in favor of all humane methods, such as by recreation, useful employment, amusements, and an appeal to the best remaining or active elements of the mental life. Physical restraint is reduced to a minimum, although in the most violent cases it cannot be entirely abolished. Punishment is practically abandoned. It is satisfactory to know that all our best regulated hospitals for the insane are enabled to report annually a good percentage of recoveries, and this is in accord with the teaching and practice of modern science, which regards insanity entirely from its physical aspect as a disease of the brain. With this definition this brief article may end as it began.

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Inscriptions. The term inscriptions comprises, in its widest sense, all words or word-signs engraved (or painted) on relatively durable materials such as natural cliffs, wrought stone, baked clay, metal, or even wood. For rea sons of practical convenience, however, certain sorts of inscriptions are grouped apart; for example, legends on coins and the lettering on painted vases. The etymological sense of inscription (Latin *inscriptio*, "in-scratching") is not to be taken so strictly as to exclude raised lettering. The role of inscriptions in modern times accords in general with the ancient use, but is much less extended. Then, copies of official and religious documents were frequently promulgated in the form of inscriptions, a usage that no longer survives, though commemorative and titular inscriptions are still plentifully employed. In general, inscriptions serve one of two purposes: (1) they constitute a record, and the material containing them is wrought for the express purpose of receiving the inscription (example, known from literature only, Moses' stone tables that held the decalogue): (2) the object on which the inscription is engraved fulfils a purpose of its own, while the lettering indicates the name, nature, purpose, maker, or owner of the material object (commemorative column, mirror, ring, etc.). To these may be added another class, (3) the incidental inscription, a notice or entry upon an object not prepared to receive it.

Inscriptions furnish materials of value to students in many fields. To the historian — and we must understand history to be the life-record of the nation and its citizens — they supply evidence of great value, all the more valuable because nearly always contemporaneous with the facts recorded. The incidental as well as the formal record may bear testimony. An example of this sort has been found on the leg of a colossal statue at Abusimbel in Nubia, whereon Greek mercenaries who had ascended the Nile under the leadership of Psammetichus — more probably the second (594–589 B.C.) than the first (654–617) of that name — traced a brief notice of their expedition. The incidental inscription is particularly apt to furnish details valuable for social history. To the archæologist inscriptions of the second class furnish testimony of value for topography (witness the fragments of the marble *Forma Urbis*, an ancient inscribed plan of the chief buildings of Rome) and for the precise identification of statues and other works of art. The discovery of inscriptions is among the express tasks of the excavating archæologist, who thus supplies the raw material, so to speak, for the historian or philologian. To the philologian inscriptions yield the key to the history of writing and, if his interests lie in the comparative and historical study of words, give him a fuller knowledge of their form. To the philologian of literary interests inscriptions yield a knowledge of historical fact or of vocabulary that may lead to a correct interpretation of a difficult literary passage. For example, the Greek historian, Thucydides, records (6.54) an altar inscription set up by Peisistratus (527–510 B.C.), which, he says, was still "in clear evidence," but "in dim letters." The identical inscription was found in 1877, with lettering perfectly distinct, and the literary interpretation of "dim" had to be revised and brought into accord with the facts. Meantime, the archæologists had learned that red or blue paint was employed to bring out more clearly the lettering of Greek inscriptions, and it was easy to infer that not the incision but the coloring of this inscription was dim in the time of Thucydides. Inscriptions previously known from literary works have for the philologian the added value of yielding testimony concerning the reliability of the manuscript tradition. Thus the best manuscript of Thucydides is of the 10th century A.D. and, as the last in a long chain of copies, must have been exposed to a great deal of corruption in transmission. The fact that a treaty recorded by the historian (5.47) corresponds almost exactly with the (fragmentary) inscription recording the alliance is reassuring for the MS. tradition. The *littérateur*, even, may be concerned with material furnished by inscriptions. One of the most considerable fragments of the poet Simonides, for example, has reached us in a copy on stone of an epitaph (epigram) in honor of the Megarians who fell in the Persian war. Some literatures have survived only as inscriptions.

It is safe to declare that inscriptions are as widely diffused as the art of writing. Even a primitive picture, if painted to convey a message, would constitute an inscription. Hieroglyphics (conventionalized picture writing) constitute the most primitive type of writing, and inscriptions of this sort, in the Maya language, are found in Yucatan. Though probably not earlier than the discovery of America, these represent, as regards writing, the same stage of culture as the hieroglyphics of Egypt (4700 B.C.). Chinese inscriptions — the Chinese being a highly conventionalized hieroglyphic script — of 1,200 B.C. are also extant. The Mayan (and Aztec) system is still very imperfectly understood. Egyptian hieroglyphics were likewise long undeciphered, but in 1822 the Rosetta Stone (q.v.), a trilingual in Greek, demotic Egyptian, and hieroglyphics, whereon the names Ptolemy and Cleopatra were of frequent occurrence, furnished a clue to the hieroglyphics which had been conventionalized, through a syllabary, to a pure phonetic system.— — This means, to invent an instance, that a picture (symbol) representing motion [=(to) go] comes to be used for the syllable *go* in a proper name like Goshen (this step was taken by Aztec hieroglyphics), or in a word like gopher: and that in the last stage the syllable sign *go* reduces to the letter g. — — The decipherment and interpretation of Egyptian inscriptions belongs to the science called Egyptology. See EGYPT.

The cuneiform script, invented by the Accadians of Chaldæa, found its way to the Semites of Babylonia and Assyria. This was a syllabary, developed from an earlier pictorial system, and such it remained in those countries, where not only small objects like seals and cylinders, but whole libraries of clay tablets (reaching back into the 4th millennium B.C.), have been found. These tablets contain genuine literary works as well as the documents and announcements commonly included under the term inscriptions. The University of Pennsylvania is in possession of some 35,000 cuneiform documents, a collection particularly rich in fourth and second millennium records, and outnumbered only by the British Museum and the Louvre collections. The Tell-el-Amarna Letters are historically among the most noteworthy cuneiform inscriptions. Found by an Egyptian peasant woman in 1887, the collection is now split up between the Berlin and British museums, though a part remains in Egypt. These tablets contain a correspondence between three kings of Egypt (15th century B.C.) and the rulers of Babylonia, Assyria, Armenia, the states of Asia Minor, Syria, and Palestine. Of transcendent importance for the early political history of Western Asia, this correspondence is also accounted to confirm the validity of the Hebrew Scriptures as an historical record. It is noteworthy for the history of culture that the petty chief of every town could command the services of a scribe able to write a letter in Assyrian — the common correspondence language, it would seem, of all those countries. The science of Semitic Cuneiform belongs to Assyriology (q.v.).

Fortunately the Assyrian syllabary, after being borrowed by the Medic Aryans, was converted into an alphabetic system. King Darius (521 B.C.) caused an Old Persian (Protomedic) inscription of 413 lines, averaging 6 feet each, with versions in Neo-babylonian and Neo-elamitic, to be inscribed on the Great Rock of Behistun, at a height of 400–500 feet. The same script had been observed on other short inscriptions found at Persepolis, which evidently contained proper names chiefly. As early as 1802 Grotefend allocated the names Darius, Xerxes and Hystaspes to certain script groups in these brief formulæ, and correctly isolated 9 of the 13 symbols concerned. In course of time the entire Protomedic cuneiform alphabet was identified and subsequently the more complex Semitic syllabaries were worked out, resulting in the decipherment of the older cuneiform. In the Behistun inscription Darius, following precedents of Assyrian kings, summed up the history of his accession and reign. Copied in 1844 by Mr. H. C. Rawlinson, it has been carefully inspected again (1903) by the American scholar, Mr. A. V. W. Jackson.

Farther west, the Phœnicians, also Semitic, developed, perhaps from Egyptian hieroglyphics, a true alphabet, out of which sprang, on the one hand, the scripts used by the Hebrews, Arabs, Persians and Hindus, and on the other the Greek (and Roman) type. The most notable early inscription in alphabetic Semitic is the Moabite Stone (q.v.) (9th century B.C.), which recounts the victory of Mesha, king of Moab, over Israel. The language used differs but slightly from that of the Hebrew Scriptures, of the historical validity of which the Moabite Stone, like the Tell-el-Amarna Letters, is held to be in general confirmatory. For facsimile, transcript and translation see Hastings' 'Dictionary of the Bible' iii., p. 405 seq. Phœnician-Greek bilinguals from Cyprus, belonging to the 4th century B.C., are extant; also Phœnician-Cypriote, which furnished the key to the Cypriote syllabary. Punic inscriptions proper are chiefly of the dedicatory sort, and relatively late, all after the Greek period. Aramaic dockets on Assyrian contract tablets (8th century B.C.) form another instance of early alphabetic Semitic.

India also has its inscriptions. The oldest (250 B.C.) and most interesting are the religious edicts of King Piyadassi, known as the Asoka Edicts, which are engraved on rocks and pillars. They inculcate the religion and morals adopted by this king after his conversion to Buddhism. These inscriptions, in two unknown alphabets (Karosthī and Brahmī), were deciphered chiefly by James Prinsep, who, in the winter of 1837–8, single-handed, unraveled the Brahmī script. He guessed that in certain brief Brahmī inscriptions, plainly of a votive character, a frequently recurring final group of letters must stand for the notion "gift" and be equivalent, if the language was Sanskritic, to *dānam*. He further surmised that the consonant preceding *dānam* must be the genitive (possessive) sign — *s*. He thus isolated the three consonants *s*, *d*, *n* and, with this start, soon identified the entire alphabet.

Greek and Roman inscriptions have been more studied and are accordingly more systematized for study than any others. The ancient Greeks were themselves conscious of the importance of inscriptions. Herodotus used them as sources, and Thucydides and Xenophon quoted them. Decrees are sparingly mentioned by Isocrates, but freely quoted by Demosthenes, who probably made use of the papyrus originals from the department of archives, not all decrees being promulgated on stone. Euripides alludes to the custom of inscribing formal compacts on tripods and dedicating them in temples. Greek antiquaries and scholars even made collections of inscriptions and Polemon (300 B.C.), who was neither the first nor the last of these collectors, owing to his zeal as an inscription hunter, got the nickname of *stēlokopas*, "tablet-picker." Roman writers also — Cicero, Livy, Pliny the Elder, Suetonius — occasionally mentioned inscriptions of historical interest. Varro, the antiquary, and the lexicographer, Verrius Flaccus, commented on the diction of inscriptions; while Polybius, the Greek historian of Rome, actually cited inscriptions, making a fuller use of them than Livy. But no interest in collecting inscriptions, comparable to the Greek interest, ever developed among the Romans. From the Revival of Learning on scholars were not lacking to show an interest in classical inscriptions, but the modern impulse may be said to have had its point of departure in the first quarter of the 19th century when the Prussian Academy, under the promptings of August Boeckh, inaugurated the great collection known as the 'Corpus Inscriptionum Graecarum' (4 vols, 1825–56), which contained nearly 10,000 numbers. But fresh inscriptions are ever coming to light — *dies diem docet* — and in 1891 the number was estimated at 50,000. There has been a steady increase ever since. Excavations are now pursued in Greece and Greekish countries with a diligence and at an outlay never before known. Almost all the great nations have established archæological institutes in Athens, and all of these issue some form of learned journal devoted in part to the publication of the new inscriptions discovered; for example, 'Papers of the American School of Classical Studies at Athens,' 'American Journal of Archæology,' 'Bulletin de Correspondance Hellénique,' 'Ephemeris Archaiologikê,' 'Journal of Hellenio Studies,' 'Mittheilungen des Deutschen Archæologischen Institut,' 'Archæologisch-Epigraphische Mittheilungen aus Oesterreich,' etc. Further great collections like Boeckh's have been issued, for example, the 'Corpus Inscriptionum Atticarum' and the 'Sammlung Dialekt-Inschriften' (in progress). A similar activity has been exhibited at Rome also, with the same establishment of archæological institutes. In 1863 the first volume of the 'Corpus Inscriptionum Latinarum,' also supported by the Prussian Academy, was issued. Since then 15 volumes, with numerous supplements, have been published, new inscriptions being first provisionally printed in the 'Ephemeris Epigraphica.' In all, some 150,000 Latin inscriptions are now accessible in print.

Classical inscriptions require two classes of investigator, the field collector and the closet student. A knowledge of Greek and Latin acquired from printed books does not equip the student for field collecting. It is true that the decipherment of the known script of classical inscriptions does not present problems like those solved by the ingenuity of Grotefend and Prinsep but, for all that, training is needed for the accurate reading and copying of the inscription. Absolute accuracy in copying is difficult of attainment, but a "squeeze" made of (unsized) paper, wetted and packed into every crevice, or a copy made by covering the inscription with a sheet of dry paper and rubbing the same with powdered graphite secure excellent results. America has produced one collector of large and successful experience, Mr. J. R. Sitlington Sterrett, whose collections are to be found chiefly in the 'Papers of the American School.' After correct copies have been secured it remains intelligently to divine words and letters lost by mutilation and to expand the abbreviations, but the latter have been so thoroughly listed in works on epigraphy (= the science of inscriptions) as now to present little difficulty. The same works have so classified the script-forms as greatly to simplify the act of reading the inscription, and their topical arrangement of the subject matter of inscriptions is a great aid to interpretation.

Greek official inscriptions were chiefly recorded on marble, Roman on bronze. The latter material, being available for so many uses, proved the less enduring. But marble slabs were also converted into building material or foundation stones of ramparts, and at Rome many an inscribed stone was calcined into lime. So many were the hazards to which inscriptions were exposed that it is exceptional to find an important one in its original location. For purposes of study the modern habit of gathering inscriptions into museums is highly convenient. In Greece, besides public squares and buildings, temples were a favorite repository for inscriptions, such as state treaties, tribute and treasure lists; dress, armor, weapons and other offerings of gratitude — all with dedicatory inscriptions — made the temple a sort of museum; images of afflicted parts of the body that had been cured, with accounts of the case inscribed thereon, were offered to gods of healing, forming a sort of nucleus of an anatomical collection and a medical library. Commonest of all forms was the sepulchral inscription which began with simple announcements but grew into sounding eulogies. Among the Greek inscriptions none has been found so comprehensively important for history as the Great Rock of Behistun, but Mr. C. T. Newton, in his essays 'On Greek Inscriptions' ['Contemporary Review' (December 1876); 'Nineteenth Century' (June and August 1878, reprinted in 'Essays on Art and Archæology,' p. 95. seq.)], has set forth with great charm their collective value for history and the things pertaining to religion. At Rome, Augustus caused a succinct account of his deeds to be engraved in bronze and set up before his mausoleum. This inscription, widely diffused in the Augustus temples throughout the empire, was discovered at Ancyra (now Angora). The Monumentum Ancyranum constitutes an extensive historical document of the very first importance. The Edict of Diocletian (303 A.D.) has quite a modern ring, being a law to control mercantile "combinations in restraint of trade" by fixing a maximum price for provisions and other commodities. The Acta Fratrum Arvalium form an important memorial of a religious guild. A fragmentary black cippus unearthed in the Roman Forum (1899), supposedly near the grave of Romulus, aroused great enthusiasm. Its early date (550 B.C.) has been held to make for the credibility of the traditional account of Roman history as given by Livy rather than to give countenance to the skeptical method current since Niebuhr's time. Unfortunately, save for a few words of great interest for the comparative grammarian, the inscription admits of no more definite elucidation than the conviction that the words probably belonged to a religious prescript. The *graffiti* (wall-scratchings) of Pompeii form a large and interesting class of incidental inscriptions which comprises quotations, paraphrases, catchwords, proverbs; lovers' messages, complaints, tarryings, rendezvous; names and greetings. Among them the painted inscriptions (*dipinti*) contain election notices chiefly. The dialects of Latin are known almost entirely from inscriptions. The chief remains of the Umbrian language (dialect) are the Tabulæ Iguvinæ, seven bronze tablets found at Gubbio in 1444. They contain long ritual prescripts. Some 250 inscriptions, few of great importance save to the grammarian, represent the Oscan dialects. Etruscan inscriptions in considerable number have been found in Italy — one (supposedly) as far to the east as the island of Lemnos — but, pending the discovery of a long bilingual, these, though written in a well-known alphabet, still await definitive interpretation. The same is true of Iberian inscriptions (some 75 in number, several of between 50 and 150 letters). Runic inscriptions, in an alphabet derived from the Greek, have been found in Scandinavia and in England; the oldest (300 A.D.) being engraved on the utensils found at Thorsbjerg, others on stone monuments, rocks, weapons, ornaments and coins; the longest containing 16 words.

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Insecticide, any agent which destroys insects. This definition includes natural as well as artificial means of control, the latter being those operated by man. The most important of the former are adverse temperatures, excessive or insufficient moisture, fire, bacteria, fungi, mites, spiders, fish, reptiles, insects, and birds. The artificial controls may be grouped according to their mode of action. Two principal groups are recognized; those intended to reach the alimentary tract through which they act, and those that act through the respiratory apparatus. The former are effective only with such insects as bite off and swallow pieces of plant tissue; the latter more or less also with these, but most frequently used upon insects which suck the plant juices from beneath the punctured epidermis. Caterpillars, beetles and their larvæ, grasshoppers, etc., all chew their food and have been most effectively controlled by Paris green, hellebore, arsenate of lead, etc., applied to the infested foliage either as a spray or as a powder. Plant-lice, plant-bugs, and other sucking insects have been held in check best by kerosene emulsion, whale-oil soap, fir-tree oil, or other substances that choke the breathing-pores in the insects' bodies. Some of these insects are dreaded because of their great prolificacy, their small size and resistance to treatment. Gases are often used under favorable circumstances to reach insects troublesome in stored grain, among clothes, upon plants in greenhouses, and even upon plants in the open air — these last being covered with tents or boxes while being fumigated. Various chewing insects which tunnel through the tissues cannot be controlled by sprays, and are usually beyond the reach of gases. The leaf-miners, which burrow just beneath the epidermis of leaves and green stems, have never been effectively controlled. Some borers (currant-borer) can be kept in check by burning the twigs they infest, (peach-borer) by prodding them in their burrows, (squash-vine-borer), by cutting them out, the method being suggested by the nature of attack. Other chewing insects (plum curculio) are jarred into kerosene. Lastly there are various oils and greases which are used upon animals and man to destroy fleas, lice, etc. Tobacco water and carbolic acid are also similarly employed.

Formulæ and Methods of Application.— Paris green should be mixed with a little water to form a creamy fluid, and then added to water or Bordeaux mixture (see FUNGICIDE) at the rate of one pound to 200 gallons or more. Arsenate of lead may be applied somewhat more liberally. Hellebore may be mixed with water (1 ounce to 3 gallons) and a little glue or flour paste to increase adhesiveness. Each of these may be applied as a powder sifted on the plant, through a salt sack or blown upon them through a powder-gun. A little flour aids the sticking quality. When powders are used, the plants should still be wet with dew or rain. Kerosene emulsion is made by intimately mixing a solution of hard soap (one pound to two gallons of hot water) with four gallons of kerosene, and diluting as needed for use with from 30 to 60 gallons of water. Pure kerosene and crude petroleum can be safely applied only to dormant plants, and then only upon bright breezy days, which will hasten evaporation. Kero-water pumps mix kerosene and water drawn from separate tanks, and apply the mixture direct to plants. They have hardly passed the experimental stage. Whale oil soap is mixed with water (1 pound to 1 or up to 10 gallons), and applied as a wash or spray. Carbon disulphide may be used where there is no danger of its inflammable fumes coming in contact with flame. An ounce is sufficient for from 50 to 75 cubic feet of air-tight space; and the exposure should be for 24 hours or longer. Hydrocyanic acid gas is prepared by adding cyanide of potassium (98–99 per cent pure) to water and sulphuric acid (cyanide, 1 ounce; water 2¼ ounces; acid, 1½ ounces for every 250 cubic feet of greenhouse; 100 cubic feet of nursery stock-room and 125 feet of dwelling house rooms, flour-mills, trees, etc.). Exposures may be from 30 to 60 minutes for trees, the former time being for plants in active growth, the latter for dormant ones; from 12 to 24 hours is usual for rooms, granaries, etc. Since these gases are considered violent poisons the greatest care should be exercised in their application. Oils and greases are merely rubbed on infested animals and man. Boiling water is effective in destroying both lice and eggs in clothing, but the clothing must be boiled for hours to destroy the eggs of the body-louse and the crab-louse. Dust, tobacco-dust, etc., are useful in poultry yards for the birds to wallow in. Carbolic soap is the favorite remedy for insects on pet animals. But with all stock, poultry, pets and man, cleanliness is the great preventive.

For condensed information concerning insecticides, consult: Circular No. 1, Division of Entomology, U. S. Department of Agriculture, 1891; Marlatt, 'Important Insecticides,' Farmers' Bulletin No. 127, U. S. Department of Agriculture; Hinds, 'Carbon Disulphid as an Insecticide,' Farmers' Bulletin 145 (as above); Johnson, 'Fumigation Methods' (New York, 1902).

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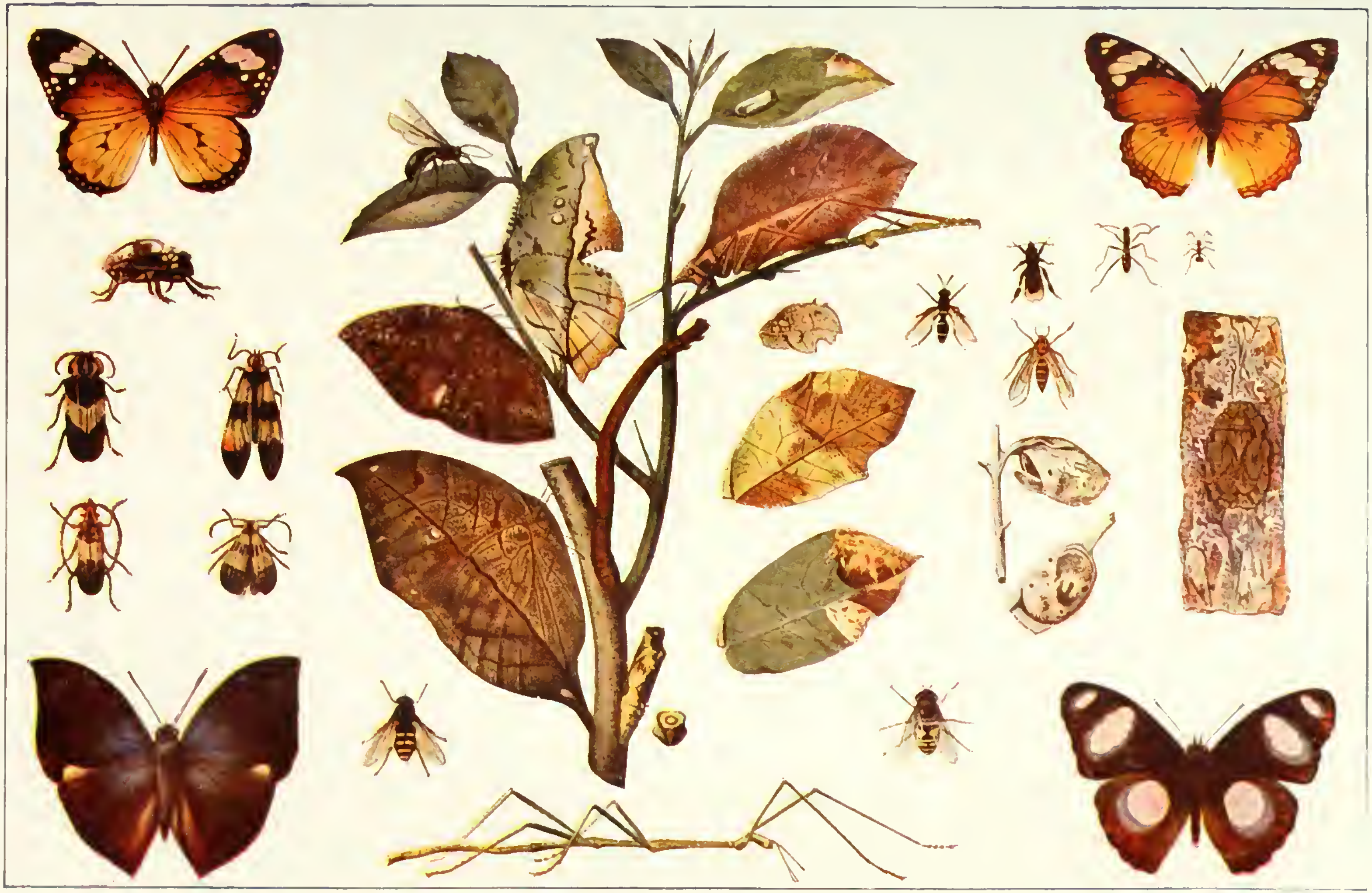
Insectiv'ora, an order of mammals, all of small size, usually five-toed, more or less plantigrade, and as a rule, possessing clavicles. "The snout is generally long, and is often prolonged into a small proboscis. There is a tendency for the teeth to be of a generalized type and their number is often the typical mammalian 44. Moreover, trituberculate teeth, which are certainly of an ancient form, are common." These teeth are adapted to feed on worms and insects alone. Many other evidences go to show that the type is a very old one, and Beddard thinks it may have survived because of the small size, imitative adaptiveness and nocturnal habits. Woodward speaks of the group as probably the little-altered survivors of some of the most primitive placental mammals, agreeing with the *Creodonta* in their low type of brain. Most of the families may be traced back to the upper Eocene. The order falls into two divisions, (1) True Insectivores, including the hedgehogs (*Erinaceidæ*), squirrel-shrews (*Tupaiidæ*), tanrecs (*Centetidæ*) otter-shrews (*Potamagalidæ*), hutias (*Solenodontidæ*), golden moles (*Chrysochloridæ*), elephant-shrews (*Macroscelidæ*), aquatic moles (*Talpidæ*), shrews (*Soricidæ*); and (2) Dermaptera, embracing only the colugos (*Galeopithecidæ*). See Hedgehog; Mole.

Insectiv'orous Plants. See Carnivorous Plants.

Insects. (Lat. *insectum*), a class of *Arthropoda* characterized by the body being divided into three regions, that is, a head, thorax, and hind-body or abdomen, and by the presence, in all but the more primitive and certain degraded forms, of wings, and of three pairs of thoracic legs. The body of insects consists of 21 segments (somites) of which six are used together to form the head, while there are three thoracic, and from 10 to 12 abdominal segments. To the head are appended five pairs of jointed appendages, that is, the antennæ, mandibles, and two pairs of maxillæ, while in the embryo of certain insects and in the adult *Campodea*, there has been detected a pair of vestigial appendages. Besides these appendages, there are two compound eyes, one on each side, and usually three simple eyes (ocelli) situated in the middle of the head. While the antennæ are undivided the first maxillæ are subdivided into three branches, an inner (lacinia), a middle (galea), and outer (palpifer), bearing the palpus. The second maxillæ are fused together, forming the under lip or labium; each second maxilla is composed of a lacinia, the palpus, while vestiges of the galea occur in certain forms. In bees certain accessory appendages called paraglossæ are present. Besides the maxillæ, the so-called tongue or hypopharynx is present, being highly developed in bees; it lies on the under side of the mouth, just above the labium; in caterpillars it receives the end of the salivary duct, and is called the spinneret. Attention should also be called to the upper lip or labium, on the under side of which is the epipharynx, which bears minute taste-pits. The thorax consists of three segments, which can be easily distinguished in the primitive wingless forms (*Campodea*) and in the cockroach and locust, but in the more specialized forms as beetles, moths, bees and flies, the segments are more or less fused together and, owing to the movements of the wing muscles, are subdivided into many separate pieces. In the wasps and bees the basal abdominal segment becomes toward the pupa state transferred to the thorax. The legs as a rule end in five jointed tarsi, the last joint bearing a pair of claws with a cushion (pulvillus) between them. Insects are enabled to walk on glass, etc., by means of a sticky fluid exuded from the ends of hollow hairs fringing the cushion. They climb by means of their claws.

Insects differ from all other animals except birds and bats in possessing wings, and their presence, especially that of the muscles of flight, have greatly modified the shape and structure of the thorax. The front pair of wings is attached to the middle thoracic segment (mesothorax) and the hind wings to the metathorax. In the two-winged flies (*Diptera*) the second pair of wings are reduced and modified to form the balancers (halteres). The wings are flat sac-like outgrowths of the skin, and are strengthened by the "veins" which form hollow rods. These veins contain a trachea, so that there is a space between the air-tube and the outer wall. When the insect emerges from the nymph or the pupa, the vein is filled with blood. The spaces enclosed by the veins and their cross-branches are called cells, and their shape often affords valuable generic and specific characters. In the more primitive insects there are numerous cross-veins, and such wings as in locusts, etc., are said to be net-veined. In the *Lepidoptera* there are few cross-veins. In the *Diptera* and *Hymenoptera* the number of veins is limited, the cells also being few. The skin of insects is hard, dense and elastic, due to the deposition of chitin.

Internal Anatomy.— One of the distinctive characteristics of insects is their mode of respiration. This is effected by an intricate system of internal air-tubes (tracheæ), which are filled with air by openings (spiracles) in the sides of the body; of these spiracles there are from one to two pairs in the thorax, and eight pairs in the abdomen. The tracheæ are kept permanently open by a series of threads (tænidium) each of which makes from three to five turns around the thin tube; in this way the entire tracheal branch is provided with what at first was supposed to be a continuous spiral thread. The slit-like openings of the spiracles are guarded by a grate of stiff hairs to prevent the ingress of dust, etc. It should be borne in mind that no insect breathes through its mouth, but through the spiracles. Hence the efficacy of all oily or greasy substances in destroying every kind of insect in whatever stage of growth; wherever the oil touches the body a thin film spreads over it, covering the air-openings so that the insect soon dies by asphyxiation. Though



PROTECTIVE MIMICRY AMONG INSECTS

insects have a delicate pulsating tubular heart, they have no arteries and veins, since the air in the tracheæ seeks the blood in the remotest parts of the body. The blood is thin and colorless. The aquatic larvæ and a very few perfect insects breathe by external tracheal gills, the spiracles being in such cases often absent. The genital opening is always situated near the end of the body, in front of the vent on the under side. Besides a complicated digestive canal, insects have urinary tubes opening into the end of the intestine.

The nervous system consists, besides the brain, of a chain of ganglia the greatest number of which is 13, but which become more or less fused in the more specialized groups, especially in the flies. The brain is remarkably complex, in accordance with the varied and complicated movements of the segmented body and jointed appendages, all capable of different kinds of motions.

Sense of Sight.— The compound or facetted eyes (ommatea) are composed of numerous simple eyes called ommatidia, which vary in number from 12, in *Lepisma*, to 20,000 in the dragon-fly (*Æschna*), and even 25,000 in a beetle (*Mordella*). Yet notwithstanding the wonderful complexity of these compound eyes, most insects are near-sighted, and perceive rather the movements of other animals than their exact outlines; the dragonfly and butterfly can see for a considerable distance. The simple eye probably only enables the insect to distinguish daylight from darkness, or at most very near objects. Insects, like bees and butterflies, have the color-sense, and prefer certain colors to others.

Sense of Smell.— Insects are chiefly guided by the sense of smell. This resides in the antennæ, in which there are microscopic pits filled with fluid; to this pit goes a fine nerve whose fibres end in staff-like sense cells. The number of these olfactory organs is in some insects enormous; thus in the European cockchafer there are 39,000 in the leaves of the male antennæ, and about 35,000 in those of the female; in a single antenna of the hornet (*Vespa crabro*) are about 13,000 to 14,000. In the cockroach the abdominal cerci or feelers also possess such pits.

Sense of Hearing.— The auditory organs of the locust are drum-like ears situated one on each side of the base of the abdomen, directly behind the first abdominal spiracle; in the green grasshopper, katydids, etc., a little auditory sac is lodged in the fore-legs (*tibiæ*). It is supposed that most insects are destitute of the sense of hearing, at least auditory structures have not yet been detected; yet all sound-producing insects must have ears to hear.

Sense of Taste.— The taste organs are little pits or papillæ which resemble the olfactory organs, but which occur on the inside of the upper lips, on the epipharynx, or at the base of the proboscis and maxillæ in the bee.

The Egg and Growth of Insects.— The eggs and the fertilizing fluid of the male are produced in glands which open near the end of the body on the under side. The eggs are deposited by the female in the earth or in wood, leaves, etc., by means of the ovipositor, an apparatus composed of three pairs of hard appendages, and which in the wasps and bees form the sting. Most insects die on the approach of cold weather, when they lay their eggs, the species being represented in the winter by the eggs alone. The eggs hatch in spring, the embryo passing through remarkable changes.

Metamorphoses.— Most insects after hatching pass through a remarkable series of changes called a metamorphosis. The small flies, moths or beetles, are not the young of large ones, but adult insects, while the most primitive insects have no marked metamorphosis, the mature locust only differing from the young in having wings; the more specialized forms, as beetles, moths, wasps, bees, and flies, pass through two stages of growth, that is, the larva and pupa, before becoming winged and sexually mature.

Larva.— The name was first given by the ancients to the caterpillar because they thought it masked the form of the perfect insect. Swammerdam supposed that the larva contained within itself "the germ of the future butterfly, enclosed in what will be the case of the pupa, which is itself included in three or more skins, one over the other, that will successively cover the larva." But the discovery by Weismann (q.v.) of the germs of the imago (imaginal disks or buds) in the larva completely changed our notions of the nature of metamorphosis (q.v.), and revolutionized our knowledge of the fundamental processes concerned in the change from larva to pupa or chrysalis, and from pupa to imago. Not only are the larvæ of each order of insects characteristic in form, so that the grub or larva of beetles is readily distinguished from the larvæ of other groups, or the maggots of flies from the footless larva of ants, wasps and bees, but within the limits of the larger orders there is a great diversity of larval forms, showing that they are the result of adaptation to their surroundings and mode of life.

The larvæ of nearly if not all the metabolous animals are probably secondary in their origin. Fritz Müller (q.v.) pointed out that this is the case with the larvæ of the higher insects. The larva of a beetle is popularly called a grub; that of a fly a maggot. The young of the more primitive insects, such as the cockroach, locust, all bugs, etc., which undergo an incomplete metamorphosis, is called a *nymph*. See LARVA.

Pupa.— The word pupa is Latin, meaning baby. Linnæus gave it this name from its resemblance to a baby which has been swathed or bound up, as is still the custom in Southern Europe. The term pupa should be restricted to the resting, inactive stage of the holometabolous insects, that is, those with a complete metamorphosis. The typical pupa is that of a moth or a butterfly, popularly called a chrysalis. A lepidopterous pupa in which the appendages are more or less folded close to the body and soldered to the integument, was called by Linnæus a *pupa obtecta;* and when the limbs are free, as in Neuroptera, Mecoptera, Trichoptera, and the lepidopterous genus Micropteryx, it is called a *pupa libera*. When the pupa is enclosed in the old larval skin, which forms a pupal covering (puparium), the pupa was said by Linnæus to be *coarctate*. The pupa of certain Diptera, as that of the orthoraphous families, is nearly as much obtected as that of the tineoid families of moths, especially as regards the appendages of the head, the legs being more as in pupæ liberæ. The pupæ of Coleoptera and of Hymenoptera, though there is, apparently, no near relationship between these two orders, are much alike in shape, and.

as Chapman pertinently suggests, those of both orders are helpless from their quiescence, and hence have resorted for protection to some cocoon or shell. But it is quite otherwise with the pupæ of Lepidoptera and Diptera, which vary so much in adaptation to their surroundings, and hence afford important taxonomical and phylogenetic characters. This, as regards the Lepidoptera, was almost wholly overlooked until Chapman called attention to the subject, and showed that the pupæ had characters of their own, of the greatest service in working out the classification, and hence the phylogeny of the different lepidopterous groups. The pupæ of the Neuroptera, Coleoptera and Hymenoptera differ structurally from the imago, in the parts of the head and thorax being less differentiated. Thus in the head the limits or sutures between the epicranium and clypeus, and the occiput and gula, are obscurely marked, while the tergal and pleural sclerites of the imago are not well differentiated until the changes occurring just before the final ecdysis. It is easy, however, to homologize the appendages of the pupæ with those of the imago of all the holometabolous orders except in the case of the obtected pupa of the Lepidoptera (and probably of the obtected dipterous pupæ), where the cephalic appendages are soldered together.

Classification of Insects.— The number of known species of insects is from 200,000 to 300,000, but it is estimated that there are upward of a million species now living. In fact, the class of insects vastly outnumbers all other groups of animals. This is probably due to their being winged, and to their great fecundity. At present the class of insects is divided into two subclasses, that is, the (1) *Synaptera*, represented by the wingless orders Thysanura and Collembola; and (2) *Pterygota*, comprising 15 winged orders and which may be thus tabulated:

Series 1.— *Heterometabola*, with an incomplete or variable, though slight, degree of metamorphosis. No distinct larva or pupa state, the young being nymphs.
- Order 1. Dermaptera. (Earwig.)
- " 2. Orthoptera. (Cockroach, locust, grasshopper, stick insect.)
- " 3. Platyptera. (Bird lice, Perla, white ant.)
- " 4. Odonata. (Dragonfly.)
- " 5. Plectoptera. (Mayfly.)
- " 6. Thysanoptera. Thrips.
- " 7. Hemiptera. (Bugs.)

Series 2.— *Holometabola*, or with a complete metamorphosis.
- Order 8. Neuroptera. (Corydalus, lace-wing fly, ant-lion.
- " 9. Mecoptera. (Panorpa, Boreus.)
- " 10. Trichoptera. (Caddis flies.)
- " 11. Coleoptera. (Beetles.)
- " 12. Lepidoptera. (Moths and butterflies.)
- " 13. Siphonaptera. (Flea.)
- " 14. Diptera. (Mosquito, fly.)
- " 15. Hymenoptera. (Saw-fly, ant, wasp, bee.)

Fossil Insects.— About 3,000 species of fossil insects have been described, of these from 200 to 300 are Palæozoic, 500 Mesozoic, and the remainder are Tertiary. The oldest fossil insect-remains is the wing of a supposed bug (*Protocimex*) from the Ordovician of Sweden. The wing of a cockroach (*Palæoblattina*) has been detected in the middle Silurian of Calvados, France. From the Devonian shales of St. John, N. B., nine species of primitive net-veined insects have been collected. The coal measures are characterized by cockroaches, primitive dragonflies, May-flies, and grasshopper-like forms, phasmids, etc., also occurring. All of the Palæozoic insects known are very primitive. Modern forms, those having a complete metamorphosis, begin to appear in the Triassic and Jurassic, where remains of beetles, a saw-fly, and a moth occur. Ants, bees and butterflies date from the Oligocene and Miocene Tertiary.

Bibliography.— The latest general works on insects are Carpenter's 'Insects, their Structure and Life' (London, 1899), and Sharp's 'Insects' (Vols. V. and VI. of Cambridge Natural History, 1895–9); both contain sufficient references to other works. For American insects consult: Packard's 'Text-book of Entomology' (1898), and 'Guide to the Study of Insects' (1889); Comstock's 'Manual for the Study of Insects' (1895); 'Insects and Crustacea' (Vol. II., Standard Natural History, 1884); Howard's 'The Insect Book' (1901). The last named contains a copious bibliography, especially to the voluminous publications of the Entomological Division of the U. S. Department of Agriculture.

See FRESH-WATER INSECTS; MARINE INSECTS, and the names of groups and species, as FLIES, HYMENOPTERA, MOTHS, etc.

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Insects and Flowers. See FLOWERS AND INSECTS.

Insects, Fungi Affecting. See FUNGI.

Insects, Injurious and Beneficial. See ENTOMOLOGY, ECONOMIC.

Insects, Propagation of Disease by. See FILARISIS: FLIES: MOSQUITOES; MYIASIS, ETC.

Insessores, ĭn-sĕ-sō'rēz, a discarded term in Ornithology designating a group styled «perchers,» which included the majority of the smaller and more familiar birds. The term has been abandoned because the group denoted by it is a purely arbitrary one.

Insid'ious Flower-bug. See FLOWER-BUG.

Insolvency. In a popular sense the word insolvency applies only to persons without property or means sufficient to satisfy their creditors. The legal definition embraces all who are unable to pay their debts at maturity in the ordinary course of business, even though they may possess assets exceeding their liabilities. A failure to meet overdue obligations renders a person liable to proceedings against him in a court of insolvency, in which his assets may be taken into the possession of the officers, marshaled, and distributed to his creditors. Should there be an amount in excess of what is required to pay the creditors and the expenses of administration, the balance so remaining is the property of the debtor. From a very early period in the history of civil government, laws have existed providing for proceedings by creditors against insolvent debtors, by which the debtor's property could be taken from his possession, to be held by another as a trust fund to be applied to the payment of his just debts. In case of an insufficient amount to pay all debts in full, provisions are usually made for a *pro rata* distribution. These laws have generally provided for classes of preferred debts, payments of which were to be made in full, even though such payments exhausted the entire assets. Preferred claims commonly included all claims of the government or state, and often claims for labor to a limited amount, and claims for the necessaries of life. Provisions are usually made for the exemption of certain articles to the use of the debtor, not to be included in the assets. The Constitution of the United States provides that Congress may establish uniform laws on the subject of bankruptcy throughout all the States, and the first act upon that subject was passed in 1800, since which time there has been some Federal bankruptcy law, with brief interregnums. A uniform national law upon the subject now exists. The first act of Congress upon this subject provided for proceedings by the creditors only, but in 1841 an amendment provided for voluntary proceedings by the debtor, by which he could surrender his property and obtain a discharge from all of his debts, provided he had been guilty of no fraud. In the absence of a national law on the subject of insolvency, the States all have authority to enact and enforce laws upon that subject. The Federal act now provides for voluntary proceedings by the debtor, as well as proceedings against him by the creditors, with provisions for his discharge. The various State acts have usually contained such provisions. The Federal act suspends all State insolvency laws during its continuance. See Bankruptcy Laws.

Inspiration, in theology, the communication by the Holy Spirit, to writers and speakers, of a portion of the knowledge and feeling of God, in such fashion that they can be communicated to other men; especially used in relation to the Bible. On the fact of inspiration rests all attribution of divinity to the sacred writings above any others; but theories of its method and extent have necessarily changed with the advance of critical knowledge. They have never had an authoritative pronouncement even from the Church of Rome, which allows liberty of judgment on this; the Bible not holding the supreme place there as in Protestant bodies, and the latter being too divided for a credal statement on this point, by the very causes which call for one. All theories rest not only on the necessary implication of divine character in the Bible, but on two specific passages: 2 Tim. iii. 16: "All Scripture is given by the inspiration of God, and is profitable for doctrine" (Revised Version, "Every Scripture inspired of God is also profitable for teaching," which does not relinquish the claim of inspiration); and 2 Pet. i. 21, "Holy men of God spake as they were moved by the Holy Ghost" (Revised essentially the same). The Scriptures were the Old Testament.

The early Church did not generally dwell on theories of inspiration, regarding it as a passive "ecstasy" in which divine truth was communicated, but rarely going on to its effects on the inspired writings or the methods which produced them. Origen, however, the great builder of doctrinal framework, formulated an exact theory of "plenary" or entire inspiration, which preserved the writers from all faults of memory, and left no iota either incorrect or superfluous in Scripture. But others held that all believers were inspired in different degrees; as this made all believers infallible interpreters of the Scriptures, the perilous nature of such a doctrine led to the opposite one, that there was an inspired official depositary of interpretation as well as an inspired canon of writings. The mediæval schoolmen evolved the theory that there were two kinds of inspiration in the Scriptures: direct, found where moral and doctrinal truths are directly taught; and indirect, in historical passages, whence ethical truths can only be derived by allegorical interpretation.

Regarding inspiration not as a purpose but a method, there are three explanations within the limits of orthodox Christianity: the "plenary" or verbal, the dynamic, and what may be termed the "irradiant" theories. The remaining one, which makes the inspiration only that common to all human beings — who are part of the divine mind — and having no part in any special revelation, is really not a theory of inspiration at all, as it holds that there is none; that all things are parts of the world's evolution, and the sacred writers and the Bible were evolved like the rest, though the latter is the greatest moral product of the world, and to be reverenced in the moral rank as we reverence the greatest writers and thinkers in theirs.

In the early uncritical ages of the Protestant churches, the universal and obvious theory of inspiration was the plenary. The original text of the Bible was dictated word for word by the Holy Spirit, the writers being merely penmen, or media on whom were impressed certain phrases, which must not be varied on peril of distorting the divine revelation. The words of Scripture thus transmitted are God's words, to each reader as if spoken directly to him by the Deity, and no matter to what subject they relate, be it doctrine or history, the origin of man or the duty of man. That there are different styles, corresponding to different writers, means only that God has accommodated his expressions to their natures, for his own utilities. Hence the least particle in the Scriptures is surcharged with meaning, and if anything seems in conflict with science, history, or other portions of the Bible, it arises from corruption of text, bad translation, or other change from the actual revealed language. This is the only theory with perfect logical continuity; unhappily it can only be maintained, in face of the increasing body of knowledge of texts, facts, and natural ethics, by those willing to abnegate their own right of criticism wholly in favor of their own infallible interpretation. Indeed, the chief argument for the latter is that the divine purpose would be defeated, if its intention in giving the revelation were made null by the misunderstanding of fallible human faculties.

The dynamic theory is the first step outside this bulwark enforced by the impossibility of maintaining verbal inspiration, and relegates the divine agency to an indirect function. In place of its dictating the exact phraseology and the precise facts, the writers are so filled with divine force that for all purposes of conveying the essential divine purpose, that of showing the truths of sin and danger and the path of salvation, they are a portion of the divine and incapable of error. Under this theory the writers are left a free hand, according to their own limitations and those of their age, in dealing with narrative facts or their own guesses at them; but are guided explicitly in all matters of faith and morals. In order to be received, the revelation had to be accommodated to the mental conditions of different ages; and men of each received guidance from God to present it so that it was true in relation to them, and remained so for all ages under all conditions. The warrant of the Bible is its incomparable and superhuman system of ethics, and its proof of divine origin is that evident superiority to all human devices.

The "irradiant" theory is a recent one, and a step farther from the old claim of entire divinity. In this view the record as such has no divinity, nor infallibility of any kind. There is a divine revelation, but it acts by generating moral ideas in certain great selected men, and which, once generated, are left to fight their way and take their chance like the other useful ideas of the world, and undergo disbelief and mutilation, with the certainty that according to God's purpose, truth will prevail at last. The proof of divinity in Christianity lies in the fact that its moral truths are the greatest in the world, and were original with it.

Instinct. Instinctive acts are those physiological activities in which mind or consciousness is involved. Instincts may be regarded as intermediate between simple physiological or reflex actions and acts of reason exhibited by man. Animals of a grade higher than sponges, polyps, most mollusks and other forms of a corresponding grade, have organs of sense, of perception, and in the higher vertebrates a brain and nervous system and other organs of the same type as those of man, and such animals react to something more than mere physical stimuli. We know by observation that the social insects, birds and mammals, at least those which have become domesticated, have sufficient intelligence to meet the ordinary exigencies of life, and that at times the ant, bee, beaver, elephant, dog, and ape can meet extraordinary emergencies, that is, rise with the occasion; that they may to a very limited extent be free agents; that they are not mere automata. It has been observed that the more intelligent animals are not solely guided by the physical stimuli of light, odors, etc., but that they exercise the power of choice, selecting this or that kind of food, this or that mate. Animals are subject to what we call the passions: they show anger, even when not hungry or under the domination of the reproductive instincts; their sounds express dissatisfaction or contentment. They possess memory: with its aid ants and bees find their way back to their nests.

Definitions of Instinct.— Descartes believed that animals are automata. It is popularly supposed that animals are automata, physiological machines in which have been implanted by supernatural power what we call instincts. This view is still insisted on by two excellent observers of the habits of insects, Favre and Wasmann, who claim that instincts are special innate or natural propensities, "transcending the general intelligence or experience of the creature." But of late years the impression has arisen and gained force that instincts are "innate" and "natural" because they have arisen by a natural process and have been gradually acquired and transmitted from one generation to another.

Erasmus Darwin held that instincts were the result of imitation by young animals of the actions of their parents. This view is still held by Wallace, and, as Eimer claims, the power of rapid learning has played a part in the evolution of certain instincts. Thus the fox or rat learns from its parents, and becomes more cunning or sagacious with age and training. Lamarck practically regarded the lowest animals as automata, but in the higher animals, that is, those with a nervous system, we have instinct. "Hence, instinct in animals is an inclination which necessitates that from sensations provoked while giving rise to wants the animal is impelled to act without the participation of any thought or any act of the will." To satisfy these wants they contract different kinds of habits; these are transformed, he says, into so many propensities, from which "originate their habitual actions, and special propensities to which are given the name of instinct." He then adds that the same habits and the same instinct are perpetuated from generation to generation, "without offering any notable variation, so long as it does not suffer change in the circumstances essential to the mode of life." He thus intimates that instinct may vary, and he states that in birds and mammals instinct is variable.

Darwin does not give a formal definition of instinct, but after stating that several distinct mental actions are commonly embraced by this term, he adds that "a little dose, as Pierre Huber expresses it, of judgment or reason often comes into play, even in animals low in the scale of nature." He calls attention to the points of resemblance between instincts and habits, showing that habitual action may become inherited, whence it results that "the resemblance between what originally was a habit and an instinct becomes so close as not to be distinguished." He concludes that, by natural selection, slight modifications of instinct which are in any way useful accumulate, and thus animals have slowly and gradually acquired through successive generations, their power of acting instinctively, and that they were not suddenly or specially endowed with instincts. Herbert Spencer defines it as compound reflex action, and also as "a kind of organized memory," arguing that instinctive actions grow out of reflex, and in time pass into intelligent acts. Romanes defines instinct as "reflex action into which there is imported the element of consciousness." Lloyd Morgan also says: "It is a bit of animal automatism not necessarily involving more than the lower brain centres," but it is a bit of automatism accompanied by a consciousness in a broad sense. "The role of consciousness in a chick's pecking is to select the adequate responses, and to steady the muscular mechanism to its work." As the result of recent experiments Loeb regards instincts as inherited reflexes so purposeful and so complicated in character that nothing short of intelligence and experience could have produced them. Packard gives the following definition: "The sum of inherited reflex acts, becoming habitual and arising from blended reflex and subconscious though involuntary acts, performed at birth or through life blindly, without practice or previous experience, effort, training or thought."

Examples.— It should be understood at the outset that instincts in animals are fundamentally connected with the means of obtaining food, or with reproduction, the latter involving care for the young, as in egg-laying, the selection of a nesting place by insects and birds, the construction of the nest, and the defense of the young, and in the birds and mammals the training of the young to fly, or to hunt for prey.

Reflex acts are simply physiological responses to external physical stimuli, as muscular irritability, the different tropisms, such as response to odors, and other chemical properties, to cold, heat, etc. Many of the movements of the lowest animals, as the protozoa, sponges, polyps, worms, etc., their modes of selecting and getting food, of escaping their enemies, are scarcely more than reflex. As examples of instinctive acts are those of very young chicks. Morgan regards as instinctive in these birds the act of "pecking, walking, scratching themselves, preening their down and feathers, stretching up and flapping their wings, squatting down and dusting themselves, scattering and crouching when alarmed, uttering the danger-warning *churr,* and other sounds." Young ducks afford examples in the way they "seize and mumble their food in the bill, their aptness in swimming directly on leaving their shell, piping, and smoothing the down of their breast with their bill."

It is when we observe the complicated nesting habits of the spiders, and of the social insects such as ants, wasps, bees, as well as those of birds and the muskrat and beaver, when such striking and inexplicable forms of intelligence arise that we become perplexed how to explain them. Thus take the mode in which the honeybee builds its cells. Is it simply mechanical, the result of several bees working together, and due to the mechanical pressure of the insects against each other during the formation of the cell? While some contend that if left alone to build a single cell, this would probably be round, others show that a solitary wasp will build its cells in very regular hexagons. It is now conceded by Darwin, Romanes, and others, that the process is not a purely mechanical one, but is "constantly under the control of intelligent purpose." It is most probable that the hexagonal-cell building instinct is the result of habits which gradually arose, and which became fixed by heredity. In birds the modifications sometimes occurring in the shape and situation of their nests show that their instincts are, owing to change of conditions, plastic, reason teaching them to modify their nests so as to adapt them to new conditions. Experience and intelligence lead to such changes. The beaver manifests in his works intelligence and reasoning capacity, both in the construction of dams, canals, and in the mode of felling trees, and in the use in certain localities of "slides." In the monkeys and apes we apparently have the nearest approach to human intelligence, judging by the instances narrated by Romanes. Were it possible to breed apes for many successive generations more light would be thrown on their psychology. Meanwhile many acts performed by the domestic animals, the horse, dog, cat, elephant and even the pig, and their susceptibility to be trained, show that they may often act intelligently, and are prompted by a low degree of reason.

Instincts Variable and Sometimes at Fault.— Lemmings in their migrations, impelled by their instincts to go ahead, will swim out into the sea and be drowned. Ants will store up beads instead of seeds, and there are many instances where instinct is at fault. Certain instincts may also by change of the environment become directed into new channels. This is illustrated by numerous cases of insects, reptiles, and mammals which have become adapted to an aquatic life. An entire new crop of habits and instincts may thus arise. The instincts of young animals, particularly of larval forms, caterpillars, grubs and maggots, are of a different description from those of the pupa state, and more especially of the adult state. In fact, instincts are pliable, variable, and in certain cases may lapse altogether, to be replaced by a new set. Were this not the case we should have no progress in the evolution of life. The more generalized animals have vastly less intelligence than the highly specialized forms. Compare the instincts of so complex a being as the ant, or wasp, or bee, with that of the locust or bug, or the instinctive and intellectual acts of social insects, with their wonderful differentiation of the individual into workers of different castes and the normal and supplemental males and females. Such are what are called complex instincts, and they are all brought into action through the principle of the division of labor.

Do Animals Reason? — Lloyd Morgan observed that the chick rapidly profits by experience after a few practical trials; hence he concludes that intelligence is founded on experience. He allows that chicks have intelligence, this involving the association of impressions and ideas, and the power of making a choice. He then asks the question, "Do animals reason"? "Do they focus the therefore"? "Do they think the why"? Probably not. Reason is not (as animals "reason") adaptation; they do not profit by experience of actions to varying circumstances. Hence, he thinks that animals probably do not reason as man is capable of reasoning. Here might be quoted Herbert Spencer's definition: "Reason or intelligence is the faculty which is concerned in the intentional adaptation of means to an end." Finally, it is safe to assume that the higher animals, especially the domestic animals, which have been in contact with and more or less trained by man, exhibit the germs of reason, and while they cannot make inductions and deductions or predictions, their intellectual acts differ rather in degree than in kind from those of the lowest human races.

Consult: Romanes, 'Animal Intelligence' (1883); 'Mental Evolution in Animals' (1884); Morgan, 'Animal Life and Intelligence' (1890–1); 'Animal Behavior' (1900); Loeb, 'Comparative Physiology of the Brain' (1902).

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In'stitute of France, a learned body organized after the first outbreak of the French Revolution, during which all the academies of learning and arts in France had been suppressed. It was formed by the decree of 25 Oct. 1795, to replace the Académie Française, the Académie des Sciences, and the Académie des Inscriptions et Belles-Lettres. Its object was the advancement of the arts and sciences by continual researches, by the publication of new discoveries, and by a correspondence with the most distinguished scholars of all countries, and especially by promoting such scientific and literary undertakings as would tend to the national welfare and glory. The Institute was composed of a number of members residing at Paris, and an equal number of associates in the different parts of the Republic. Each class could also choose eight learned foreigners as associates. It was at first divided into three classes, each of which was subdivided into several sections. The first class embraced the physical and mathematical sciences, the second the moral and historical, and the third literature and the fine arts. The number of active members, exclusive of the associates, was limited to 144. The Institute received, however, its final organization by a decree of 23 Jan. 1803. It was then divided into four classes: (1) the class of the physical and mathematical sciences, consisting of 65 members; (2) the class of the French language and literature, consisting of 40 members; (3) the class of history and ancient literature, of 40 members; (4) the class of the fine arts, with 28 members. A royal ordinance of 21 March 1816, restored the former names of the classes, so that the name of Institute was applied only to the whole body collectively. The same ordinance assigned the first rank to the Académie Française, as being the oldest; the next rank to the Académie des Inscriptions et Belles-Lettres: the third to the Academie des Sciences: and the last to the Académie des Beaux-Arts. These united academies were under the personal direction of the king, and each had an independent organization. To each academy were attached 10 honorary members, who had merely the right of being present at the meetings. In 1832 the old class of Sciences Morales et Politiques was reconstituted as a separate academy, so that there are now five academies.

The Académie Française had for its chief object the cultivation of the French language, and was charged with the composition of a French dictionary, the merits of which have been often disputed and its plan condemned. The disposal of its vacant chairs has not always been regulated by the best taste and judgment, Descartes, Pascal, Molière, La Bruyère, J. J. Rousseau, Balzac, Dumas père, Daudet, and Zola having been rejected, while in former times many a shallow court favorite was accepted.

The Académie des Inscriptions et Belles-Lettres has 40 members, 10 free academicians, and 8 foreign associates. It has 40 correspondents at home and abroad, and devotes itself chiefly to subjects of a historical nature. The most distinguished scholars, both in and out of Europe, are, or have been, connected with it. Committees of this academy superintend the erection of public monuments and the preservation of those already in existence. Works brought out under its auspices are: 'Histoire littéraire de France,' 'Recueil des Historiens de France,' and 'Corpus Inscriptionum Semiticarum.'

The Académie des Sciences has for its province the various branches of knowledge connected with the physical and mathematical sciences, natural history, medicine, etc., there being in all 11 sections. It has 66 members, 10 free academicians, and 100 correspondents. The number of foreign associates is limited to eight.

The Academie des Beaux-Arts has 40 members, 10 free academicians, 10 foreign associates, and 61 correspondents. A committee of this academy was charged with the publication of a dictionary of the fine arts.

The Académie des Sciences Morales et Politiques, has 40 members, 10 free academicians, 6 foreign associates, and 48 correspondents.

Members of the Institute of France are elected for life by ballot, and have an annual salary of 1,500 francs.

Institute of Social Service, American. See Social Service.

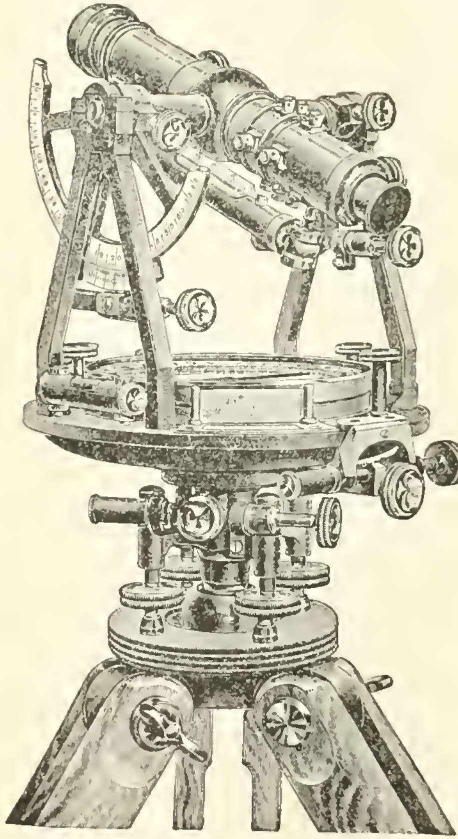
Institutional Church, a non-credal organization of Christians, to supplement the regular church methods and ministrations — preaching, prayer-meetings, Sunday school, and pastoral visitations — by helpful social work in the community. The moving spirit is the same as in the Y. M. C. A., University Settlement, Salvation Army, Rescue Missions, Christian Endeavor societies, etc.; but "with the emphasis on Church, not Institution." The prime object is to reannex to the church the functions which other bodies have been compelled to fill by its neglect of its duty: and strengthen it by gathering potential Christian elements which under the old system do not come to it, as well as by combining in itself all the claims to public gratitude and interest now shared between the purely ecclesiastical and the purely social institutions, or the half-way houses like the Y. M. C. A. It differs from the latter in not merely furnishing a religious atmosphere which may lead to church membership, but enrolling members at once in a real church of Christian work by absorbing the secular features of the other: in a word, to do, without vows or uniforms, what the Catholic Church has always done with its charitable functions — make them an integral portion of the church organization. Hence, it is not by itself a church in the sense of the Roman Catholic or the Methodist Church, but in a broad sense a description of any church which adds educational or social work: in general use, a title of any which throws into this work its predominant vitality. Free pews are an essential accompaniment, as the social aristocracy fostered by rented pews contradicts the basal democratic principle of institutional work; hence it is sometimes called Free Church, but preferably Open Church. The present name originated with President Tucker of Dartmouth College, who applied it to Berkeley Temple, Boston.

The movement started chiefly with the High Church element in England, modeled on the Catholic idea: it flourished for two generations in that country before reaching the United States, about 1880, and it has hardly been a vigorously spreading one here for above 15 years. Now, however, a large number of churches — Episcopal, Congregational, and Baptist in the forefront, but also Methodist, Presbyterian, Unitarian—have adopted the idea with increasing vigor, besides the work of this class always performed by the brotherhoods and sisterhoods of the Roman Catholic Church. One of the earliest of these was Plymouth Church of Indianapolis, inspired by the memory of Mr. Beecher. Notable among others are the St. Bartholomew, St. George, St. Paul, and Judson Memorial of New York, and the Tabernacle of Jersey City: Berkeley Temple, Parker Memorial, and Ruggles Street Baptist of Boston; Grace and Bethany of Philadelphia: Ninth Street of Cincinnati, Pilgrim of Cleveland: Plymouth Tabernacle of Detroit: People's of St. Paul: and the Denver Tabernacle. In 1894 the Open and Institutional Church League was organized in New York: it held several conventions in Eastern cities (1895–1901), and for three years published the 'Open Church' as its organ, but has practically lapsed, being merged in the 'National Federation of Churches and Christian Workers.' The total of its work, however, is not shown by its nominal membership; the same spirit has infected outside churches, and their methods are being more and more adopted as a general basis of work.

The platform of the League stated that it aimed to save all men by "abolishing, so far as possible, the distinction between the religious and the secular"; by "open church doors for every day and all the day, free seats, a plurality of Christian workers, the personal activity of all church members, a ministry to all the community through educational, reformatory, and philanthropic channels, to the end that men may be won to Christ and his service, that the Church may be brought back to the simplicity and comprehensiveness of its primitive life." It is not correct to say, as is often done, that its methods are purely secular: its *additional* methods beyond the regular religious ones are so, for the very reason it exists. These involve a thorough organization for social and philanthropic work; but the religious features are sedulously conserved and carefully fitted to the work, the spirit of worship being cherished and made the centre of inspiration. The service generally ends in the communion; there is congregational singing of both hymns and chants, led by a highly trained choir, and often responsive readings; the whole with the sermon are intended to be brief, varied, and attractive. Sunday schools are carefully attended to; prayer meetings given new features; in summer there are open-air meetings; and other Christian associations, endeavor societies, brotherhoods, etc., are encouraged. The officers and workers of the church are given active special duties, such as pastoral visiting, reception and welcome of strangers, canvassing for the various activities of the church; and there are not only sub-pastors, but deaconesses, sisters, and nurses. The purely secular side embraces all departments of culture, physical, intellectual, and moral, as well as direct charities. Morally, the church work above should be sufficient. The charitable departments include not only direct aid to the poor, but wood-yards, employment bureaus, etc.; personal endeavor to provide employment for those willing to work; dispensaries, hospitals, and crèches; and encouragement to thrift by savings funds. Special buildings are often erected.

That the movement is liable to perversions is admitted; such is the case with every institution. Secularization is one; but unless it can be faced, the churches cannot influence or draw in those outside them, for the simple reason that the latter cannot be brought within hearing. Sensationalism, to draw in hearers to be benefited, is a graver one, and ill-judged; as one of its chief workers puts it, "a camp-stool congregation neither pays nor repents," and a lasting work must be content with slower processes.

Instruments, Engineering. To attempt a definition of an engineering instrument is hardly practicable, as the wide range of departments into which the profession is now divided demands so many special appliances for their requirements that no one description is possible, and an extended catalogue is inadmissible within the limits of this article. The earliest known engineering instrument was the Diopter of Hero of Alexandria, 130 B.C., although rude appliances must have been used long before that time by the ancient engineers in the construction of the public works of Chaldæa and Egypt, the ruins of which even now awaken our admiration and wonder. It was not, however, until the beginning of the 19th century that the great impulse to the construction and use of engineers' instruments was given by the advance of civilization and commerce incident to the application of steam as a motive power on sea and land. Since that time great advances have been made not only in the design and accuracy of engineering instruments but also in the invention of new instruments for the many purposes required by engineers in the construction of railroads, canals, bridges, harbors, etc.



The characteristics of engineers' instruments differ in the various nations as the requirements of engineering practice, and thus American engineers' instruments possess a distinct character of their own as compared with other nations, having as a rule few parts and lightness of construction combined with great strength and an adaptability of parts for the special service required. It is not the purpose of this article to attempt a description of the various instruments used by engineers — this may be found in the article SURVEYING,— but to give the reader a general idea of their construction. The metals used in the construction of engineers' instruments are principally the alloys of copper and tin with small quantities of silver, aluminum, and German silver. Great care must be constantly exercised that these substances be free from iron or other material which would affect the magnetic needle. In the construction of an instrument such a distribution of the metals is aimed at that the greatest strength consistent with light weight may be obtained and that the metals coming into contact at the bearing surfaces may be of such varying composition as to cause the least friction.

Take, for the purpose of better illustration, an American transit, illustrated herewith, as typical, as far as the construction is concerned, of nearly all engineering instruments. The plate of the instrument on which the magnetic needle is mounted, or, as it is termed, the compass circle, is turned with great care so that the surface may be absolutely true, and is graduated usually into 720 spaces, each representing one half of a degree.

Compass circles are usually figured in quadrants of a circle, that is, from 0 at the point marked "N" or "North" to 90 and back again, while the figuring of the limb varies with the custom of the maker or the requirements of the engineer.

In engineers' instruments, however, the angular measurements are made usually without the use of the needle, by a telescope so mounted as to revolve in a vertical or a horizontal plane. The angular measurement of its movement being indicated on circles divided into fractional spaces of a degree and read for convenience to finer spaces by one or more verniers. Accuracy of graduation of the compass circle, and especially of the limb, is essential to the perfection of the instrument, and great pains are taken by manufacturers in perfecting and improving engines for graduating. The best machines are automatic in action and the spaces are so accurately laid off that there is no appreciable error in the finished work. The instrument rests on the socket or bearing surface to which the compass plate and limb are attached; the surfaces of the socket must be so accurately fitted together as to produce no error when the parts are moved on each other. The socket is mounted on a leveling head, which is actuated by three, or in the usual American practice, by four leveling screws, as shown, by means of which the instrument can be accurately leveled. Upon the compass plate are placed the standards which support the telescope, the preparation of the optical parts of which is next in importance to the fitting of the socket and the graduation.

The telescope consists of an eye piece and object glass mounted in a tube. The eye piece is simply a magnifier of the image produced at the focus of the object glass. Two kinds of eye pieces are used, one showing the image erect, and the other showing the image inverted. The object glass is composed of two plates of optical glass of such specific gravity and refractive index that it will magnify the image clearly without prismatic colors. To secure achromatism the two parts of the object lens are made the one of crown and the other of flint glass, the crown being a light glass of soda and silica and the flint being a heavier glass containing potash and lead. The surfaces of each are curved to such a degree that the rays of light entering the object glass may be properly refracted and concentrated at a point called the focus.

The making of the lenses is an operation requiring much skill in manufacture, as upon the accurate grinding of the curved surfaces depends the quality of the telescope.

At the focus of the object glass are placed the cross-wires, which are filaments of spider web or very fine platinum. In conjunction with these are often used two more wires commonly called stadia wires, so placed that they intercept on a rod a space proportional to its distance from the instrument, thus furnishing an efficient method of ascertaining distances directly by the observer. The metal parts of the instrument, having been prepared, are polished with some suitable material, a preparation of rouge being generally used for finishing the surface of the screws, and the larger surfaces being finished with fine emery paper. The larger parts are usually colored dark to avoid reflection of the sun, while the smaller ones, such as screws, etc., are left bright in order that there may be a pleasing contrast between the different parts of the instrument. The parts, prepared as above, are covered with a thin coat of lacquer, a preparation of shellac and alcohol, applied after heating. All the parts are assembled and fitted together, and the instrument is then ready for the final complete adjustment. This consists in fitting the sockets so that they will move freely on each other, placing the compass plate and limb in position on the sockets, making the limb truly concentric with the socket and placing the vernier in position. The telescope must be so adjusted that its parts may work freely, and having been supplied with optical parts, etc., it is then fitted to the standards or supports previously placed in position on the compass circle. The whole instrument is then tested for accuracy and if found correct is packed in its case and is ready for use.

The above description is only intended to give a general idea of the construction of a typical instrument, but in the same methods will practically apply in the construction of all engineering instruments, such as levels, plane-tables, the various kinds of compasses, etc.

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In'sulator, a body used to separate an electrified conductor from other bodies, and which offers great resistance to the passage of electricity. Glass, shellac, resins, sulphur, ebonite, gutta-percha, silk, and baked wood are notable insulating materials. Wires in which currents of electricity are passing are often arranged in coils. To prevent the lateral passage of electricity from one coil to another, the wires are usually covered with silk and shellac. Insulators on telegraph poles, to which the wires are attached, are usually made of porcelain, glass, or stoneware. Underground telegraph wires are usually of copper, insulated by means of a coating of gutta-percha or india-rubber, and protected by tape or iron wire, metal tubes, or wooden troughs filled with bitumen. The core of a submarine cable consists of a copper wire insulated by a covering of gutta-percha whose weight is greater than that of the wire. See Electricity (*Conductors and Insulators*).

Insur'ance, a contract by which one party, for a stipulated consideration, undertakes to indemnify or compensate another party against loss by certain specified risks. The party undertaking to make the indemnity is usually called the insurer or underwriter, the other the insured or assured; the agreed consideration is termed the premium; the written contract, a policy; the events or causes of loss insured against, risks or perils; and the thing insured or the subject to be protected, the insurable interest. Marine insurance relates to property and risks at sea; insurance of property on shore against fire is called fire insurance; life insurance, in its widest sense, is a contract entered into by the insurer to pay a certain benefit contingent upon the duration of one or more lives. Besides these classes of insurance there are many others; the traveler may insure himself against loss entailed from damage by rail or sea; the farmer from the inroads of disease among his live stock; the employer from the fraud of a dishonest cashier, etc.

The practice of marine insurance seems to have long preceded insurances against fire and upon lives. It is impossible to state the precise period of its introduction, but it is probable that it dates from about the beginning of the 15th century; though it is contended, on the authority of certain ancient writers, that traces of this form of insurance are to be found among the Romans. Some Anglo-Saxon guilds insured their members against loss from fire, water, robbery, etc. Commercial insurance, however, seems to have originated in Flanders about 1300, although priority is claimed for both Italy and Spain. It is probable that insurance was introduced into England by the Lombards early in the 16th century, but few court cases pertaining to it are found till the middle of the 18th century.

In Great Britain fire insurance has been practised for over two centuries, but on the Continent its introduction dates considerably later. The history of life insurance, as well as that of various other forms now in practice, belongs to a still later time. For the history and development of the principal insurance systems in this country, see INSURANCE, MARINE; FIRE INSURANCE IN AMERICA; INSURANCE, LIFE, IN AMERICA; INSURANCE, FRATERNAL.

Insurance, Accident. See ACCIDENT INSURANCE.

Insurance, Casualty. The definition of the word casualty is, "chance, or what happens by chance; accident; contingency; an unfortunate chance or accident, especially one resulting in bodily injury or death," etc. The term Casualty Insurance is commonly held to include those forms of indemnity providing for payment in case of bodily injury or death, or for loss or damage to property (except from fire or the elements), resulting from accident or some other such unanticipated contingency. The four great headings into which this insurance is usually divided are Personal Accident, Liability, Steam Boiler, and Plate Glass.

Personal Accident Insurance.— The first of these to be introduced into this country was personal accident insurance which had flourished, in a limited way, for many years in Europe, but was not attempted here until 1863. The pioneer of accident insurance in America was James Goodwin Batterson of Hartford, Conn., who, while traveling in England in 1859, learned of accident tickets insuring against injuries or death resulting from railway accidents and purchased one of these tickets in going from Leamington to London. Being at once impressed with the possibilities of developing this idea to include all forms of accidents in place of travel accidents only, he consulted with many well-known English insurance experts on the subject, all of whom with the exception of the famous statistician, Walford, expressed grave doubts as to the feasibility of the scheme. However, Mr. Batterson came home determined to make the experiment and in 1863, the first American accident insurance company was organized at Hartford, Conn. There is reliable authority for the statement that the first contract made by this company was a verbal contract entered into by the president of the company with a citizen of Hartford, whereby in consideration of a premium of 2 cents, the company agreed to become liable in the sum of $5,000 in case of accident to the assured while journeying from the post-office to his home on Buckingham Street. The second contract was a more formal one and was issued in consideration of $1 to protect the assured against loss of life or personal injury while journeying from Hartford to Washington, D. C., and return.

An accident policy is a contract of insurance against loss of life, limbs, sight, or time through bodily injuries effected solely by external, violent, and accidental means. The full amount of the policy is payable in case of death, or for the loss of both hands or both feet, or both eyes, or one hand and one foot. Proportionate amounts are payable for the loss of one hand or one foot or one eye, and a fixed sum is payable per week during the term of temporary disability.

The first rates, based upon the statistics of the English companies proved inapplicable to American conditions and accident insurance had a hard struggle to obtain a legitimate foothold on American soil. However, a series of catastrophes by land and sea in the following two or three years emphasized the importance of this form of protection, and little by little the business became more firmly established. During this time about 70 companies started, but all either failed or were absorbed by the pioneer company, which held the field for many years alone.

Gradually, however, other companies were organized, each newcomer profiting by the experience of its predecessors until on 1 Jan. 1904 25 stock companies were writing accident and health insurance in the United States, with aggregate premiums amounting to the enormous sum of $13,337,000. The first accident policies were very primitive affairs compared with the elaborate and almost unlimited contracts of to-day. In the early times, policies covered merely loss of life, limbs, or total disability, conditions were numerous and technical, and policies for small amounts were the rule. Gradually, however, the competition of progressive and aggressive underwriters made itself felt in the broadening of the contract. One of the first important changes consisted in extending the period of weekly indemnity from 26 to 52 weeks. Some of the more conservative companies hesitated for a long time to follow this lead, but the pressure proved too great and they were finally forced to acquiesce. The policies of the leading companies have now reached the limit of liberality on this point by providing for the payment of weekly indemnity in a sum equal to the principal sum insured. One of the important innovations was the introduction of the combination policy, covering not only all of the features of the regular policy, but giving double benefits for accidents happening in or on a moving conveyance using steam, electric or cable power and provided for the use of passengers. This clause was later extended to include accidents in elevators and burning buildings, as well as in any vehicle used as a carrier of passengers, such as carriages, coaches, omnibus lines, and the like.

During this period of evolution, other changes were taking place. Conditions and agreements, that for years had been considered indispensable, began to disappear one by one. The fundamental theory that accident insurance was indemnity for loss of income, resulting from total and absolute disablement, was qualified by the broader and more flexible rule of partial disability, whereby a varying percentage of the weekly indemnity called for by the policy became payable in case the assured was not totally disabled, but was partially prevented from attending to his business duties. This payment was fixed at 50 per cent by some companies, irrespective of the nature and extent of the partial disablement, whereas other companies adopted what may seem to be a more logical basis, providing for not less than 25 per cent, nor more than 75 per cent of the weekly indemnity, depending upon the special circumstances of each case. Other important concessions were made by the elimination of conditions that had been deemed a *sine qua non* to the safe and proper conduct of the business. One of the principal of these conditions was that "injuries, of which there is no visible mark on the body, the body itself in case of death not being deemed such a mark," were not covered by the policy. Others were the exclusion of accidents from "sunstroke or freezing; from injuries intentionally inflicted upon the insured by himself or by any other person, injuries from unprovoked assault excepted; from voluntary overexertion; violating law; violating rules of a corporation; voluntary exposure to unnecessary danger, expeditions into wild or uncivilized countries," etc. Many of these exceptions were reluctantly abandoned by the companies, oftentimes only after long and expensive litigation, the result of which was usually against the company.

The policies now issued by most of the companies are entirely free from all of the above-named conditions and are practically "conditionless," save as to the methods of reporting and adjusting claims. It was, however, not until 1890 that the most radical innovation yet to be introduced into the business of accident insurance was brought forward in the shape of health and disability insurance. It was perhaps but the logical sequence of events that after perfecting the accident policy to the point of the greatest liberality, the demand should make itself felt for insurance against "all the ills that human flesh is heir to" and underwriters in America again turned to their European neighbors, who had already taken the initiative. Sickness policies had become quite widely introduced into many Continental countries before that time and the system of compulsory insurance against accidents and sickness had been successfully instituted by many European governments. It is true that as early as 1847 sickness insurance was attempted in America, by the organization of companies in Massachusetts and Pennsylvania, but these companies, after brief and unprofitable careers, gave up the struggle, and nothing further was attempted in this way until about the year 1896. At this time a rider to accident policies, covering about eight diseases, was adopted by one or two companies. However, the statistics available on sickness insurance did not make the business appear very attractive, and hence, during the first year or two after its general introduction into the United States, few companies were prepared to assume the risk and then only from a limited number of diseases, about 15, comprising a few of the more prevalent forms, the balance being contagious and rare diseases. Soon, however, competitors entered this field and the number of diseases covered was increased to 30, and upwards, until finally all ordinary diseases were included under the policy. At first, a health policy was not issued alone, but was combined with the accident contract, the two constituting disability insurance. Many of the leading companies still adhere to this practice; others issue the so-called unlimited health policy alone, but do not write the limited health contract, which covers a specified list of about 30 diseases, except in connection with an accident policy, while a very few companies still issue either form of health contract separately.

The introduction of disability insurance was the signal for a still further broadening of the benefits and conditions under accident contracts. The most important of these benefits are the "Schedule of Operations," providing for a fixed sum, in addition to weekly indemnity, to cover the cost of a surgical operation for any of the injuries listed in the schedule; the "Schedule of Indemnities" providing for a specified sum to be payable in lieu of weekly indemnity for any of the injuries enumerated, and the "Accumulation Table" providing for a 10 per cent increase in the principal sum insured on each annual renewal until this accumulation amounts to 50 per cent of the original sum.

A startling innovation in the year 1903 consisted in the insurance of the beneficiary, without extra charge, in addition to the policy holder. This was limited, at first, to indemnity for loss of life from travel accidents, including accidents in elevators and burning buildings. However, this was extended in 1904 to cover loss of limbs as well, from accidents above described. It is difficult to predict what limit will be reached by the companies in the eager contest for business, unless a standard policy is adopted by agreement or through legislative enactment.

The figures for 10, 20 and 30 years of premiums written and losses paid, give some astonishing results. From 1873 to 1883, premiums amounted to $11,029,385 and losses to $4,221,616. From 1883 to 1893, premiums were $30,997,822 and losses $13,904,155, or an increase of 181 per cent in business and of 229 per cent in claims. From 1893 to 1903, premiums amounted to $64,-832,874 and losses to $28,686,686, or an increase of 109 per cent in business and of 106 per cent in losses over the previous 10-year period, and an increase of 487 per cent in premiums and of 580 per cent in losses over the first 10-year period. These figures speak eloquently of the enormous strides already made by accident insurance in America, and are but a forerunner of the growth and development that can reasonably be expected in the future.

Liability Insurance.— Liability insurance is of comparatively recent origin, and was unknown in America prior to 1887. As in the case of accident insurance, the business was first exploited in Europe, and its real development began after the passage of the English Employers' Liability Act of 1880. From time immemorial, the liability of employers for injuries caused by or suffered by their employees in the course of employment has been a part of the Common Law of all civilized nations. An eminent authority states that, as early as 1500 B.C. the Jewish law provided that "if a master were the means of causing the loss, either intentionally or unintentionally, of the eye or of the tooth of his slave, he was bound to let him go for his eye or his tooth's sake." And again, according to this same law, "if an employer allowed his ox to gore either his servant or a stranger, he was required to pay various compensations to the injured if he survived, or to his relatives in the event of the injury being followed by death."

Under the Roman law, a master was responsible not only for injuries suffered by his employees if due to his own negligence, but under the legal maxim, "Respondeat Superior," was liable for any personal injury sustained by a third person, due to the wrongful acts or omissions of his servants, acting as such and within the regular scope of their employment. The legal obligation to employees was expressed in the maxim, "*sic utere tuo, ut alienum non laedas*"; but the rule became subject to two important exceptions; firstly, that if the person injured and the one causing the injury were fellow-servants, the master was relieved from liability for the injury; secondly, under the doctrine of "*volenti non fit injuria*," if the person injured had actual knowledge or the means of knowing of and understanding the hazards incident to the employment and then voluntarily accepted the service, he was deemed to have assumed all the usual and ordinary dangers of the work and in case of injury, resulting therefrom, no recovery could be had against the master.

The passage of the Liability Act of 1880 by the English Parliament resulted in the organization of a number of companies for the protection of employers against the provisions of the act as well as against the expenses of litigation arising out of claims and suits instituted by employees for injuries sustained.

In 1887, the State of Massachusetts passed an Employers' Liability Act, fashioned to a great extent after the English statute, but with such changes and modifications as were necessary to suit the changed conditions.

One of the English companies then in successful operation abroad, deeming the time opportune to extend its field to America, determined to establish an American office and selected Boston, doubtless because of the existence of the act above referred to. It is stated that the local agency for the American branch was offered to various prominent insurance agents of Boston, but was declined by each in turn, as both the company and the class of business were unknown and there appeared to be no demand whatever for the kind of indemnity offered by the new-comer. It later became evident, however, that liability insurance had come to stay, and within the next few years a number of American companies were incorporated to carry on the business, and several foreign companies established American offices on somewhat the same lines as the first company had done.

During this early period, the business was entirely experimental and rates were constantly altered to suit the changing conditions, as they arose in the development of the various features of the insurance. At the outset, the indemnity was limited to employers' liability, under substantially the following form of contract: That the company, in so far as regards fatal or non-fatal injuries to any employee or employees of the insured at the place or places mentioned in the application, during the period covered by the premium paid or by any renewal premium, would pay to the insured or his legal representatives all such sums for which the insured might become liable in damages not exceeding the limits of liability stated in the policy, such payments to be made within one week after the receipt by the company of satisfactory proofs of claim. Soon, however, the insurance was extended to public or outside liability, whereby the insured was indemnified against loss in damages on account of common law or statutory liability for personal injuries suffered by any third person and due to the business operations of the insured or of his sub-contractors. This contract was limited for some time to contractors and builders, but gradually the demand arose for similar protection on the part of owners and lessees of buildings, which resulted in the further broadening of the insurance scheme to include general liability. This contract, briefly, provided indemnity to owners or occupants of hotels, apartment houses, office buildings and wholesale and retail stores "against claims for compensation for personal injuries to any person or persons whomsoever for which the assured may be legally liable, resulting from accident (fire excepted), happening to such person or persons on or about the premises of the assured, or caused by any of the horses or vehicles of the assured used in his or their business." It was further provided, that, subject to the limits of liability expressed in the policy in respect to any accident which should cause death or injury to any one person or to several persons, "the company will pay to the assured or his legal representatives, within one week after the receipt by the company of satisfactory proofs of claim, all sums for which the assured shall become liable for personal injuries caused and limited as aforesaid, during the period covered by the premium now paid or by any renewal premium, by virtue of the common law or any statute."

It was a comparatively short step from this contract to the issuance of separate policies covering liability for injuries caused solely by horses and vehicles, known as teams insurance, and for injuries caused by elevators, known as elevator insurance. Meantime a few of the companies were engaging quite freely in the insurance of common carriers' liability, covering "any and every accident to or caused by the cars, horses, plants, ways, works, machinery or appliances" used in the business of steam or street railroads, steamships, steamboats and ferries. It is but proper to say that this feature of liability insurance was looked on very unfavorably by the more conservative companies, and one of the companies engaging in the business notified its agency force after the disastrous results of this underwriting became first apparent in 1893 that "we are not now seeking to push these specialties, as we find competitors (particularly companies whose managers have a commission interest), doing such business at rates which can only be productive of serious loss. Railways we take only when the lines are short, and street railways not at all in great cities." But the handwriting was already on the wall, and in November 1893 one of the largest and most important companies was forced into bankruptcy, largely through the losses sustained on common carriers' liability. This placed almost an embargo on that class of business, only two or three companies continuing to issue such policies. Two of these later discontinued the business entirely, and the other, after a somewhat meteoric career, collapsed in 1897 with heavy liabilities and few assets. In March 1896 the first significant action was taken with a view of placing liability insurance upon a sound scientific underwriting basis in the shape of a conference of the leading companies held in New York. After a series of meetings and discussions extending over a period of several weeks, an organization was effected known as the Conference of Liability Companies. A bureau of statistics was formed, with a well-known underwriter in charge, and the work of compiling the experience of the various companies was vigorously taken up. Frequent meetings of the Conference were called at which the managers and officers of the various companies discussed the different phases of the business and compared experiences. Policy forms were analyzed and conflicting conditions either eliminated or reconciled. As a result of these meetings, and of the work of the bureau, a manual of rules and rates was promulgated in the summer of 1896 and standard policy forms were adopted shortly afterwards. From time to time thereafter manuals and supplements have been issued by the Conference companies altering rates already established and publishing new rates, these changes and additions resulting from the statistical work carried on by the bureau.

Logical development of liability insurance in America dates from the formation of the liability Conference. Standard rates and policies having been adopted, competition was reduced to practically legitimate methods, and for three years the business went on smoothly and grew rapidly.

This highly satisfactory condition of affairs was rudely disturbed early in the year 1900 by the withdrawal of one of the largest companies from the agreement, and while the Conference continued in existence, its usefulness was considerably impaired. Shortly after this time three foreign companies established American offices and two additional companies were organized in this country, and as none of these newcomers became members of the Conference, the situation grew more critical than before and the companies comprising the Conference came to be the minority, while they had formerly constituted the majority. Early in 1903 one of the smaller companies in the agreement withdrew, being unable to withstand the competition of the outside companies. At the beginning of 1904 the Conference consisted of five companies, while twelve companies were operating independently.

This great discrepancy in numbers has forced the Conference to become almost solely a bureau of statistics and there is little attempt made to the adherence of standard rates in cases of competition, which are of course the rule rather than the exception. In spite, however, of what might be termed these unsatisfactory conditions, the business has grown and developed astonishingly. From the inconspicuous beginning in 1887 already noted, liability insurance has in the comparatively short space of 17 years taken its place as one of the most important branches of underwriting in this country involving more technical and difficult features than almost any other kind of insurance business.

The liability policies of the present day are substantially the same with all companies, and are known respectively as Employers' Liability, Public Liability, General Liability, Teams Liability, Elevator Liability, Owners' Contingent Liability, Theatre Liability, and Marine Vessel Liability. The premium is based, in most cases, on the estimated annual payroll of employees, and is subject to adjustment at expiration of the policy according as the actual payroll expended is greater or less than the amount estimated. To ascertain this, the assured is required to render a payroll statement to the company which is usually verified by an audit of the assured's books.

Under the various forms of policies issued, protection against legal liability for damages on account of accidental death or injuries to employees and the public is afforded to manufacturers, and contractors, owners, lessees, and tenants of buildings; to owners and users of horses and vehicles, including automobiles, elevators, vessels and boats; to theatres, agricultural exhibitions and shows, and to owners and general contractors of buildings in course of construction. While at first the limits of liability were rarely in excess of $5,000 for one person injured or killed and $10,000 for two or more persons injured or killed in any one accident it is now quite common to provide double these limits and in fact the indemnity is often fixed at limits of $10,000 for one person and $50,000 for a number of persons injured or killed in one accident. These increased limits are due not only to the inevitable tendency of the courts in the majority of States to sustain verdicts for large amounts, but more particularly to the enactment of laws increasing and extending the liability of employers and others in cases of negligence. For example, in New York State the statutory limit for damages in case of fatal injury from negligence was $5,000 for an individual until this limit was removed by the legislature a few years ago, leaving the amount recoverable in such cases unlimited. In Illinois, likewise, the sum of $5,000 was formerly the maximum amount payable, but an act of 1903 increased the individual limit to $10,000. While it was rare to read 10 years ago of a verdict for $5,000, such amounts are now deemed quite reasonable in serious or fatal cases, and it is not unusual to find that verdicts of ten, twenty, and even fifty thousand dollars are sustained by the courts of last resort. In fact, legislation is playing a most important part in the evolution of liability insurance in this country. The Employers Liability Act of 1887 of Massachusetts, while the most important statute yet to be enacted on this subject, in America, has never been quite satisfactory and just as changes and amendments have been constantly suggested for the English acts of 1880 and 1897, so the legislators of the Bay State have attempted from time to time to extend and alter the provisions of their act. The latest effort in this direction, proposed in 1904, is known as the Workingman's Compensation Act and is quite revolutionary in its character so far as this country is concerned, for nothing of the sort has ever been attempted here before. In the words of an eminent member of Congress from Massachusetts, while discussing this measure, "One of the principal reasons for it is because there have grown up in this country, lawyers and doctors who combine together to hunt up trouble and cheat the injured person out of his money. Another great trouble and reason for the proposed legislation is the employee's habit of bringing suit at once, without trying to bring about amicable relations with the employer. As things are to-day, while employers frequently have to pay out large sums of money, in many cases the injured employee is not benefited. Now, an employee has to show that he received his injuries as the result of the neglect or fault of the employer. This new law does away with all of this and favors the compensation of an employee for the loss of an arm or other serious injury, whether the employer is to blame or not." The passage of the so-called Slater Act of 1902 by New York State was another step in the direction of absolute compensation to workingmen and it is only a question of time and probably a short time, when most of the important States will have legislated on this subject. Not only so, but there is some talk of a national act to be put forward by the United States government affecting these vital questions of the relations between capital and labor.

It may not be entirely utopian to believe that the ameliorating influences of these State laws either with or without a national statute will result ultimately in the more friendly and unselfish attitude between employers and employees and in the discontinuance of strikes and labor disturbances generally.

The growth of liability insurance has kept pace with the industrial development of this country during the past 15 years as will be noted from the following exhibit: From 1889 to 1893 inclusive, premiums amounted to $9,319,591 and losses to $3,838,665. From 1894 to 1898 inclusive, premiums were $20,535,668 and losses $10,084,319, or an increase of 120 per cent in income and of 162 per cent in claims. From 1899 to 1903 inclusive, premiums were about $50,000,000 and losses about $25,000,000 or an increase of 250 per cent in premiums and of 250 per cent in losses over the previous five-year period, and an increase of 437 per cent in premiums and of 552 per cent in losses over the first five-year period.

Steam Boiler Insurance.— The first steam boiler insurance in America was written in 1866, dating almost as early as accident insurance, and like that other branch of indemnity, it owes its origin in this country to the thrifty, practical citizens of Connecticut. It was, however, not until 1869 that the business became well established. At the close of that year total premiums amounted to $55,819, and total losses to $2,188, a modest beginning considering that for the year 1903, premiums aggregated about $2,000,000, and losses about $200,000, while the amount of insurance in force had grown from $5,000,000 to over $600,000,000.

For many years the pioneer company had a monopoly of the field, as, for some unknown reason, capitalists seemed disposed to leave this business alone, due, perhaps, to the slow growth of the premium income, as well as to the mechanical technicalities of the insurance.

At the outset, the form of contract was limited to indemnity for loss or damage to the boiler or boilers and other property of the assured, and to property of others for which the assured could be held legally liable, due to the explosion, rupture or collapse of the boiler or boilers. As a guarantee of the value of this indemnity, as well as a protection to the company against the insurance of old and unsafe boilers, a periodical inspection is made of each boiler during the term of the policy by an inspector of the company, and a written report is forwarded to the policy holder showing the condition of the boiler, recommending such repairs or changes as appear necessary, and stipulating the pressure under which the boiler can safely be run. Steam users were at first slow to grasp the many advantages offered by this new scheme, and engineers of plants strongly resented the reflection on their skill and management implied by some of the features of the insurance. Conflicts of opinion between the inspector of the company and the engineer of the assured were of frequent occurrence and oftentimes much hard feeling was engendered. Nothing daunted by these obstacles, the company vigorously pushed forward the business and at the end of the first 20 years the premium income had grown to about $1,000,000.

In the year 1887 another company was organized which gave considerable impetus to the business and introduced a new feature, namely, indemnity against loss from legal liability for fatal or non-fatal injuries suffered by any person or persons due to the explosion, rupture, or collapse of the boiler or boilers. From this time forward the business increased rapidly.

On 1 Jan. 1904 nine companies were engaged in the business of the insurance of boilers, tanks, dryers, rotaries, digesters, and other objects operated under steam pressure. Nearly 150,000 boilers were regularly inspected in 1903 and a small army of inspectors are maintained by the various companies at an annual expenditure of several hundred thousand dollars. Policies are frequently issued for as much as $100,000 limit for any one loss, and a limit of $50,000 is quite common. Notwithstanding the great number of objects insured annually, and the large limits of liability as above mentioned, serious explosions have been comparatively rare, and the average loss ratio of the largest company for 35 years has not exceeded 10 per cent per year. This showing would seem to indicate that there is an exceptionally large profit to be made in this branch of casualty insurance, but such is not the case, for owing to the inspection system before mentioned, the management expenses range from 60 to 85 per cent of the premium income. Some of the companies maintain in connection with the inspection department, a force of draughtsmen for the purpose of furnishing plans and specifications for new boilers, at the request of their policy holders or of prospective clients. This service is rendered without charge and adds somewhat to the already heavy expense of conducting the business. It is interesting to learn from the statistics of one of the companies, that from the beginning of their business to 1 Jan. 1903 the number of visits of inspection made was 1,815,405. The total number of boilers inspected was 3,508,838. The total number of defects discovered was 2,559,592, of which dangerous defects numbered 270,856, and 15,169 boilers were condemned as unfit for use. During the year 1902 the company made 142,000 visits of inspection, examined 264,708 boilers, condemned 1,004 boilers, found 145,489 defects, of which 13,000 were dangerous.

The total premiums of all companies during 35 years, to the close of 1903, amounted to nearly $25,000,000, and total losses to almost $2,500,000, and with the rapid increase in the number of new manufacturing plants throughout the country, and the general expansion of business, it is safe to predict that steam boiler insurance will develop much more rapidly in the next decade than in the past quarter century.

Plate Glass Insurance.— The first American plate glass insurance company was organized in New Jersey in 1868, but unlike the pioneers in the other casualty lines, this company does not rank among the leading companies in point of financial strength or amount of business written. In 1874, the first New York company was started, and from that year the business steadily increased in volume, total premiums for 1903 amounting to over $2,000,000, and total losses to over $800,000. There have been fewer changes in the plate glass policy than in any other of the casualty contracts, presumably because the business is less intricate and there has been no occasion to make many changes. Plate glass insurance provides indemnity on account of loss or damage caused by breakage of glass, provided that such breakage is the result of accident and due to causes beyond the control of the assured. No claim is paid, however, for breakage resulting directly or indirectly from fire, earthquake, inundation, insurrection, riot, or any military or usurped power, or from the blowing up of buildings or from alterations or repairs to the premises. While for years the insurance was limited almost entirely to what is known as plain plate glass, many different kinds of glass, such as bevelled, mitred, cathedral, leaded, chipped, bent, Florentine, jewelled, ribbed and wired glass are now insured freely by all companies

In 1900 plate glass underwriters were confronted with an entirely new proposition in the shape of clamped or patented plate glass, resulting from riveting the sides and tops of plate glass together without the use of wooden frames that before that time had been indispensable. The rates formulated for patented glass were at first entirely inadequate and the companies lost a considerable sum while experimenting with the subject. Not only was there great trouble and delay in having broken glass replaced, but the patentees, having a monopoly, were disposed to secure the full benefit from the product of their ingenuity As a result of these conditions, the companies placed an almost prohibitive rate on all patented glass in the hope that they could successfully taboo that kind of risk, but the public demand for it was too great and patented glass has come more and more into general use. However, near the close of the year 1903, the leading companies found that the experience with patented glass had been more favorable than had been anticipated, and, as a result, the rate was materially reduced.

Plate glass insurance is now almost as general as fire insurance, and while the average premium is small, the business has assumed very considerable proportions. During 30 years ending 31 Dec. 1903 total premiums amounted to over $20,000,000, and total losses to over $8,000,000. Fifteen stock companies were on that date engaged in the business, in addition to numerous local mutual companies located in various parts of the country. From time to time in the past 10 years, compacts have been formed between the largest companies for the purpose of regulating rates, and establishing sound underwriting practices. Unfortunately, however, these agreements have been of comparatively short duration and as oftentimes happens in similar cases, the demoralization following the termination of the compact has been even greater than before it was made.

It is difficult to predict what will be the final outcome of the admittedly unsatisfactory state of affairs prevailing in plate glass insurance, with rates low, commissions excessively high (sometimes as much as 50 per cent), and the cost of replacements increasing, unless the companies form a national compact and place the business upon a logical underwriting basis. One company heretofore writing plate glass insurance alone, decided early in the year 1904 to add a personal accident department, and it is probably only a question of time when every company engaged in this one line of business will be forced either to add other lines of insurance, or to consolidate with other companies engaged in the same business.

Sprinkler Leakage Insurance.—While not constituting one of the main divisions of casualty insurance, this form of policy is written to a limited extent by two of the casualty companies, as well as by some fire insurance companies. The contract covers loss or damage to the building and contents caused by the accidental discharge or leakage (except from fire) of the sprinkler equipment erected in or on the premises. The premium, based at a varying rate, depending on the class of merchandise covered, is predicated upon a certain percentage, usually 10 per cent, of the cash value of the building, stock, and machinery. Sprinkler leakage insurance has been in vogue only nine years in America, during which period the total premiums have not amounted to any considerable sum. There is, however, a slow, steady growth of the business, due to the wider use of sprinklers in mercantile and manufacturing plants, principally in the Eastern and Middle States.

Fly-wheel Insurance.—This is one of the less important branches of casualty insurance and is of recent origin in this country. One company alone is engaged in the business at this time, and hence the statistics are limited. The contract covers loss caused by the explosion, bursting, or disruption, during rotation of the fly-wheels or any of them, first for loss upon the fly-wheel or fly-wheels and upon other property of the assured; second, for loss from liability of the assured for loss upon property of any other person or persons; third, for loss from liability of the assured for bodily injuries or death sustained by any person or persons. Fly-wheel insurance is more or less allied to boiler insurance, and the limits of the company's liability in case of loss, as well as the rates of premium and the methods of handling the business, are very much the same as in boiler insurance. The insurance against breakage of machinery in general is being introduced to some extent in one or two European countries, but has not yet been attempted in America. There appears to be a field for such a policy, and doubtless the indemnity will be offered by some American company before very long. In fact, at the present time, a few corporations are engaged in the business of insuring the maintenance of electric machinery and of making the repairs found necessary from a periodical inspection of the premises or plants.

Physicians' Liability Insurance.—This is another of the modern schemes in casualty insurance, and provides indemnity against loss from common law or statutory liability for damages on account of bodily injuries fatal or non-fatal suffered by any person or persons in consequence of any alleged error, mistake, or malpractice by the assured in the practice of his profession. The limits of the company's liability are uniformly $5,000 for one person injured or killed, and $10,000 for any number of persons injured or killed during the term of the policy. Naturally, the moral hazard is the main consideration in a contract of this nature, and, while a fixed premium is charged, a careful selection is made by the conservative companies of the risks offered.

Taken all in all, the field for casualty insurance is an ever widening one, and the vast interests involved have given to this branch of indemnity a place in the front rank of insurance schemes. The magnitude of the business, the great scope of the contracts, the elaborate and comprehensive machinery required to properly conduct the affairs of these great corporations, can best be understood and appreciated when it is known that during the period in which the various lines of casualty insurance heretofore enumerated have been written by the total premiums have exceeded $221,000,000, the total losses have been more than $88,000,000, and the total amount of insurance in force on 1 Jan. 1904 was estimated at the bewildering sum of over $5,000,000,000.

EDWIN W. DE LEON,
Vice-President Casualty Company of America, New York.

Insurance, Credit, is a business proposition which offers to the seller of merchandise on credit protection against excessive losses as the result of bad debts. When loss occurs a certain percentage is to be borne by the party insured, and the balance of the loss is made good by the company issuing the policy of indemnity. To illustrate: Application is made for an insurance bond on sales amounting to $400,000 a year, and a bond is written on a basis of one half of 1 per cent loss; this one half of 1 per cent on sales, or $2,000, would represent the insured's own risk in bad debts, and if he lost no more than that amount he would receive nothing from his insurance. But should his losses be $5,000 in bad debts, his own loss would still be only $2,000, and the excess, or $3,000, would be paid him by the insurer, provided the losses had come within the terms and conditions of the bond. Credit insurance is a natural product of the present age. The first important systematic aid to the credit system was the establishment of the commercial agency, which is now recognized as indispensable to an intelligent transaction of credit business. But this first aid was not complete within itself, and a supplementary system was needed to still further minimize the risk of excessive losses through insolvency of debtors, which want is supplied by credit insurance.

The annual losses in the United States by the insolvency of debtors exceed by about 50 per cent the losses by fire. It has long been the general custom to pay insurance companies to carry the risk of loss by fire, but until comparatively recent years each merchant had to carry his own risk of loss through insolvency of debtors. Credit insurance is based on the sound economic principle which recognizes the province of the specialist. Both fire and life insurance offer protection superior to that which can be obtained through any other medium, because the principle of the law of average cannot be efficiently employed except by the specialist. Protection is against the possibility of abnormal loss no less with fire than with credit insurance. Credit insurance from the standpoint of the insurer proceeds on the principle of average which promises a profitable return on the sale of protection. The cost of protection is assessed on the basis of normal losses accruing in any given business for a period of years. Such loss may be termed the normal loss. Normal loss is that inevitable impairment of resource which can be borne by a business and yet admit of a satisfactory dividend on capital invested. Abnormal loss is loss in excess of that which permits satisfactory dividend on capital investment, and it is against such loss that credit insurance offers protection. From the standpoint of the insured, credit protection cannot be considered a profit-earning investment. It is simply and solely protection against excessive loss by bad debts. A crop failure; an epidemic of disease, or a widespread or protracted industrial labor strike, are possibilities of danger which no man can provide against, as respects commercial credits, except through the medium of insurance protection. Experience may qualify a credit man to guard against bad debts through the rascality or impaired credit condition of those seeking credit, but no amount of experience or capacity can of themselves render it possible to provide against contingencies growing out of such cases as above mentioned.

Great care should be exercised by the insured in taking out a policy of credit indemnity. The peculiar need of his business should be intelligently considered. Precedent cannot be safely followed, for the character of every man's business is in more or less degree individual. Unless an intelligent application of the principle of credit insurance is made to each individual case, the greatest amount of protection cannot be realized. The principle of credit insurance being economically sound, it follows that if the insured in any given case does not realize the protection contemplated, it is because the conditions of the indemnity are not adjusted to the needs of the business. No amount of indemnity can be considered a profit maker of itself; its true sphere is that of a profit saver. In explanation of the proposition that an insured is always a loser, when his losses make demand on the indemnity company, it is conceivable that excess losses should so dovetail with the conditions of the policy as to reimburse the insured for every dollar of excess loss, but such instances would be rare indeed.

It would be practically impossible to limit precisely the line of credit on every individual case to the exact ratio of protection. Such a conservative policy would by no means realize the best results of credit protection, and, if strictly adhered to, would restrict rather than expand business. Protection can be made to operate injuriously in both directions, and it would be as false policy to limit business to the letter of protection as it would be to expand it beyond the limits of the spirit of indemnity. A credit should not be extended merely by reason of the collateral security furnished by credit-indemnity, but such security should be used to justify a risk which would not otherwise be undertaken, and to increase a line of credit beyond its natural unsecured limit. A bank will not lend on collateral alone. The personnel of an individual borrower is an equation which can not be eliminated, whether the loan be in money by a bank or in merchandise by a merchant. Collateral security in the case of a bank operates to reduce the interest rate, and the difference between the rate which would be demanded without collateral and the rate with collateral, measures the premium paid by the bank for the protection. In the case of a merchant, the rate paid for protection is the cost of carrying the security as represented by the premium on the policy of indemnity. The banker, therefore, pays a higher rate for collateral protection than the merchant.

The essential features of the contract between the insured and the insurer are: (1) The insured to bear a normal loss of an agreed percentage of his annual sales. The said ratio of own loss to be determined by facts established by the record of the business for a series of years. (2) Insurance to apply to both rated and unrated accounts at an agreed ratio, as the circumstances of the business in question may require and justify. (3) Liberal insolvency conditions, in which technical distinctions are eliminated, and the actual and virtual facts equitably arrived at. (4) Prompt payment of losses at the period of settlement.

J. A. TAYLOR,

Prest. Wilmington, N. C., Board of Trade.

Insurance Engineering, a science or method of procedure for the better application of principles and rules in the business of insuring property against fire. The decision of the trustees of the Massachusetts Institute of Technology to establish a course in what for want of a better name has been designated insurance engineering, is commendable and should meet with hearty encouragement from the fire underwriters. Its object will be to instruct those who take the course in the selection and constructive use of materials with a view to minimize the risk of destruction by fire. Naturally, this will for the present relate more directly to mill and factory property than to dwellings, but the influence of such a school should soon be felt in every department of architecture, especially if out of its work shall grow a determination on the part of the fire underwriters to make such discrimination against buildings in which they are expected to take all the risks as will make it to the advantage of those who build or buy houses of any kind to do what is possible to share this risk by guarding against fire within practicable limits of slow-burning construction.

The latest official calculations — those of Insurance Commissioner Dearth of Minnesota — lead to the conclusion that 75 per cent of the enormous annual loss from fires in this country results from fires which are preventable. The policy of the insurance companies has lent itself to the encouragement of indifference on the part of owners of insured property to everything except the rate of premium. Commissioner Dearth's further conclusions are:

> It is not to the large number of promiscuous fires that heavy losses to property are attributable, but more to the larger select risks occuring in heavy commercial circles where great values are involved. One of the greatest evils in fire underwriting is in the matter of over-insurance, which places a premium upon criminal carelessness on the part of the assured, if not absolute incendiarism. For this evil the companies themselves alone are, of course, to blame, and consequently have it entirely within their power to eliminate. There is very little question that the companies are at the present time exercising a far greater degree of precaution in this direction than heretofore; in short, cancelations, reducing the liability of the companies on all the more hazardous classes of risks, are causing not only the local agents, but the assured, no end of trouble, and much greater care is, beyond question, being exercised in the line of inspections, especially looking to the matter of values as compared with the amount of insurance covering on the property. These are all matters that are being strenuously considered by the underwriters throughout the country, and beyond question must result in a material decrease in the fire waste.

The erection of insurance engineering into a profession will enable the insurance companies gradually to reorganize their business on safer lines, and in so doing discourage the practices which have grown up through the co-operation of owners and agents to saddle them with larger responsibilities than any scale of practicable premiums would warrant. The number of men qualified to practise as insurance engineers has never been great enough to meet the requirements of the companies. The new school should have an immediate and important practical relation to the public welfare in the safeguarding of life and property and the raising of the standards of construction in buildings admitting of classification as insurable risks.

The undertaking has the enthusiastic support and co-operation of Edward Atkinson of Boston, whose efforts in recent years have materially changed the methods of mill construction and the theories of industrial insurance; and it has appealed so strongly to mill owners, builders, manufacturers, and other investors to whom fire is a constant menace that, at Mr. Atkinson's instance, a fund sufficient to place it at once on a substantial money basis with liberal allowance for the heavy initial expense has been raised.

Insurance, Fraternal. The principles which govern the system of fraternal insurance can be gleaned only from the decisions of the courts of law, the dictum of the insurance departments of the different States, the files of the leading fraternal journals, and the official reports issued by the National Fraternal Congress, the associated fraternities of America and the fraternal societies themselves.

Fraternal Insurance, as popularly understood at the present time, is "The obligation of a fraternal beneficiary association to pay the benefits prescribed in its constitution and laws when all requirements by or on behalf of the members are fulfilled." In the early days of fraternalism in America the term "protection" was universally used in describing the benefits furnished by the different beneficiary societies. See Fraternal Beneficiary Societies in America.

The term fraternal insurance, although originally a misnomer, and clearly inapplicable in any true conception of the real aims and objects of a fraternal beneficiary association, has, however, come into general use of late years as being synonymous with the words fraternal protection and fraternal benefits, whenever reference is made to the money benefits paid by a fraternal beneficiary society. This change has come about so gradually that it is difficult to trace its origin or fully measure its effects. The primary cause of this mingling of insurance terms with fraternal names has undoubtedly been the failure of the officials of the different societies to constantly keep in mind the distinction between the insurance contract supplied by an insurance company and the fraternal protection furnished by a fraternal society, while a secondary cause has been the efforts of the insurance commissioners of the different States to compel all fraternal beneficiary associations to comply with the regulations in force as to insurance companies.

In order, therefore, to fully understand the scope and meaning of the term fraternal insurance, as now understood, it is first necessary to ascertain the meaning of the word insurance. Webster defines it as "a contract whereby for a stipulated consideration called premium one party undertakes to indemnify or guarantee another against loss by certain specified risks." The supreme court of Pennsylvania (1890), in the case of the Commonwealth *v.* the Equitable Beneficial Association (137 Pa. St. 412) (18 Atl. 1,112), thus points out the distinction between regular life insurance and fraternal protection, as then understood.

"The general object or purpose of an insurance company is to afford indemnity or security against loss. Its engagement is not founded in any philanthropic, benevolent, or charitable principle; it is a purely business venture, in which one, for a stipulated consideration or premium per cent engages to make up, wholly or in part, or in a certain agreed amount, any specific loss which another may sustain, and it may apply to loss of property, to personal injury, or to loss of life. To grant indemnity or security against loss, for a consideration, is not only the design and purpose of an insurance company, but is also the dominant and characteristic feature of the contract of insurance.

"What is known as a beneficial association, however, has a wholly different object and purpose in view. The great underlying purpose of the association is not to indemnify or secure against loss; its design is to accumulate a fund from the contributions of members for beneficial or protective purposes, to be used in their own aid or relief in the misfortunes of sickness, injury or death. The benefits, although secured by contract, and for that reason, to a limited extent, assimilated to the proceeds of insurance, are not so considered. Such societies are rather of the philanthropic or benevolent character. Their beneficial features may be of a narrow or restrictive character; the motives of the members may be to some extent selfish, but the principle upon which they rest is founded in the considerations mentioned. These benefits, by the rules of the organization, are payable to their own unfortunate out of funds which the members themselves have contributed for the purpose, not as an indemnity or security against loss, but as a protective relief in cases of sickness or injury, or to provide the means of a decent burial in the event of death. Such societies have no capital stock; they yield no profit, and their contracts, although beneficial and protective, altogether exclude the idea of insurance, or of indemnity, or of security against loss."

We may therefore assume that insurance is a contract between an insurance company on the one hand and the insured on the other, and provides for the payment of a specific indemnity by the company in consideration of certain stipulated premium payments by or on behalf of the insured. It has been held that a verbal contract of insurance is valid, but by universal practice the contract is made in writing, and is called a policy. The policy, therefore, expresses the terms of the contract, and governs the right of the parties.

Fraternal insurance, on the other hand, is the very antithesis of insurance as above understood. A fraternal society does not, and under the laws of the different States has no power to, make an insurance contract. It does not, and cannot, issue a policy. It does not promise indemnity against loss, and is not limited to any stipulated premium payments. Its contract is not between the society on the one hand and the members on the other, but between the members of the society, each with the others, and this contract is not expressed in the certificate of membership issued by the society. This certificate which it issues is not a policy. If it were, the society would immediately cease to be a fraternal society, and be not only classed by the insurance departments of the different States as an insurance company, but required to report and pay taxes as such. The usual form of certificate in use certifies that the holder has been duly and regularly accepted and admitted to membership in the organization, and entitled to all the rights and privileges accruing under the specified benefit, as prescribed in its constitution and laws as then existing or subsequently altered or amended by the duly constituted supreme body of the association. The certificate, therefore, is merely evidence of membership, and certifies that the holder is entitled to the rights and privileges flowing therefrom. It is in no sense a policy, and has never been so construed by any court of last resort.

Of late years there has been some conflict in the decisions of the courts as to the legal effect of some peculiar certificates of membership that have been issued by fraternal associations, but in the leading cases the courts have uniformly adhered to the rule that the certificate is merely evidence of membership, and that the rights of the parties, or, in other words, the contract for fraternal protection, is governed by the constitution and laws of the organization as they exist at the time the right to the benefit accrued, although in some cases the society has been held to have waived certain provisions in its constitution and laws because of peculiar features in the certificate, and in other cases, certain practices or customs that, in the judgment of the court, tended to mislead the members, as to the proper construction or binding effect of some clauses in the constitution, have been held to be a waiver on those provisions.

The laws of the different States require every fraternal beneficiary association to have a representative form of government and to be organized and carried on for the sole benefit of its members and their beneficiaries. Each member, therefore, has a voice in the management, and has no right to complain of any lawful changes, alterations or amendments to the constitution and laws made during his membership, because they have been made by him or in his behalf, and for the general good of the entire membership.

As the organization is purely mutual, every member who is to share in the benefits ought in equity to bear his fair share of the cost, and it follows, therefore, that he is also bound by any changes that may be made in his rate of dues or assessments by the constituted authorities of the organization.

To sum up in a word, "insurance" is a contract, while fraternal protection is the result of a contract; the one makes a definite promise of a certain indemnity in consideration of certain stipulated premium payments, while the other is the obligation of a fraternal association to pay the benefits prescribed in its constitution and laws when all requirements by or on behalf of a member have been fulfilled. Many, of course, prefer to rely on the business promise of the insurance company to pay the prescribed indemnity, but the millions of members in the fraternal societies of America prefer their fraternal protection, not only because it is cheaper, but because it is better and surer. Every member of every fraternal association fully realizes that any tampering with good faith in dealing with any single member would be fatal to the organization, and ultimately injure the entire membership. In the judgment of all true fraternalists, the mutual interests of the members, therefore, constitute a safeguard that is far more reliable, and certainly more durable, than the mere promise of any purely business company. The membership of the various fraternal beneficiary associations in America that report to the insurance departments of the different States is over 4,500,000, and the amount of protection carried is in excess of $6,450,000,000. Up to the end of 1902, the various societies have distributed over $800,000,000 among the beneficiaries of deceased members. Last year their total payments for death losses were over $73,[illegible]. These figures do not include the vast number of small societies scattered through the various States which do not report to the insurance departments. For further information consult The Annual Reports of the Insurance Departments of the different States, and the Official Reports of the Fraternal Beneficiary Societies.

FREDERICK GASTON,
President The Grand Fraternity.

Insurance, Industrial. *Definition.*—Industrial insurance may be defined as family insurance at retail. While in scientific principles it does not differ at all from ordinary life insurance as described by Mr. Nichols, in practice its distinctive features are: (1) that instead of having its policies written for $1,000 and multiples thereof at varying premiums according to mortality tables, its policies call for premiums of 5 cents and multiples thereof, the amounts of insurance varying according to age; (2) the premiums instead of being payable annually, or semi-annually, or quarterly, are payable weekly; (3) these premiums are called for weekly by collectors instead of being remitted by mail; (4) the amounts of insurance payable are based upon mortality tables drawn from experience in industrial insurance, and these tables differ very widely at all ages from the tables used by the ordinary companies; (5) the insurance is taken upon lives between ages 1 and 70, without distinction of sex as to premium, and, in the largest company, without distinction as to color. Industrial insurance is so called because it is the insurance of the working classes. For this reason it has grown very rapidly, and no doubt in time will exceed in amount the annual premium insurance.

History.—For its origin industrial insurance must point to the guilds of the Middle Ages, whose place was taken in England after the Reformation by burial societies or clubs. These were voluntary associations, meeting periodically and collecting dues and undertaking to bury members out of the funds so paid in. The dues were the same for all ages and the management so bad that up to 1867 14,000 of the clubs out of 38,000 had collapsed and a large majority of the existing remainder were insolvent. In 1849 the first industrial life insurance company was founded in England, called the Industrial and General; three years later an offshoot called the British Industry Life Insurance Company was formed; two years after this — in 1854 — the Prudential Assurance Company, which had been in existence six years as an ordinary company, took up the industrial business and soon absorbed the British Industry. At the outset the business was experimental, as actuaries had insufficient data upon which to base calculations; and several tables of benefits for the weekly premium of a penny succeeded each other, widely differing in amount. The first table ran from ages 10 to 50; age 10 was found too high for practical working and the table was run down to age 7; then a demand arose from the people for insurance at younger ages which was first met privately by an agent of the Prudential on his own account. His fine business record attracted the attention of the officers, who found it arose from his practice of himself insuring the younger members of the family. This discovery led to the company's making its system a real family insurance. It was not successful until all ages were accepted. Thereafter the business grew rapidly, so that at the end of 1904 the Prudential had 15,577,161 industrial policies in force secured by £24,073,082 of assets credited to the Industrial Department, besides £30,386,422 assets credited to the Ordinary Department. The Board of Trade exhibit of regular industrial insurance (that is, excluding friendly societies) in Great Britain shows the steady and rapid growth of the business as will be seen from the following table:

INDUSTRIAL INSURANCE IN GREAT BRITAIN.

Year	No. of Companies	No. of Policies	Insurance	* Death Claims Paid	Assets
1890	8	9,432,778	£86,203,873	£1,928,406	£8,737,936
1895	7	14,990,581	144,142,569	2,418,754	13,803,227
1900	14	18,653,846	181,135,538	3,410,642	21,512,384
1904	21	23,810,937	234,217,606	3,944,927	32,412,434

The number of policies in force in the industrial companies of Great Britain equals about one half of the population of the country.

In America the first weekly premium experiment of importance was the connection of the Hildise Bund, a German society which received premiums weekly and used them to pay to the Metropolitan Life Insurance Company to be credited upon quarterly premiums on policies issued by the Company on the lives of the members of the Bund. A large business was done on this plan for several years after 1869, amounting at one time to $7,500 per week. There were other similar societies in name, but they seem not to have done much business. The English experiment had attracted a good deal of attention in America, and various industrial insurance companies were formed which, however, never got to the point of issuing policies. There was a good deal of literary discussion which culminated in a State report in 1874 by Commissioner Clarke of the Massachusetts Insurance Department, describing the work of the English Prudential Company and setting forth the principles of industrial insurance. In 1875 the Prudential Insurance Company of America, then a small corporation in Newark, New Jersey, known as the Widows' and Orphans' Friendly Society, changed its name to the Prudential Friendly Society and in November began the industrial business on the lines of the London company after which it was named. Before it attained much growth the John Hancock Mutual Life Insurance Company, of Boston, the Germania Life Insurance Company, of New York (which, however, soon ceased writing industrial insurance), and the Metropolitan Life Insurance Company of New York, old line companies of experience, began the industrial business. The progress of this system of insurance in the United States has been wonderful. Its first policy was issued in America only 30 years ago; at the end of 1904 there were in force in the United States and Canada over fifteen and a half millions of industrial policies against less than five millions of annual premium policies — the amount insured thereby being respectively: $2,134,458,411 industrial insurance and $9,360,-278,728 annual premium insurance.

The following table shows the rapid growth of the business:

INDUSTRIAL INSURANCE IN THE UNITED STATES AND CANADA.

Year	No. of Companies	No. of Policies in Force	* Death Claims Paid	Insurance in Force	* Assets
1880	3	228,357	$ 430,631	$ 19,579,780	$ 4,687,074
1885	3	1,360,375	1,919,533	140,101,632	6,573,267
1890	9	3,875,102	6,438,334	427,882,964	21,229,162
1895	12	6,947,223	12,551,865	820,062,966	54,306,416
1900	17	11,115,908	20,301,793	1,450,324,885	122,943,845
1904	11	15,599,449	31,436,785	2,134,458,411	255,255,034

The following table shows how extensively the working classes take out this insurance, by a comparison of the population of five large cities with the number of industrial policies in force in three companies (other companies are doing business in most of these cities):

City	Population in 1900	Number of Industrial Policies in Three Companies in Force Dec. 31, 1904
New York	3,437,202	2,191,818
Philadelphia	1,293,697	1,145,172
St. Louis	575,238	427,403
Baltimore	508,957	424,135
Cincinnati	325,902	294,540
	6,142,996	4,483,068

There are in the United States about 30,000 agents writing industrial insurance and the head office clerical force numbers about 5,000.

Industrial insurance was introduced in Australia in 1884, but was not vigorously prosecuted until 1887. By the end of 1902 there were six companies, with 291,198 policies in force, assuring £6,216,589. In New Zealand the Government started the business of Industrial insurance in 1875, but quickly discontinued it. In 1881 the Government revived the work of the insurance branch of its Insurance Department, but finally abandoned it in 1887.

* The figures in the columns of payments and assets include the annual premium business of the companies. As to these items, the reports do not separate the weekly premium business from the annual premium business. But so very large a proportion of the business of the companies is industrial that these figures are not at all misleading.

The business flourishes best in Anglo-Saxon countries. It is scarcely known anywhere else except in Germany, where in 1900 there were 34 companies, having two and a half millions of policies in force for $115,000,000. In Austria, Holland, Denmark, Sweden, Switzerland, Hungary, and Belgium the business is transacted on a very small scale.

Policy Contracts.—We have said that the unit in industrial insurance is the five cent premium: the amounts of insurance vary with the age of the insured and the duration of the policy. The curve in the mortality table descends from birth to age 12 and then ascends, and the companies for the same premium increase the amount of insurance with each age up to age 10. The amount of insurance thereafter does not decrease through life; for the policies are, like the annual premium policies, constructed with a level premium carrying a reserve from age 10 on whole life and on endowments at all ages. Insurance at younger ages is term insurance. Different kinds of policies are issued. The Prudential and John Hancock companies' policies are nearly all whole life; the Metropolitan policies issued for the last ten years have been practically all endowments; together these three companies have in force and issue yearly about 95 per cent of the American business. This table of the largest of the companies shows the benefits payable on children for a 10 cent premium with the period of endowment:

PREMIUM OF 10 CENTS, IN USE BY THE COMPANY WHICH HAS IN FORCE ABOUT ONE HALF OF THE AMERICAN BUSINESS.

Amount payable provided death occur after the policy has been in force for the following periods:

Age next Birthday	Under 3 months	Under 6 months	Under 9 months	Under 1 year	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years
2	[illegible]	[illegible]	24	[illegible]	34	[illegible]	[illegible]	[illegible]	110	100	200	240
3	[illegible]	22	[illegible]	34	[illegible]	[illegible]	58	102	150	200	240	
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	200	240		
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	240			
[illegible]	[illegible]	32	44	[illegible]	[illegible]	[illegible]	[illegible]	240				
[illegible]	[illegible]	[illegible]	52	[illegible]	[illegible]	[illegible]	240					
[illegible]	[illegible]	44	[illegible]	[illegible]	[illegible]	240						
9	[illegible]	[illegible]	[illegible]	[illegible]	240							

[illegible] policy, after the [illegible] re[illegible] of age, there will be added to the [illegible] the above table. ONE DOLLAR.

[illegible] the amounts payable at the end of each [illegible] are as follows:

Policy issued at age	2	mature in	[illegible]	years	for	[illegible]
"	"	"	3	"	48	"	[illegible]8.00
"	"	"	4	"	49	"	[illegible]
"	"	"	5	"	51	"	[illegible]83.00
"	"		6	"	53	"	286.00
"	"		7	"	56	"	200.00
"	"	"	8	"	62	"	297.00
"	"	"	9	"	68	"	[illegible]

For five cents per week the benefits are one half th[illegible] above.

No higher premium than [illegible] cents will be taken.

It will be noticed that the amount payable increases materially after the policy has been in force for several years. The reason is that in the early years insurance is not needed in so large amounts and the unearned part of the premium charged is used to increase the amount of insurance in the later years as well as to shorten the endowment period. Technically in industrial insurance adult insurance begins at age ten because the old actuarial tables were not carried below that age. Above that age at each advancing year at entry the amount of insurance for the same premium decreases. Thus, entering at age 10 the amount of insurance is $230 for 10 cents; entering at age 20 $154; entering at age 30 $120—and so on. These amounts are payable (with certain dividend additions) at age 80 or prior death. There are other tables, whole life tables, where the insurance at certain ages for the first few years of insurance is slightly higher for the same premiums; and there are also 20-year endowment tables, where obviously the death benefit for the same premium is less.

The provisions of the policies in industrial insurance do not differ in principle from the annual premium policies. Because of the small premium payable weekly the policies are only in partial benefit during the first year of insurance, that is, one quarter is paid if death occurs within six months, and one-half if death occurs after six months and within a year. The insurance is payable immediately upon receipt of proofs of death: and these proofs are prepared by the companies' agents without charge. The intention of the insurance being mainly to provide for expenses of sickness and death, everything is done to facilitate the payment of the premiums of the company and of the claims to the insured. Collectors call weekly for the premiums; the companies have local offices convenient to the policy holders and from there death claims are attended to and paid either without reference to the home office or on telegraphic instructions therefrom. Four weeks' grace are allowed in the payment of premiums which in practice is usually extended to five weeks, within which time claims are paid even if premiums have not been. Paid up policies are issued after two, three, or five years in different companies. The Massachusetts law provides for two years; the New Jersey law for three years; the New York law does not compel paid-up insurance—but the company grants it nevertheless. Revivals are freely granted in cases of lapsed policies, and where policies have been long lapsed, so that payment of arrears is difficult, the companies loan the amount of arrears on the security of the policies. Special allowances are made in cases of long strikes and lockouts, death claims usually being paid even if policies are lapsed.

Dividends.—Policies of industrial insurance have in form been mostly non-participating; but of late years three American companies have begun to pay dividends and have voluntarily disbursed to industrial policy holders over nine and a half millions of dollars—averaging over a million of dollars annually in cash dividends for the last eight years. The profits come from a very small margin upon an enormous amount of business. It has been estimated that the reduction of premium one cent a week on each policy would bankrupt the largest of the companies in five years. The only feasible way of reducing the cost to the holder is therefore the return of surplus by dividends. Two of the companies once in five years return to the holders of life policies a cash dividend equal to ten weeks' premium — or about 20 per cent of the premiums for a year. One of these companies, which in 1896 practically withdrew the whole life form and has since issued endowments, substituted as to this form of contract a reversionary dividend guaranteed in the policy; that is, after the third year a sum is annually added to the face of the policy equal to the sum of ten weeks' premiums. Thus a policy which is for $230 after the first year (premium 10 cents, age 10 years) eventually is for $297 payable as an endowment at age 80. One advantage of this long endowment is that the amount of paid up policy is readily calculated by the insured — being for such a proportion of the amount of the policy as the number of years paid bears to the endowment period. The other of the large American companies provides in the policies for reversionary dividends to be paid when death occurs after 5 years; for cash dividends after 15 years and quinquennially thereafter; and for cash surrender values after 20 years.

Mortality.—When the cost of industrial insurance is considered, the first thing to be noted is the increased mortality among the industrial classes. Let us compare the number per thousand dying at each of several specified ages according to (*a*) Farr's English life table of the general population in Great Britain, compiled from two censuses (we have no such table in America): (*b*) Actuaries' table, (that is, a table of insured lives formulated from the combined experience of 17 companies, compiled by English actuaries, which is made the statutory basis in many of the United States for the computation of insurance liability); and (*c*) the Metropolitan Life Insurance Company's industrial table (based on observation of twelve millions of insured lives):

DEATHS PER 1,000.

Age Next Birthday	Farr	Actuaries	Metropolitan
20	7.74	7.29	10.52
21	8.46	7.38	11.56
25	9.24	7.77	14.14
35	11.24	9.29	17.15
45	14.50	12.21	22.56
55	21.75	21.66	35.22
65	41.20	44.08	64.51
70	60.80	64.93	90.99

A glance at these tables shows the net cost of industrial insurance of adults to range from 140 to nearly 200 per cent of the Actuaries' table. As the experience of the American companies shows an actual mortality of only about 80 per cent of the Actuaries' table, it follows that the industrial mortality is from 170 to 230 per cent of annual premium insurances. At age 35, generally taken as an average age, the percentage is 230. A comparison of industrial mortality with general mortality shows a less, but still large, percentage of difference. It is reasonable that it should be so, because, in the first place, industrial insurance in this country has not yet reached, in proportionate amounts, the agricultural and rural population, which is so large a percentage of the whole population. In the second place, the mortality of the working people in cities is large, because of the exposure, the mode of life, the hard toil and confinement, the carelessness of self which the observation of everybody must have noted among working men and women. To some extent there is also a selection against industrial companies, often unconscious, which is the correlative of the unconscious selection against tontine and endowment policies in annual premium companies. A man vaguely conscious of low vitality will insure himself more readily than his opposite, just as one vaguely conscious of superior virility will prefer tontine to whole life insurance.

Insurance of Children.— The insurance of children has been the subject of much discussion in England and America, and legislation against it has been proposed; but no law of prohibition has been passed in any State where the business has been well established. In England the law has remained for many years permitting the insurance of children within the limits previously adopted and maintained by the companies; and this after repeated Parliamentary investigations. In America, New York State in 1892 adopted as part of the insurance code a provision authorizing the insurance of minors according to the table of benefits in use by the companies. The Province of Ontario, Canada, followed a few years after with a similar table. In the States of Massachusetts, New York, Pennsylvania, Ohio, Connecticut, New Hampshire, Tennessee, Missouri, Wisconsin, Michigan, Georgia, Virginia, North Carolina and California proposed legislation forbidding the insurance of children has been defeated, in many of them repeatedly. In Massachusetts in 18[illegible] the joint legislative committee took six weeks to investigate the subject, examining hundreds of witnesses, resulting in a vote of 143 to 29 against the prohibitive bill. Colorado is the only State which forbids the business and the law was passed there without a hearing of the company which had only recently begun business in the State — in other words, in anticipation of, not after experience of, evils. So France, which is without experience of industrial insurance, recently passed a prohibitive act; while in Australasia, where such insurance has been written for years, New Zealand has passed a law on the lines of the English permissive act. The tables above printed show the American limit on child insurance by the practice of the companies. It is apparent therefrom that at the earlier ages the insurance is simply burial insurance, while at the older ages it amounts to a very respectable endowment insurance. No case of child murder or abuse for insurance has ever been shown in the United States. In England the matter is thus summed up by Doctor Jones of the Royal Southern Hospital in Liverpool (where child insurance is most common and has been for many years) in a book 'On the Perils and Protection of Infant Life': "The incentive to child neglect and child murder is *not* the prospective receipt of insurance money." Statistics in both England and America show that the mortality of insured children is less than the general child mortality. The following table compares the mortality of the company which has in force one half of all the industrial policies in the United States and Canada, with that shown by Farr's English life table of the general population of

Great Britain and by the United States census of 1880.

DEATHS PER 1,000 AMONG CHILDREN.

Age Next Birthday	Farr's Table	United States Census: General Population 1900	United States Census: 31 Cities 1880	Co.'s Experience 1904
2	63.59	46.6	[illegible]	32.7
3	30.13	20.5	[illegible]	22
4	22.39	13.2	22.7	12.8
5	17.92	9.4	17.9	8.5
6	13.53			
7	10.75			
8	9.15	5.2	8.9	5.1
9	7.59			
10	6.56			

* The census tables of 1880 were the last to give mortality percentages for the group of 31 cities. Improvement in the mortality of the general population and of the company's experience is shown in the adjoining columns. The company's business is, however, done almost entirely in cities, and a very large proportion is in the 31 cities referred to in the census of 1880.

The companies limit the amount of child insurance to the amounts fixed by the New York statute, which are practically those shown by the Infantile Endowment tables printed above; and the rule in case of over-insurance is either for all companies to cut down the payments proportionately or for the companies issuing the latest policies to return the premiums. No specialty of child insurance is made. Industrial insurance is, as we have said, family insurance. This is strikingly shown by comparing the percentage of population at various groups of the ages with the percentage of policies in force at the same ages in the largest industrial company:

Ages	Percentage of Population Census, 1900	Percentage of Policies in Force, 1904
1 to 4 inclusive	9.57	9.57
1 to 9 inclusive	[illegible]	[illegible]
1 to 14 inclusive	31.94	34.66
1 to 19 inclusive	41.91	45.35
5 to 17 inclusive	28.42	31.65
20 to 29 inclusive	18.29	[illegible]
30 to 39 inclusive	13.88	12.83
40 to 49 inclusive	10.16	9.96
50 to 59 inclusive	[illegible]	[illegible]
60 to 69 inclusive	[illegible]	4.86
1 to 69 inclusive	[illegible]	98.74

Expense.—Like everything else sold at retail the cost of industrial insurance is high. Its cost, however, is scientifically adjusted. The loading on the net premium is necessarily about double that used in annual premium companies; and, as we have seen that the mortality is also double at some ages, the cost of industrial insurance is necessarily high compared with annual premium insurance. The expense ratio is high because of the system of weekly collection of premiums, because of the large number of policies for small amounts which have to be recorded and cared for at the home office, because of the relatively high cost of medical examinations, because of the large companies medically examine every applicant, adult and infantile, on every application, however small, and the third examines in cases of policies over $300), and because of the heavy lapse rate. One company paid $550,000 in the year 1904 for medical examinations of applicants for industrial insurance. As the premiums are payable weekly there are 52 opportunities each year for lapsing, as against 1 to 4 in annual premium companies; and in the first year of insurance the lapse ratio is very high. All of these lapses are a pecuniary loss to the companies: and this largely accounts for the high expense ratio. In fact it takes nearly and in some cases more than the fund accumulated from premiums for five years to cover the reserve. Of the business lapsed within the first three years, more than half goes off within the first three months, and six sevenths during the first year of the life of the policy. The lapses in industrial insurance, while they cause a heavy loss to the companies, do not usually represent any serious loss to the insured. The premiums are weekly and the policies are carried on grace for four weeks after lapse; and they are reissued upon payment of a single week's premium; the loss is therefore not like that of those who pay annually. On the infantile table the policy, if reissued, is for the same amount as the policy lapsed would have called for at the age of reissue, because up to age 10 the amount of death benefit increases each year; so that the only loss is from the partial benefit rule for the initial year. On the adult table a policy lapsing during the first year in force can be revived at any time without any loss to the insured; after a policy has been in force a year it may be revived within a year after lapse at the original amount in full benefit. Here also is no loss. If the policy has been in force two years and lapses, the premiums will within two years thereafter be loaned by the company if the applicant wishes to revive and is unable to pay the arrears. Here therefore there is no loss. If not revived and new insurance is taken, the amount of insurance at each advancing year is very little less than the preceding year. If the policy is kept in force until it is entitled to be surrendered for paid-up insurance, the holder may have paid-up insurance; or he has the alternative privilege of extended insurance, by which the full reserve is applied to the payment of premiums upon a new policy issued at the attained age. If he elects to take the extended insurance he can begin paying again when the period of extension has elapsed and thereby lose nothing by his original lapse except the reduction in the amount of the policy by his increased age at the date of the new policy. It goes without saying that in all these cases lapses are no great source of loss to the insured. There can be no doubt that the lapses in industrial policies are very largely by those who subsequently take new insurance, suffering no loss at all in case of revival, and otherwise suffering only the small loss arising from partial benefits during the first year and the small decrease of benefits by reason of advanced age. The fact is there are many who insure and lapse and reinsure, according to their disposition of mind and their resources, with small loss to the holders but large loss to the company, which is put to the expense of commissions for placing the business and the large expense of caring for it. After three years the business is very persistent; so that the average persistence of industrial business as a whole compares very favorably with annual premium business. The average duration of the policies in force in the largest English company is $10\frac{3}{4}$ years, and that of the policies of the largest American company (which has been in business only about half as many years) over $6\frac{1}{2}$ years. In Australia, in 1902, the average duration of the policies in the company which had two thirds of all the industrial insurance in force was about 6 years. The expense of insurance to the industrial classes has been greatly reduced by the introduction of what is known as intermediate policies. These are policies which in 1896 the two largest industrial companies designed and issued for the working classes. They are policies for an even amount of $500 each, premiums payable yearly or in half or quarter years. The premiums of the largest company are based on the industrial table of mortality and the loading is similar to that used in annual premium policies. The result is a moderate priced ordinary policy contract issued on all the usual forms — whole life, limited payment and endowment — and placed in a separate class for dividends. A working man who has got beyond the necessity of making small weekly payments and can afford to pay dollars annually where he has been paying cents weekly, finds in these policies insurance approximately as cheap as his rich neighbor buys. There were at the end of 1904, 308,796 of these policies in force in the United States and Canada, insuring $152,710,657. The English Prudential had at the same date 742,147 ordinary policies in force, of which a very large proportion is endowment, averaging less than £100 each, the premium averaging about £5. The English Prudential policies are participating, the dividends being applied to increasing the amount of insurance. In America the "Intermediate" policies are also participating, kept in a separate class; the dividends have been large, derived principally from saving in mortality and gains in interest; they are payable in cash reduction of the premium or in reversionary additions. The industrial companies on both sides of the water claim that by the issue of this class of policies they have perfected the system of industrial insurance and have performed their full duty to the wage-earners by furnishing insurance adapted to the condition, means, habits of life, and requirements of all: weekly premiums for those who can afford no better, and for those of an age unsuitable for large insurances; annual premiums for small policies with dividends as earned, bringing the cost down to nearly the cost of what is known as ordinary insurance. HALEY FISKE,

Vice-President of the Metropolitan Life Insurance Company.

Insurance, Life. Life insurance is the application of insurance to loss or injury caused by death. It may be defined as a contract under which one party called the insurer, in consideration of certain stipulated payments, termed premiums, agrees to pay to another a moneyed benefit upon the happening of a contingency dependent on the duration of a human life. The person whose life is the subject of the contingency is termed the insured, and the party receiving the benefit the beneficiary, while the benefit itself is called the insurance money. The contract when in writing is known as a policy. In practice the contingency involved is either the death or the continued survival of the insured. If the benefit is to be paid upon the death of the insured, it is known as a strictly life insurance contract, if upon his survival to a given age, it is called an endowment. The issue of such contracts is confined to companies incorporated for the purpose and to benevolent and fraternal associations. The fundamental object of life insurance is the protection of families and dependents, or of business interests from the pecuniary loss which is liable to result from the death of the party insured. It furnishes a method of at once providing a fund which shall be available in case of such misfortune, by means of a series of limited payments made during the continued life of the insured. The latter is able for a small consideration to secure the benefit of an immediate investment payable upon the expiration of the contract, instead of awaiting the slow and uncertain process of accumulating a capital which may be defeated by his untimely decease. The business man is thus enabled also to protect his creditors or his business as well as those dependent on him. In case of the endowment the policyholder is able to unite such protection with a fund available for his own use should he survive during a stipulated period. In short, life insurance may be regarded as a method of purchasing immunity against moneyed misfortunes liable to result from death, and appeals with special force to those whose chief dependence is on their daily or yearly earnings. It offers peculiar advantages, too, because it can be placed beyond the reach of creditors and need not be involved in business misfortunes, while the policies themselves can be hypothecated or sold like ordinary commercial securities.

The policies are issued by the companies upon written applications from the purchasers, in which detailed statements are required regarding the health, habits, and family history of the applicant, accompanied by the certificate of a physician based on a careful examination. The policy stipulates as to the amount and character of the benefit to be paid, the party to whom it is payable, and the premium payments to be received, together with such other provisions as may be needed to express the complete contract with the applicant. The premiums are usually payable annually or at shorter intervals in advance.

History.—Life insurance in its more modern form was practically unknown until it was introduced into England by the establishment of the Amicable Society in 1696. Other companies were gradually started there. But for many years afterward it was prohibited on the continent of Europe as immoral. Modifications of the system, however, known as annuities and tontines had long been familiar, and the former had been employed as a basis for national loans. It was not until the 17th century that sufficiently reliable observations on human life were compiled to furnish a satisfactory foundation for the business, and that the commercial elements of society attained an importance sufficient to give it the needed support. Companies thereafter multiplied in Great Britain and the business gradually extended to the continent of Europe.

Life insurance was introduced from Great Britain to America, and the first society was organized in Philadelphia in 1759 for the relief of Presbyterian ministers and their widows and children, followed 10 years later by a similar corporation for the benefit of Episcopal clergymen and their widows. Their operations, however, were confined to the classes named. The first company to attempt a general business was the Insurance Company of North America, organized in the same city in 1796. A number of other companies gradually followed in that and other important cities during the earlier part of the 19th century. All these earlier offices, however, combined fire or marine insurance, or banking and trust business, as well as annuities with life insurance, and gradually abandoned the latter. Popular prejudice proved to be too strong, and the economic condition of the country to be too little developed to make its prosecution successful. The real beginning of modern life insurance in the United States dates from the organization of the Mutual Life Insurance Company in New York in 1843, which was quickly followed by that of others, both there and elsewhere, some of which had already secured charters for the purpose. The business of these new companies was confined to life insurance, and their success led to the gradual multiplication of such companies until within 20 years it had attained proportions which made these corporations among the most important financial institutions of the land. The business has since continued to expand until the enormous sums now invested in life insurance in America far exceed those in any other country. Its leading institutions are unrivaled in their size elsewhere, and several are transacting business in every quarter of the globe.

Insurable Interest.—Every form of insurance presupposes some pecuniary interest in the subject insured, without which it would be a mere speculation or gamble and a temptation to crime which public policy does not permit. Where the insurance is on property, such interest on the part of the insured must usually be commensurate with the amount of the insurance. The insured is restricted in his recovery on the policy to a sum which will indemnify him for his loss. This doctrine, however, is relaxed in case of life insurance, since no strictly moneyed value can well be placed on a human life. The principle of indemnity goes no farther here than a requirement that the party procuring the insurance shall have such an interest in the life insured as shall prevent the contract from being a mere gamble on its survival. Any reasonable expectation of pecuniary advantage from the continuance of the life is deemed sufficient, such as dependence or the payment of a debt. Every person, too, is assumed to have an interest in his own life, which he may insure to any amount, and may make the policy payable to any beneficiary whom he may elect so long as the scheme is not a mere cover for gambling.

Classes of Companies.—Life insurance is carried on by two distinct classes of institutions. One consists of those which treat it as an ordinary commercial or financial business, the other, of those which deal with it as a form of benevolence or fraternal aid. The former may be again divided into those in which the premiums are definite in their amount and time of payment, and those which depend on assessments from their policyholders to pay claims as they become due. Life insurance as a business, however, is chiefly carried on by the first mentioned, which are known as old line or legal reserve companies. It has been found the only business method which has successfully stood the test of experience. Two systems have been adopted in this class of companies. One is the mutual, in which the policyholders are regarded as the owners of the corporation, and all profits or surplus arising from the business are distributed among them. Such surplus performs the functions of an ordinary capital. The choice of directors or trustees and consequent management of the company is usually placed in the hands of the members. The majority of companies in the United States are conducted on this system. The other is the stock plan, in which the company is owned and controlled by stockholders, who deal with the policyholders simply as customers and divide the profits of the business among themselves. Higher premiums are charged for mutual policies for the purpose of creating a surplus, which may be eventually returned in dividends to the policyholders. In the stock policy, on the contrary, the holder sacrifices the right to dividends in exchange for a lower premium rate. Many of the companies combine both features, mutual offices issuing also stock policies, known as non-participating, at lower rates of premium. Often, too, a stock capital is added to a mutual company which is restricted by the charter to the amount of dividends which it can receive. When the stock is allowed to share in the profits in excess of its legitimate earnings as an investment, the system is known as the mixed plan. Sometimes, too, the election of directors is apportioned between the stock and policyholders, or, in a company otherwise mutual, may be restricted to the former. In some of the States a capital stock is required by law in the organization of a mutual company until it can be replaced by surplus belonging to the policyholders. The distinctive feature of the legal reserve company, apart from its fixed premiums, is that it must at all times maintain a reserve fund adequate to the payment of its future obligations, less the future premiums which it will receive; in other words, it must in a commercial sense be financially solvent. It is also known as an old line company because conducted on the principles which have always characterized life insurance as a business until the introduction of the assessment plan.

Assessment companies were started in the United States over 30 years ago for the purpose of furnishing life insurance at lower rates than those charged by the regular old line companies. Instead of a fixed premium, assessments were levied on the policyholders to pay the losses as they occurred. Various methods were adopted for levying such assessments, and, as the policyholders were in theory liable for whatever assessments were needed, they only became insolvent when unable to meet their claims. The plan was an adaptation of methods employed by fraternal orders, and for a while was exceedingly popular among those seeking a cheap form of insurance, since the actual cost of insurance being low in the early years, the assessments were correspondingly light. But the increased cost as time went on ultimately so increased the assessments that it was found impossible to enforce them, and most of the companies were compelled to retire or change their methods. Comparatively few now remain, and the system itself has been condemned by some of the State authorities. Many of the companies were accustomed to assume the character of benevolent organizations in their operations.

Stipulated premium insurance is a combination of the assessment and legal reserve systems with a view to correct the defects of the former. The premiums, as in the old line company, are definite payments, supplemented, if needed, by assessments, and a moderate reserve is carried to reduce or render such assessments unnecessary. It has been employed by some of the assessment companies as a method of establishing their business on a firmer foundation. But life insurance as a business in the United States, as well as in other countries, is chiefly done by old line legal reserve companies, whose definite contracts, financial strength, and scientific business methods give to such contracts a commercial standing unattained under any other system.

Industrial insurance is a branch of the legal reserve system designed to furnish burial funds for the poorer classes, and especially children. Its principles do not differ from those of ordinary insurance, but its methods are essentially different in many respects owing to the small size of the policies and the character of the applicants. The premiums are payable weekly or at short intervals, and are collected by agents through house-to-house visitations. It was introduced into the United States from Great Britain about 30 years ago, having been an outgrowth of the burial clubs and friendly society system of that country, and has attained enormous proportions in America, as well as Great Britain. See INSURANCE, INDUSTRIAL.

Fraternal and benevolent societies have been popularly associated with assessment companies owing to the similarity of their methods. But they are a distinct class, having the character of social clubs solely for fraternal or benevolent purposes, with a form of insurance as merely one, though it may be their most important, feature. They are strictly mutual in their character. Their general type of organization is that of the ordinary society or club known as a lodge, whose members meet for social or fraternal purposes. The society is formed of a combination of such lodges, through chosen representatives, into a single grand lodge, by which the insurance is carried on, the subordinate lodges acting the part of agents in securing members and collecting the payments. The insurance itself is simply a death benefit allowed to the members under provisions in the constitution, and not a business contract secured by the purchase of a policy. The premiums are paid in the form of dues and assessments, much after the manner of assessment companies, the dues being used for expenses and other incidental features. Efforts are being made to scientifically adjust the payments and benefits of these societies according to the cost of insuring the various members, as is done in the legal reserve companies. The insurance which they furnish is regarded as a species of fraternal aid to the members and their dependents, and their operations are not subject to the same legal control as those of business corporations. See INSURANCE, FRATERNAL.

Mortality Tables.—The life or mortality table, from which the premiums must be determined, is at the foundation of the business. The tables mostly employed are constructed from the experience of the companies themselves with insured lives which have been found to have a mortality distinct from that of the population at large. Such a table in its simplest form consists of a statement of the number surviving at the beginning of each succeeding year out of a given number living at any age, from which the number of deaths and percentage of mortality at each age are readily determined. The latter is the important function employed in life insurance. In America the two tables which are chiefly used, and which have been recognized by the various States as standards for determining the liabilities of the companies, are the Actuaries or Combined Experience and the American Table. The former was constructed from the experience of 17 prominent English offices, and was published in 1843. Its general accuracy has since been confirmed by later observations. The American Table was constructed from the experience of the Mutual Life Insurance Company of New York, and came prominently into use about 1868. It was found to represent the actual experience of American companies better than foreign tables which had been employed. Many other mortality tables have been constructed which have attained a recognized standing. Prominent among them were the Northampton and later the Carlisle Table, both of which were framed from mortality returns of English towns, and were successively used both in England and America, until replaced by the Actuaries' Table. Farr's Tables, constructed from the census returns in Great Britain and published in 1864, have been much used for certain purposes. Various tables, too, have been constructed from observations in other European countries and employed there as standards. The three requisites of such tables for insurance purposes are that they should be safe, should be properly graduated, and should fairly represent the mortality to be expected.

Premiums.—The premiums, which must equal the cost of insurance, are computed from the risk of death, as shown by the mortality table; and since the former are usually fixed sums, while the risk increases with age, it is necessary to charge more than the actual cost in the early years in order to offset the deficiency later on. This excess above the cost is accumulated at compound interest by the company, and constitutes its reserve fund. The rate of interest assumed in the calculation is such as the company is justified in expecting will prevail during the continuance of the contracts. In the United States 4 per cent was formerly considered a safe rate, but the continued fall in interest has led to a general substitution of 3 or 3½ per cent for newer contracts. The payments, which, when thus accumulated will be sufficient on the average to meet the claims on the policies as they fall due, are known as the net premiums, to which additional sums are added for expenses and other contingencies. When thus loaded they are known as gross or office premiums, and are the real amounts charged by the company

These loadings may vary from a trivial addition to 40 per cent or more of the net premium, according to the character of the contract. Premiums in ordinary insurance are usually payable annually in advance, and are then known as annual premiums. Frequently the payments are restricted to a certain number or term of years. These are known as limited payments. Sometimes the entire payment is made at the start. This is known as a single premium payment. The annual premiums, too, are sometimes payable in instalments at shorter intervals to suit the convenience of the policyholder.

Expenses.—The expenses of a life company are chiefly made up of two classes, the cost of securing the business, and the office expenses incident to its care. The principal element in the former is the commission or other compensation paid to the agents, which also varies with the character of the contract. It is usually a large percentage of the first premium paid, and a very moderate percentage, in the nature of a collection fee, for those succeeding. The office expenses aside from the salaries of the officers and employees include taxes, fees, rents, and those numerous items involved in the care and investment of funds, and the conduct of the business.

Legal Reserve.—The legal reserve is the measure of an ordinary life company's liability on account of its insurance contracts to which, in addition to any other liabilities, its funds must be equal in order that it may be legally solvent. The process of estimating this reserve is known as valuing the policies. Two methods of valuation are used, known as net and gross, dealing respectively with the net and gross premiums charged. The former is generally employed in the United States, and is the one usually adopted by the State authorities. It consists in determining what fund the company must have in its possession in addition to the future net premiums which it expects to receive in order to meet future claims on its policies. This fund is the net or legal reserve. It assumes that all other expenditures are cared for by the premium loadings. The gross valuation, on the contrary, deals with the gross or office premiums, and a certain deduction is made from the resulting fund for assumed future expenses. The latter method is regarded as furnishing the surest test of a company's actual condition, and is sometimes employed when the question of legal solvency is in doubt. The former has the advantage of compelling the use of the premiums for the purposes assumed by the company in their computation.

As in the case of the premiums, the computation of this reserve depends on the future rate of interest which is assumed. In most of the States 4 per cent, as in the case of premiums, was formerly regarded as a safe rate, and even 4½ per cent was at one time allowed, but during recent years 3 or 3½ per cent have been insisted on in the case of new contracts by some of the States.

The mortality on which the sufficiency of the premiums depends is lighter in the case of insured lives, owing to their careful selection, than among the general population or that called for by the mortality table for a number of years after the policy has been issued. The cost of insurance in mutual companies is reduced to the policyholders by this lighter mortality. In American companies the mortality among lives that have not been newly selected remains nearly stationary after age 20, or increases but slightly until age 40 is reached, when it is not far from 1 in 100, increasing more rapidly with each age thereafter until it is about 2 per cent at age 50 years and 4 per cent 10 years later.

Form of Contract.—As before remarked, policies may be either participating or non-participating, the chief difference being that smaller premiums are charged in the last and no provisions are included for sharing the profits. Policies for short terms are more frequently made non-participating. The classes of policies most in use are three in number, whole life, term, and endowment. In the first the insurance is simply against death and covers the whole term of life, while in the second it runs only for a certain term of years. The pure endowment is an insurance payable at the end of a certain term of years only in case the insured is alive, and is the reverse of a term policy. The ordinary endowment which is almost exclusively used, however, and which has of recent years largely supplanted the whole-life policy, is a combination of the pure endowment and the term policy. The insurance money is payable to the insured if alive at the end of the endowment period, or to some beneficiary in case of his previous death. Such endowments are usually issued for periods of from 10 to 30 years.

The annuity is a contract frequently combined with life insurance in which the life insurance principle is reversed. The purchaser buys outright a contract under which he is to receive an annual payment during life. Annuities have been familiar since an early period, and before life insurance became understood was the principal form of contracts dealt in by this class of companies. It secures a fixed income during life to those who may wish to surrender their capital for that purpose.

Still another form of contract is the tontine, in which the funds of a body of subscribers are pooled and the accumulations are divided among the survivors after a certain time. Societies of this kind were formerly common in Europe and were occasionally found in the United States, though few, if any, remain.

All these different contract forms are now frequently combined in various ways in the ordinary life policy, in order to increase its attractiveness or to better meet the requirements of policyholders. Various methods of premium payments and of paying dividends are also combined for the same purpose. Great ingenuity has been displayed by the companies in making these combinations, and an almost innumerable variety of contracts have resulted. Among those more familiar in the United States are the tontine or deferred dividend policies, in which dividends are accumulated and divided among the surviving policyholders after a certain period; limited payment policies, in which the premiums are limited in number; instalment policies, in which the insurance money, instead of being payable in a single sum, is converted into a series of annual payments as an annuity; and debenture bonds, which are similar to instalment policies, except that the insurance money is represented by a bond bearing an annual interest and payable at the end of a certain time. Besides, there are policies insuring the life of more than one party. When they are payable upon the death of either of the parties insured, they are known as joint life insurances; when payable only on the death of all they are survivorship insurances. The greater part of the business in the United States is written either in the form of continued payment life, 20-payment life, or 20-year endowment insurance. Renewable term insurance is another plan for reducing the cost of insurance during the early years and avoiding the accumulation of a reserve. The premium is only sufficient to pay for the temporary cost of insuring and increases with age. The policies are written for a single year or term of years, with the right to renewal at the increased premium. The subsequent increase of cost, however, has been found a serious obstacle to the plan. Preliminary term insurance is also insurance for a single year, but with a right of renewal for the entire period at the same rate of premium. The object of such policies is to enable the company to use the fund which, under the law, must otherwise be added to the reserve during the first year of insurance to meet the cost of securing the business, and is a favorite method with young companies having a limited surplus.

Dividends.—Dividends are apportioned from the accumulated surplus according to the equitable share of each policy. Many different methods of determining this share have been devised. That chiefly employed in the United States is what is known as the Contribution Plan. The surplus is treated as made up of gains from a lower mortality and expense and a larger interest earning than those assumed in computing the premiums, and the contribution of each policy to the fund is estimated. Dividends are applied according to the provisions in the policy in various ways. They may be used as single premiums to increase the amount of insurance, which is called a bonus addition, or to shorten the term of the insurance, or to the payment of the premium, or may be received in cash. When, as in tontine dividends, they are to be apportioned among a special class, the share of surplus belonging to that class is separately dealt with. Sometimes a minimum future surplus earning, which can be relied on, is made the basis for guaranteeing the payment of a certain dividend in the policy. But as such earnings are uncertain, the usual estimates of these amounts, as given by the companies, are simply expectations and not obligatory as promises. The fall of interest rates has tended to reduce dividends during recent years. At an earlier stage of life insurance, dividends were payable at intervals of five years or more. Afterward, as the business became better understood, the practice of declaring annual dividends in the United States became universal. Of late, however, the introduction of deferred dividend policies has again lengthened the distribution periods among these special classes. Notes were at one time received by many of the companies in part payment of premiums, but the practice has been for the most part abandoned.

Policy Loans.—Practically all forms of life insurance in which a level premium is paid involve an investment or savings bank element, which is represented by the reserve and is now treated by the law and the contract as belonging, in a sense, to the policyholders. This is the basis of the policy loans which are so generally granted. The portion of the reserve fund belonging to the individual policy, or a portion of it, may be borrowed by the policyholder as a loan bearing interest, on his own note with the policy as a collateral, and is deducted from the insurance money when the policy becomes payable.

Termination of the Contract.—The life insurance contract is terminated either by becoming a claim, which is usually payable at once after satisfactory proofs have been furnished, or by previous lapse or forfeiture through a violation of its conditions, especially non-payment of the premium, or through a voluntary surrender. Policies usually provide for their surrender and allow the insured to receive back a large part of the reserve held against them, called the surrender value, either in the form of paid-up insurance for such an amount as this value will purchase, or insurance of the original amount for such a term as it would pay for, called extended insurance, or else in the form of cash. Statutes in many of the States require similar returns in case of lapse for non-payment of premium, and such provisions are also usually incorporated in the policies. Non-forfeiture laws, as these statutes are called, are designed to prevent the assumed hardship or injustice entailed on the insured through the forfeiture of the money standing to his credit in the reserve fund. This money is regarded as a saving bank accumulation for his future benefit, which is in a sense his property and which should be restored after reserving a surrender charge to compensate the company for his loss. Since healthy lives are most likely to lapse and the cost of insurance to be made greater for those who remain, the selection against the company, as it is termed, is an important element in determining the surrender charge.

Insurance for the Benefit of Wife and Children.—The fundamental object of life insurance as a family protection is liable to be defeated if the policies can be attached for debt. Therefore, statutes have been enacted in many of the States exempting from the claims of creditors policies up to a certain amount made payable to wives and children. The interests of such parties, too, have been held unassignable, at least without their consent. The life insurance contract, except in the case of benevolent societies, is held to be the property of the party who is the beneficiary, when not otherwise stipulated, and not of the party who may pay the premiums, and can usually be assigned as collateral or sold outright by the owner. Policies not protected by statutes, as above, may, like other personal property, be attached for debt to the extent of their surrender value; and where, as in endowments, two interests are sometimes involved, the interests may be severed.

Medical Examinations.—Medical examinations of applicants for insurance are essential to prevent an inroad of unsound lives that would wreck the company, whose mortality rates are based on the acceptance only of healthy lives. For this purpose medical examiners are employed, who report the health, physical condition, and habits of the applicant and the life history of his near relatives. These reports are passed upon by the medical directors of the companies to determine whether the life is up to the normal standard fixed by the company, otherwise the application is rejected.

Sub-Standard Insurance.— Parties who may not be seriously diseased and yet who are not insurable as healthy lives, on account of constitutional weakness or predisposition, are known as sub-standard or under average lives and are insured by some companies as a separate class under special rates of premium, or under special policy conditions, according to the defects of each applicant.

Limitation of the Risk.— Formerly many restrictions were imposed in the policy as to the residence, travel, and personal habits of the insured, and military employment and suicide were debarred. These have been gradually modified or removed, until it has become customary with some companies to issue so-called indisputable policies, which in the absence of fraud, can only be forfeited by failure to pay the premiums.

Moral Hazard.— The moral hazard in the business arises from deceptive representations as to health, the temptation to insure as a mere speculation lives in which no insurable interest exists, in the expectation of an early death, and the temptation to destroy life through suicide or murder in order to secure the insurance money. The ability of an average applicant to judge of his future health is shown in the higher death rates among those classes of policies where an early death would profit the applicant and is an element of the moral hazard.

Legislation and Supervision.—Until about 1860 little or no supervision was attempted over life insurance by the various States. Legislation concerning it was chiefly confined to taxation of the companies or restrictions on their operations. The multiplication of irresponsible corporations, the growing magnitude of the business, and the recognition of the dangers involved in its mismanagement, led to the creation of special departments for its supervision, and the enactment of laws for its conduct by the States of Massachusetts and New York. Their example has been followed by most of the other States. The fundamental aim of these laws is to compel the companies to so utilize and apply the moneys which they receive as to properly carry out the contracts with their policyholders. This is accomplished by requiring the funds in the company's hands to be at all times sufficient, together with its future accumulations and the future premiums, and their accumulations receivable from its policyholders, to meet its future claims as they arise. Since the proper investment of these funds is also essential, this becomes an important part of the investigation, as well as the general manner in which the business has been conducted. Annual statements are required from the companies, embodying the facts essential to such an inquiry, and may be supplemented, if necessary, by a personal examination of the company on the part of the State official. Failure to meet the required test may be followed by a prohibition against additional business until the defect is remedied, or, if actual future insolvency is threatened, by proceedings to close the company.

Theory of Life Insurance.— The fundamental problem in life insurance is to find the average premium at each age, which, with its accumulations, will be just sufficient to meet the promised future payment. This is done by first finding the present value of that future payment, or the sum which, invested immediately at compound interest, will, on the average, with its accumulations, meet this payment when due. The probability of death occurring, and consequently the payment becoming due, during any subsequent year is determined from the mortality table. This probability, multiplied by the sum which accumulated to the end of that year would equal the required payment, is the present value of the payment if made that year. The aggregate of such values computed for each successive year of life, is the entire present value of the future payment to which the present value of the premiums to be charged must be equal. These premiums are in effect so many annuities receivable by the company, and their present value is the amount which, at once invested at compound interest, would reproduce them. The problem, therefore, now becomes the determination of the present value of an annuity at any given age. The process is analogous to that already described. The value sought is the aggregate of the amounts which, at compound interest, would provide the annuity at the beginning of each year, multiplied by the probability of the insured being then alive to pay it. Having determined the present value of any given annuity it is easy to find the annuity which has the value required. This annuity is the net premium.

Life Insurance a Science.—This brief explanation will serve to illustrate the general character of the problems involved in the theory of life insurance, many of which are exceedingly complicated and require a knowledge of the theory of compound interest and of the calculus of probabilities, which, when combined, form the mathematical basis of life insurance. The calculus of finite differences has also an important place, and even the infinitesimal calculus has been utilized to advantage, especially in preparing mortality tables. This whole subject has been developed into a special branch of mathematics termed actuarial science, which has become a recognized profession, whose members, known as actuaries, direct the mathematical computations required for the business. A special class of symbols has been devised in connection with this science, by which the processes involved in its various calculations are readily expressed in the shape of ordinary algebraic formulas. Life insurance computations have been greatly facilitated by an ingenious device known as commutation columns, through the use of which the calculations are much simplified. Published tables of premium and annuity rates and policy values, in connection with the more important benefits, too, relieve much of the office work.

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Insurance, Life, Assessment. The plan of meeting the cost of life insurance through assessments was first used in the United States about 1867 by local bodies, making no pretense to business standing or management. Their plan followed in a crude way that of the levy societies and friendly societies of Great Britain, but without the variety of benefit which these give. As a rule, they confined themselves to funeral or death benefits, with, occasionally, weekly payments in case of sickness.

The disasters which, in the early seventies, overtook companies operating on the basis of fixed premiums and an accumulated reserve, turned popular attention strongly toward a system which claimed to give corresponding benefits without the accumulation of large funds, and which confined its demands for payments to its actual needs in meeting benefits. As a result there grew up organizations operating through local councils or lodges, having a general governing body, representative in character, at least nominally. These grew, in time, into the great fraternal or beneficial orders, with hundreds of thousands of members, obligated to pay hundreds of millions of benefit, the integrity of the obligation dependent upon the ability for perpetual renewal of membership, with perpetual willingness to respond to assessments.

The marked success of these organizations in securing large memberships and temporarily meeting claims at low cost attracted the attention of men intent upon conducting life insurance as a business. There were organized a great number of business, or open, companies, which dispensed with the lodge machinery and placed the business upon a commercial footing. In organizing these, advantage was taken of the charitable and club statutes of different States. Not until 1883 was there a special law regulating this business in New York. The law in Massachusetts was enacted in 1885.

There was no attempt at scientific method, and, indeed, the claim of the earlier projectors of these companies was that, for the practical business of life insurance, a mortality table is useless. It was constantly set forth that, since contracts remain in force but a comparatively few years, a table based upon the theory that every man will ultimately die and become a claim on the funds, is essentially a falsehood.

At first, the simple plan was to collect from every member, on the death of another, $1, with generally 10 cents for expenses, and to pay to the beneficiaries of the deceased the fund formed from the dollar payments. The benefit was, therefore, indeterminate in amount, as was also the cost. An early modification of this scheme was to divide the members into classes of 1,000 or 2,000, which classes were theoretically to be kept full by the infusion of new blood, which, it was claimed, would, by keeping a level average age, result in a level cost. This theory ignored the fact that death rate depends upon actual, and not average, age.

When the plan of uniform payments began to break, through its practical discrimination in favor of older lives and heavier risks, the plan of graded assessments fixed by the age of admission was adopted. This simply modified the degree of error, by substituting for the assumption that all risks were equal, the equally inconsistent assumption that, after the admission of a member to a society, the risk of death ceased to increase. The scheme thus resolved itself into an attempt to meet the cost of insurance, which increases with increasing age, by a level premium, but without the accumulation of a reserve for the diminution of the risk. The fallacy of this was repeatedly urged by those who understood the scientific principles of life insurance, but obtained little or no effective hearing. Strenuous opposition was developed to the accumulation of a reserve, and a great parade was made of "the reserve in the pocket," ready to the call of the company when needed.

The irregular periods for calling assessments gradually merged into periodical assessments at fixed dates, varying in amount with the number of claims which had accrued since the last preceding call. Then came a tendency to call for an assessment in advance, to provide for death claims to occur, the fund thus accumulated being generally named an "emergency fund."

In the meantime, statutes regulative of the business were passed in many States, but in none was any particular regard paid to the demands of a permanent business. In fact, these statutes were in very many instances addressed to securing the advantage of a claim of State supervision, without the imposition of the requirements necessary to permanence. In 1885, however, Massachusetts provided by law that the amount of the benefit must be fixed in the contract, and this provision was finally adopted by New York in 1892.

Finally, as the proportion of older members became heavy, with rapid increase in the cost of the benefits afforded, there came rapid diminution of membership, especially among the younger, and this, in turn, had a tendency to increase the death cost by depleting the character of the risks. The transfer of memberships from one association to another followed in many instances. There was no possibility in such transfers of protecting accumulated liabilities, the result being that claimants under death claims which had accrued received but a small percentage of their face. Later, many of the larger and better managed business organizations passed under the laws regulative of fixed premium insurance with accumulated reserve, and the plant which they had established thus became foundation for new legal reserve companies. In 1899, the State of Massachusetts repealed the law permitting assessment life companies to do business therein, and provided a means by which those then authorized to do business on the assessment plan could obtain licenses under the legal reserve law.

There was an important organization of the business assessment companies, known as The National Convention of Mutual Life Underwriters, which held its first meeting in Elmira, in June 1876. Reports of the fourth meeting, in 1879, show 136 companies, with a membership of 253,000. This convention held its last session, at Mackinaw, in 1898. The report made at the session in 1897 showed 650 companies, with a total membership of 4,039,000, and insurance in force to the amount of $7,800,000. The payments to beneficiaries for the year 1896 were given at $73,000,000, and the total payments to beneficiaries, so far as records existed, since the organization of the business, amounted to $711,700,000. These statistics, to a large extent, covered the fraternal, as well as the business, organizations. The reports of the 23 sessions of this convention afford an amount of historical matter connected with the movement of great importance.

The fraternal organizations established, in 1886, the National Fraternal Congress, which still holds annual sessions and has compiled and is compiling exceedingly valuable statistics. It formulated the National Fraternal Congress Mortality Table, which has been adopted as the official standard in several of the statutes since enacted, and which is coming quite generally to be recognized as a standard table in connection with fraternal insurance. Their latest compilations show a membership of four and one half millions, with benefit obligations amounting to nearly seven billions of insurance.

There is also an organization of younger fraternal orders, known as the Associated Fraternities of America, the first meeting of which was held in 1901. The published records of both of these associations afford a vast amount of useful material to anyone who would study the history of the fraternal insurance movement of this country. GEORGE DYRE ELDRIDGE,

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Insurance, Life, Statistics. The business of life insurance is of comparatively modern growth in this country, the oldest company transacting it being but little over 60 years of age. It was practised in Europe, however, many years before, but its development there was slow. There was much prejudice against it at first in this country, and instead of being regarded as a most beneficent method whereby the widows and orphans and other dependents upon the head of a family could be provided for in the event of his death, it was denounced as a gambling scheme, a wager against death, and some clergymen went so far as to condemn it from their pulpits as opposed to biblical laws. But the pioneer companies pushed the business with vigor, at the same time carrying on an educational campaign, until the public have come to recognize the value and importance of life insurance, valuable alike to the rich and the poor. To the poor, and to those of moderate means, it is held to be an imperative duty for every man whose life is insurable to insure for as liberal a sum as he can afford, in order that, in the event of his death, those dependent upon him may not become objects of charity or be thrown upon relatives for their support. The rich man finds in life insurance a relief from possible financial entanglements that might otherwise, upon his death, wreck his estate. Men whose wealth would seem to relieve them of all financial anxiety carry insurance upon their lives in sums ranging from $50,000 to $2,000,000. Their reasons for so doing are that they have investments that may prove troublesome for their executors to close up, necessitating sacrifices that would prove costly. The insurance upon their lives is payable immediately upon their death, and the funds thus made available at once will prevent the sacrifice of any portion of their estate to meet the claims of clamorous creditors.

Primarily life insurance is designed for the especial protection of families deprived by death of their head, the breadwinner, upon whose efforts they are dependent for subsistence. By the payment of a small sum annually a policy of insurance can be obtained whereby the company contracts to pay to the heirs of the insured a specified sum in the event of his death. For instance, a person 30 years of age can obtain a policy of insurance upon his life for $1,000 upon the payment of an annual premium of $24.18, and this rate does not increase during the life of the policy — hence the term "level premium." Should he die at any time after receiving the policy the company will pay the amount to his designated beneficiary immediately upon the receipt of proofs of his death. Insurance for a larger sum is obtainable by the payment of the same rate per $1,000 of insurance. The rates increase according to the age of the applicant, for the death rate increases with age, and the added liability must be provided for correspondingly. While at age 30 the premium for $1,000 of insurance is $24.18, at age 40 it is $32.76, and goes higher as age increases. The rates for life insurance are based upon scientific deductions. Carefully prepared mortality tables show how many persons out of a given number of a certain age will die each year, and while it cannot be told of an individual when he will die, it can be estimated with certainty how many persons in his class will die each year. Life insurance is a business of averages, and the cost of insuring 1,000 or 2,000 or 10,000 persons at a particular age is mathematically determined. The rates charged by all companies are substantially identical, and a person desiring insurance, if in good health, can obtain any amount he is able to pay for from $500 to $2,000,000 — this being the largest amount carried by one man.

As stated, the early days of life insurance in this country were days of trial and tribulation to the organizers of the pioneer companies, but the characteristic energy which is found in all great enterprises has carried the American life insurance companies far in advance of any others. A few statistics, given in concise form, will serve to show the magnificent proportions to which the business has attained in this country. At the beginning of 1905 there were 93 "old line," or "level premium" companies, doing business in the United States, a few confining their operations to a particular section, but the majority of them seeking business in all the States. Of this number 84 had 3,269,089 whole life policies outstanding, insuring the lives of their owners in an aggregate amounting to $6,767,197,991, while the total insurance in force (including endowments and other forms of policies) amounted to $10,412,078,338. The 93 companies were organized at different times and several of them have not been in business long enough at this writing to have made a record. The total premium receipts of 79 of the companies since their organization amounts to $5,214,441,446; they have paid to policyholders $3,276,051,607; their present assets held for the protection of policyholders are $2,261,851,182. As these companies operate on the mutual plan, all the assets belong to the policyholders; if the assets on hand be added to the amount paid to policyholders it gives an aggregate of $5,537,002,870, exceeding the amount paid in premiums by $323,461,433. In other words, the companies have paid to policyholders or now hold for their protection $106.20 for every $100 they have received in premiums.

In 1904 the total premium income of 79 companies was $378,118,121, most of this being in cash for new policies issued and for renewals on old policies. The investment of these vast sums pouring in to the several companies requires the highest order of financial talent in order that a profit to the companies shall be secured and no bad investments made. That these funds have been carefully and judiciously handled is shown by the fact that the companies hold or have paid out in benefits $106.20 for every $100 they have received in premiums.

The vast sums received annually by the life insurance companies for investment places them in the front rank of the great financial institutions of the country. Their finance committees are constantly on the lookout for safe and profitable investments, and their detailed annual reports to the various State insurance departments show that they are large holders of National, State, city, railroad, and other bonds, paying good rates of interest. Other classes of securities that are known to be safe are purchased at times, but their soundness must be absolutely guaranteed.

Other forms of policies than those referred to as "whole life" are issued by the companies, but the fundamental object of life insurance is the protection of families when the breadwinner is removed by death. Endowment policies provide for the payment of a stipulated sum at a specified period, 10, 15, or 20 years from the issuance of the policy. The gives the insured himself the use of funds in his mature years, the proceeds of his savings in his younger years, when his earning capacity was at its best. This form of insurance is popular with young men, who can afford to pay the extra cost of such policies. The companies also sell annuities, contracting for a specific sum paid in advance, to pay to the assured a certain sum annually during his lifetime. How much can be paid annually for the advance premium paid is computed by the actuaries of the companies, according to mathematical formulas scientifically evolved. It has been the aim of the life insurance companies, in their educational campaigns, to liberalize the conditions of their insurance contracts as far as safety will permit, and to popularize them by issuing policies to suit the requirements of all classes of persons, hence there are an almost endless variety of contracts grafted upon the original "whole life" or "ordinary life" form, as the basic contract is designated. But for whatever change of form there may be, whatever of special conditions may be exacted, there must be a corresponding increase in the premium paid.

Four of the American companies are doing business in foreign countries and have been wonderfully successful. Their active and aggressive methods have enabled them to meet in competition the native companies, and generally to excel them in the volume of business written year by year. This has led to restrictive legislation in some countries calculated to restrain the activities of the American companies, but they have been found equal to the emergencies and have generally conformed to all lawful requirements.

In some States the law requires that a life insurance company, before beginning business shall have a certain amount of capital paid up, for the protection of its policyholders, but before the enactment of such law, some companies were organized on the purely mutual plan, without capital. Of the 102 existing companies, including the latest additions to the number, 38 are mutual, while the others possess capital varying from $25,000 to $2,000,000. Dividends to stockholders are generally limited to 7 per cent, all profits in excess being apportioned among the policyholders. In 1904 the capital stock of all the stock companies amounted to $16,919,930; the dividends paid to capital were $916,824, while dividends to policyholders were $33,579,020. Policyholders thus participate in the profits of the companies, whether stock or mutual, according to the varying terms of their contracts. Dividends to policyholders are computed on the anniversaries of the dates of the policies and passed to their credit, to be applied to the payment of future premiums, to increasing the amount of insurance, or in some other way inuring to the benefit of the insured, as he may direct. The insured not only provides insurance upon his life for the benefit of his dependents, but he becomes a member of a dividend-paying corporation, with an interest in all its assets. No better testimony in favor of life insurance can be adduced than is to be found in the figures above quoted, showing the millions upon millions of dollars distributed among the beneficiaries of persons insured. The funds so distributed usually reach the beneficiaries in the hour of their direst need, when death has visited the home and removed the prop that supported it.

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Insurance, Marine. American marine insurance business had its birth at about the close of the 18th century, but suffered heavily when the American flag began to disappear from the high seas. For the past quarter of a century it has had a hard struggle to keep itself anywhere near the old standard of prosperity. To do this it has had to draw for the greater part of its returns upon foreign commerce, and been forced to compete with English companies.

New York's marine-insurance history is that of all the other seaboard States, for in nearly all marine insurance once flourished, but has now succumbed to English competition. The golden period of American marine insurance was between the years 1840 and 1860, when the clipper sailing ship was developed and perfected. In those times the leading merchants owned their own ships, and frequently a member of the firm would go to China or the East Indies to supervise the proper distribution of the cargo, and to secure a remunerative one for the return. The ship and cargo were insured with an American company, and as it might be as long as nine months before the vessel was heard from, the risk was considerable and rates were high. As much as five or six per cent was charged for insurance in those times. The rate on dry goods from Liverpool to New York in the old packet sailing ships was placed at two per cent. This trade was carried in American ships, and the insurance, both on the vessel and on the cargo, was naturally placed in American companies.

But the rates of insurance have changed with the transformation of the ocean-carrying service. The East India goods are now shipped across the Pacific to San Francisco, and thence east via rail. The cost of insurance on these is now only three quarters of one per cent. Rates on the Atlantic have likewise declined. Insurance on dry-goods and like merchandise carried in the modern "liners" is placed at two tenths of one per cent. In other classes of goods depreciation in rates is in like proportion.

Marine underwriters do not ascribe the decline in American marine insurance to any trouble from unwise laws or legislative interference, but to the changed business conditions and to English competition. The bulk of the carrying trade of the world has passed into British hands, and a British merchant and ship owner insures in a British company. The English marine companies have, as well, invaded American soil, and have secured a large portion of the American business. When the English companies first established themselves in America, along in the early seventies, they began cutting rates. The American companies did not effect any combination to prevent this, but followed their example. The American companies were also placed somewhat at a disadvantage by the laws governing the admission of foreign marine-insurance corporations. The foreign companies are required to make a deposit before they can write American business; but in New York State, which has stringent insurance laws, the amount is fixed at the minimum capitalization allowed a home company, namely, $200,000. So much of the carrying trade of the world is done under the British flag and with the aid of British credit, and with countries under British control, that the American underwriter, working against all these disadvantages, is seriously handicapped. Therefore, there being no national or local tariff associations among marine underwriters, the American companies are worsted in this rate war. There are now not enough of them to form any sort of an association which would wield much power.

Despite the work of the American companies to hold their own, through loss of prestige on the ocean and active rivalry on land, there are a number of stock and mutual American marine-insurance companies which continue to do a flourishing business. The largest and one of the oldest is the Atlantic Mutual of New York, which has over $12,000,000 of assets, and has been most carefully managed throughout its career. It was formed in 1842, at the time when many stock companies were turned into mutual companies, and by which change the profits accrue to the policy-holders instead of the stockholders. The company is noted for retaining its faithful and tried officers until their death. The late John P. Jones was connected with the company for 50 years, and was its president for 40. In his life-work of building up the company he was ably assisted by Vice-presidents W. H. H. Moore and A. A. Raven, who have been with the company 30 and 40 years respectively. Among the other large companies which still do a thriving business are the two Boston corporations, the China Mutual and the Boston Marine.

There have never been many marine Lloyds in the United States, though this form of marine insurance has been most in vogue in marine underwriting in Great Britain. The origin of the term is both interesting and peculiar. The name of Lloyd originated in old Lloyd's Tavern, in Tower Street, London, far back in the days of Queen Anne. It was the practice of many ship-owners and traders to drop in at the tavern and talk over their prospective profits; and gradually a custom developed of inscribing their names on a blackboard, certifying that the men signing would be jointly liable for the loss of a vessel during a certain voyage. From this crude beginning have grown the world-famous associations in the British Isles. In the United States there are a few Lloyds, two of the principal ones being located in New York — the United States Lloyds and the New York Marine Underwriters.

The scope and definition of a marine policy is, of course, entirely different from a land fire policy. The risks insured against are many, and may be summarized as including all perils of the sea. There are two classes — a voyage and a time policy; the former is generally used in insuring vessels, and the latter for cargoes. There are naturally many clauses governing marine-insurance policies, such as capture, seizure, war, and so on. The life of the insurance on a ship begins at the port from which it is insured until moored for 24 hours at the port to which it is insured. When an insurance is made on freight to be carried under a charter, the policy attaches as soon as the vessel sails, although she may be destined to a distant port for her cargo.

Though single losses to marine underwriters have been small, compared with some of those of fire underwriters, there have been shipwrecks that have lived in marine insurance men's memories. One of the greatest losses to American marine insurance was that of the American steamer Central America, which foundered off the Cuban coast in September 1857. The Central America was bound from Aspinwall, now Colon, to New York, and was loaded principally with treasure from the California gold-mines. She carried insurance amounting to between $700,000 and $800,000, all of which had to be paid by American underwriters. Another notable loss was that of the steamer Erie, which sailed from Pernambuco, Brazil, loaded with coffee, on 1 Jan. 1893, and was burned at sea. Coffee prices were high in those days, and the Erie went down with $500,000 insurance.

Two losses which not only made inroads on the American marine companies, but which also seriously crippled the growth of American steam transatlantic service, were the sinking of the steamer Arctic, off Newfoundland, in 1854, by collision, and the disappearance of the steamship Pacific, which sailed from Liverpool for New York in January 1856, and was never heard from. Both steamships belonged to the Collins Line, which was the first one to put on steam-vessels for the Atlantic trade. These early losses were particularly detrimental to American marine insurance, because the companies carried extremely heavy lines in those days. Among the recent heavy losses was that of the steamer Oregon, which was run into and sunk off the Long Island coast in 1886. American marine underwriters had between $700,000 and $800,000 on the Oregon's cargo. The loss of the Oregon also showed underwriters how quickly even a properly constructed iron ship sinks. The introduction of iron in place of wood for building vessels has not made any material difference in the rates of insurance, for iron has hazards which wood has not, and *vice versa*.

As to the future of American marine underwriting, it is difficult to prophesy. As trade follows the flag, so marine insurance flourishes in the country with a prosperous merchant marine. The United States is again forging to the front as a great ship-building nation, and this gives American marine underwriters hope that American marine insurance may follow in the wake of the growth of American ship-building.

Insurance Patrol, an organization peculiar to New York and other large cities, which co-operates with the fire department, but is controlled by the combined insurance companies, who support it through the board of fire underwriters. The New York corps was organized in 1835, when there was an epidemic of incendiary fires. The patrol is provided with wagons and an equipment designed for its special work. Its most important service is in saving goods, which it does by removing them from burning buildings, or by covering them with rubber or oiled sheets, as a protection from water, dirt, or cinders. In some cities it is known as salvage corps, or protective association.

Insurance, Science and Economics of. Insurance, to-day, forms an integral element of our social and commercial life. From crude beginnings, the principle of providing, by the contributions of the many to a common fund against the financial consequences of individual losses due to the inherent uncertainties in human affairs, has been perfected until the modern practice of insurance includes all the more important contingencies affecting human welfare. In both science and economics insurance holds a most important position, which becomes more readily apparent as the practice and results of the business are inquired into and considered in their relation to individual and national well being. As a business insurance holds rank as one of the foremost enterprises of the age, equal in importance to banking and transportation. It would, without exaggerating, be as difficult to think of commerce without insurance as of transportation without railroads or the transmission of intelligence without the telegraph. Modern life has become so completely interwoven with the idea of insurance that there are few contingencies affecting life and property to which the principle of insurance has not been more or less successfully applied.

The scientific basis of insurance is the same in all its branches, that is, the laws of chance and probability. In considering any future event we are confronted by the uncertainty whether such an event will or will not happen, but from the facts of experience upon a large scale it is now possible to calculate with sufficient accuracy the monetary equivalent required to meet the risk assumed by an insurance company. The recognition of insurance as a science dates from 1747, when Corbyn Morris published his classical 'Essay Toward Illustrating the Science of Insurance,' wherein he attempted to "fix by precise calculations several important maxims upon this subject." Accuracy and precision is the essence of all scientific method which in its practical application to insurance does not differ in any important essential from the method which underlies all other scientific processes. The larger the mass of facts considered, the more definite must be the resulting conclusions, which for practical purposes are the equivalent of natural laws and confirmed by subsequent experience verifying the truth of the theory assumed.

Insurance science has thus far found its chief development in the department of life contingencies, due, no doubt, to the fact that the average duration of human life and its pecuniary value require to be determined with the greatest possible accuracy, since the contracts made dependent thereon extend, as a rule, over many years. In other forms of insurance, such as fire, marine, and accident, the contracts are generally for short periods, seldom of longer duration than a single year. Hence most of the scientific discussions and the numerous dissertations upon the subject relate chiefly to life contingencies, but there has been a decided improvement in this direction during recent years. The deliberations of associations of actuaries and insurance managers extending over many years, in particular the Institute of Actuaries of Great Britain, are fully entitled to rank, in thoroughness of research and grasp of fundamental principles, with the deliberations of other scientific bodies. It is, no doubt, due to this fact that insurance was included in the most recent classification of the sciences as represented at the International Congress of Arts and Science at Saint Louis, held in connection with the exposition of 1904.

Insurance as a science is a branch of economics, although only a few of the more recent writers on the subject have given careful attention to the theory of risk and insurance in its relation to public welfare. A fairly complete explanation of the economic theory of insurance is to be found in an essay by Allan H. Willett, published by Columbia University in 1901. He holds, and very properly so, that "as a general rule uncertainty exercises a repellent influence in human life, and the existence of risk in an approximate static state causes an economic loss, while (on the other hand) the assumption of risk is a source of gain to society." From this point of view the business of insurance does not differ essentially from general commercial enterprises. Risk is assumed in mining and agriculture in much the same manner as risk is assumed in the business of insurance, but in life insurance, for illustration, the assumption of a risk and the equivalent premium payments required are determined by the theory of probability and the established laws of human mortality and observed experience. In general commercial enterprise the risk assumed is, as a rule, created, while in insurance the risk is pre-existing. This marks the broad division between gambling and insurance. Insurance is not "in the nature of a bet," for in insurance an effort is made to eliminate an existing individual risk by its assumption on the part of the many, while in gambling a non-existing risk is created with resulting uncertainty and needless loss to society.

Insurance companies are chartered institutions with their powers of existence and rights of transacting business derived from the State. They are subject to supervision by special departments in charge of commissioners or superintendents of insurance, who have ample power to inquire into every important detail of office administration. At first the burdens of State supervision were light, since the companies transacted but little business outside of their home

State; but within the last generation the business operations of most of the companies have of necessity been extended to other States and territories. There has, as a result, been developed a vast system of over-supervision, accompanied by an immense amount of over-legislation, much of which is inimical to the highest and broadest development of the business. The position of the commissioner is, as a rule, a political one, subject to the changing fortunes of the parties, and new men have frequently come forward with radical ideas, which, if carried to the extreme, would have resulted disastrously to the companies and their policy-holders. It has been very ably pointed out by Senator John F. Dryden, in an address on 'The Regulation of Insurance by Congress,' that "Insurance is to-day a universal institution reaching all classes and affecting more or less all commercial interests. It is an essential element of human progress and a method and means for the uplifting of the masses to a higher level of economic security. It has become national in character, and few companies confine their operations to a single State: in fact, if operations were so limited they might prove disastrous and make the conduct of the business impossible."

The taxation of insurance is a difficult problem and a matter of serious concern to the companies. In its final analysis the incidence of insurance taxation falls upon the policy-holders and the cost of insurance is correspondingly increased. The fact is overlooked that insurance itself is in the nature of a tax and that additional tax burdens are a needless hindrance to the largest development of the business. In life insurance alone the annual amount paid in taxes, fees, etc., is not far from $10,000,000 and the proportion of taxes to income is constantly increasing, due to additional burdens placed upon the companies as a convenient source of public revenue. A tax upon premiums is an unjust burden upon the business, and is both inexcusable and unscientific. This tax falls alike upon new premiums for risks just incurred and upon renewal premiums upon risks assumed years ago. Since risks assumed years ago were calculated to produce a certain result on the assumption of a known mortality and 4 per cent interest, taxes upon premium payments must necessarily and considerably decrease the returns to participating policy-holders, and increase, in consequence, the cost of insurance. If carried to the extreme, especially in the case of companies which issue only non-participating policies, it is possible that the companies may ultimately be unable to meet their obligations in consequence of a policy on the part of the State which is as unwise as it is unnecessary.

Insurance by government is not a new proposition, but it is only during the last half century that there has been an effective effort to establish an insurance department by government in active competition with private companies. In life insurance the experiments of England and New Zealand are the most valuable because the results are, on the whole, fairly comparable with those of non-governmental institutions. Post-office life insurance in England was established in 1864, and the life insurance department of New Zealand in 1869. The former employs no agents or solicitors, while the latter, in all essentials conforms to the methods and usages of private companies. The premium rates and the results to policy-holders have been about the same, averaging fairly with those of regular companies of good standing. The business results in England have been insignificant, while in New Zealand a fair measure of success has been achieved. In New Zealand at best and at most, the results have not been better, the cost has not been lower, and the security has not been superior to that offered by private institutions, which have increased their business in force at the rate of 51 per cent during the past nine years, against an increase of 16 per cent for the government department. The private companies are gradually gaining on the government, and while in 1894, 49 per cent of the total policies in force were with the government, in 1902 the proportion was only 42 per cent. To those who believe that the government which governs best is the government which governs least, and that the limit of State duties is unduly enlarged by State trading in such directions as these, the New Zealand experiment is conclusive evidence that State effort in the field of life insurance is not likely to produce results superior to those which have made commercial life insurance the most successful business of the age.

As distinct from voluntary insurance by government or private companies, the so-called system of compulsory insurance for workmen holds a unique and important place in the social economy of certain European nations, particularly Germany. The term compulsory insurance is seriously misleading, for as a matter of fact, the system is not insurance at all, but a state provision for workmen against the financial consequences of accidents, sickness, invalidity, and old age. In its inception the German system of government insurance was a measure designed to counteract the socialistic tendency in opposition to the monarchy. In its development it has been made to include nearly the entire body of workmen and as a theory of government and social reform it has unusual attractions. Critically examined, the system is little else than poor relief under another name, and inadequate in many respects as all methods of compulsory thrift must necessarily be. It is insurance in name, but not in fact, for it is not by the sole contributions of the beneficiaries that the required funds are provided, but by the joint and compulsory payments of employer and employee, plus a state subsidy or grant from the general revenue raised by taxation. The evidence as to the economic and social results of this system is so involved and conflicting and subject to such different interpretations, that no final conclusion for or against the system can be advanced at the present time. This much, however, it is safe to say, that the anticipated benefits have not materialized, and the socialistic agitation, although much modified and of a somewhat different character, is to-day more pronounced in Germany than ever before. Nor has compulsory insurance solved the labor problem and brought about a substantial improvement in the relation of capital and labor. The most serious economic aspect is the burden of the system upon German industry and the resulting handicap upon competition in international trade. This explains the anxiety of the German government to induce other nations to follow its example and by means of exhibits, illustrations, and literature advance the cause of government insurance abroad. Even at the present time the system is but in its initial stage, and time alone can prove whether it will ultimately result to the advantage of the German people or otherwise. In the opinion of Prof. Farnam of Yale, an impartial student of the subject, "the supporters of the German system are claiming for it more than the facts of the case as they now stand warrant," and that "The German experience with this kind of insurance seems to show that, while it is possible with a highly trained intelligent administration to carry through a scheme which will compel provision against various contingencies, it has thus far been impossible to create the instinct of forethought and care which is implied where insurance is voluntary. There are many facts which go to create a strong presumption that the result of this governmental care is actually to make people less careful of the future, and less judicious in their expenditure."

Insurance had its origin in private enterprise and it has attained its commanding position as a world force for the betterment of the social condition of mankind through the initiative, ability, and courage of a group of men as much deserving of immortal fame and glory as any other class of benefactors of the human race. State trading in the field of insurance has never advanced the cause by a single important innovation or by a new theory or a material improvement in practice. The necessary reforms and changes as dictated by experience have been brought about by the companies and it is due to these and these alone that the insurance business has become one of colossal magnitude and world-wide extent. The amount of insurance of all kinds in force in the United States has been estimated by the Committee on Insurance Law of the American Bar Association to approximate $50,000,000,000. The aggregate assets of the companies approximate $3,000,000,000, and the American people pay annually for insurance of all kinds approximately $1,000,000,000, while they received from the companies during the year ended 31 Dec. 1904, approximately $800,000,000. These figures are exclusive of the business of many fraternal associations and local mutual fire insurance companies, of which there is no trustworthy or complete record.

No other business so completely enjoys public confidence and has so successfully stood the test of long experience. As the scientific principles of insurance are examined and the highly specialized administration of the companies is considered and the results are measured by a fair standard of benefits in proportion to cost, the verdict of science and economics will agree with that of the mass of mankind, that our social and commercial progress would have been impossible without insurance. Resting upon this broad foundation of human experience and public confidence, the colossal business of modern insurance challenges the admiration of the world.

Bibliography.— Insurance has a literature of its own and a most interesting history extending over more than four centuries, with suggestions of at least a conception of the insurance idea among the most ancient people of whom there is a recorded history. The limitations of this article preclude more than a brief reference to the more recently published works, among which, however, I may mention Willett, 'Economic Theory of Risk and Insurance' (Columbia University Press, New York 1901); the Yale Insurance Lectures 2 vols., C. C. Hine Company, New York 1904); Alexander, 'The Life Insurance Company' (Appleton & Co., New York 1905); Young, 'Insurance' (Isaac Pitman & Sons, London); Dean, 'Fire Rating as a Science' (J. M. Murphy, Chicago 1901); Phelps, 'History of American Insurance During the Last Decade' (American Underwriter, New York 1904); Vance, 'Handbook of the Law of Insurance' (West Pub. Co., St. Paul, Minn., 1904); Wolfe, 'Investments of Insurance Companies' (The Insurance Press, New York 1905). These are but a few of the many books on insurance which have been published during recent years. In addition there are the Insurance Year Books on life, fire, and miscellaneous insurance, published by The Spectator Company, New York, the annual reports of insurance commissioners, some of which contain critical observations on insurance problems of the day, the annual proceedings of underwriters' associations, and the national conventions of insurance commissioners, the special publications of insurance companies, their histories, etc., the discussions on State supervision and Federal regulation of insurance, of which the two more important are an address by John F. Dryden, president of the Prudential Insurance Company of America (1904), and a report of the Committee of the American Bar Association on Insurance, by Ralph W. Breckenridge, chairman, Omaha, Neb. (1905). But the chief source of information regarding insurance practice, the progress of the business, the organization of companies, etc., is to be found in the technical and general insurance periodicals, the 'Insurance Monitor,' 'The Spectator,' the 'Weekly Underwriter,' and the 'Insurance Press,' of New York, the 'Baltimore Underwriter,' of Baltimore, the 'Standard,' of Boston, and many others. The principal publishers of works on insurance are The Spectator Company, New York, and C. and E. Layton, London.

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Statistician of the Prudential Insurance Company of America.

Insurrec'tion, the act of rising against governmental authority, active opposition to the power of the state. In the United States, power to suppress insurrections by employing the militia is given to Congress by the Constitution, Art. I., Sec. 8, Clause 15. In 1792 and 1807 acts were passed giving the President power to call forth the militia when notified by an associate justice of the Supreme Court or a district judge that the execution of the laws is obstructed, and on application of a legislature or a governor, when the legislature could not be convened, and to employ also the land and naval forces of the United States. The Whiskey Insurrection (q.v.) was directed against the Federal authority and the President employed force to suppress it on notification by the Federal judge. During the Buckshot War (q.v.), in 1838, between the Whigs and Democrats in Pennsylvania, the governor of that State asked for assistance, but it was refused. The governor of Rhode Island made a similar application during the Dorr Rebellion (q.v.) and the regulars were held ready for action, but their aid proved unnecessary. These last two cases came under Art. IV., Sec. 4.

of the Federal Constitution, which provides "that the United States shall protect" each State on application of the legislature, or of the executive, against domestic violence.

When the Civil War began the President was obliged to take prompt steps in calling out the militia, though no application had been made to him as required by the acts of 1792 and 1795. His action was justified by Art. II., Sec. 3, of the Constitution, providing that "he shall take care that the laws be faithfully executed," but Congress on 6 Aug. 1861 formally validated and made legal all of President Lincoln's previous acts, proclamations, and orders. The Force Bill (q.v.) of 20 April 1871 gave the President special power to use military force in certain contingencies. In the South during the reconstruction period, and in the North, during strike riots, Federal troops have been used.

Integral Calculus. See CALCULUS, INFINITESIMAL.

In tellect. See MIND; PSYCHOLOGY.

Intent, a legal term signifying the end or object which a person had in the performance of an act, the making of an engagement, or the drawing up of a will. Generally the legal consequences of an act are considered quite independently of the intention or motive of such an act. A wrong done to the person or property of another is punishable at law without consideration of the intentions of the person committing the violence or trespass. But when an engagement has been made by person, or a written disposition of property executed, the intention of the person making the engagement or signing the deed is fair matter for legal inquiry. In this connection a subsequent stipulation by word of mouth is not competent to nullify or modify the terms of a written engagement. Intent also forms an important part in suits for defamation, fraud and negligence. Negligence must have intent to make it criminal, so must defamation and fraud and malicious mischief. Consult Thayer, 'Preliminary Treatise on Evidence' (1898); Black, 'Construction and Interpretation of Laws' (1896); Hardcastle, 'Rules which govern the Construction and Effect of Statutory Law' (1900).

Intent, in psychology, according to James, is that which intelligent consciousness "means or intends"; the intent is a feeling in consciousness which is usually identified or practically identical with the object of consciousness at a particular time. By others, however, the word intent is meant to apply to a certain point of view from which an object may be regarded. Thus when our conscious processes have a unity of interest, there is, as a rule, a certain amount of unity of object. If the interest is divided, more particularly in the attainment of a definite or a wider knowledge, the object as it becomes more perfectly known is identical with the object as previously less perfectly known; and as one's conscious thought is directed continually toward the object, it receives, little by little, further and further definite specification, the detail being more or less in the background; yet the detail is all the time in consciousness, as it were inevitably associated with the object itself. The detailed object, considered by Baldwin as the goal of conscious endeavor, may be called the intent of consciousness. The end pursued becomes defined in the pursuit of it, and so far as it is yet indefinite, and therefore only partially developed in consciousness, it is an intent. Consult Baldwin, 'Dictionary of Philosophy and Psychology,' Vol. I.

Intercollegiate Athletics. See EDUCATIONAL ATHLETICS.

In"tercolumnia'tion, in Greek architecture, the space between two columns. This space is measured in diameters of the foot of the column. Vitruvius mentions five varieties of intercolumniation. These are the *pycnostyle* (that is, with columns thickly ranged) of one diameter and a half, which are least frequently found; the *systyle* (that is, with columns harmoniously ranged) of two diameters, the *diastyle* (that is, with columns far apart) of three diameters, the *areostyle* (that is, with columns sparsely ranged) of four diameters; and the *eustyle* (that is, with columns a due distance apart) of two and a quarter diameters.

Intercontinen'tal Railway, or **Pan-American Railway**, a proposed line of standard gauge, to connect the railway systems of the United States and Mexico with those of the Argentine Republic, utilizing as far as practicable existing systems in Central and South America. At the first International Conference of American States, held in Washington (1889–90) the committee on railway communications said in their report, "That a railroad connecting all or a majority of the nations represented in this conference will contribute greatly to the development of cordial relations between said nations and the growth of their material interests." President Harrison on 19 May 1890 recommended that Congress should make an appropriation for the share of the United States in the expenses of a preliminary survey. Congress complied, and the Intercontinental Railway Commission began its work with A. J. Cassat as chairman and H. G. Davis at the head of the finance committee. The commission spent about $300,000 for surveys, maps, etc., three corps of engineers making experimental surveys between the north of Guatemala and Argentina in 1892, 1893, and 1894. It was found that the approximate length of the line to connect the southeastern boundary of Mexico with Buenos Ayres would be: in Guatemala, 230 miles; Salvador, 220; Honduras, 70; Nicaragua, 224; Costa Rica, 363; Colombia, 1,372; Ecuador, 635; Peru, 1,671; Bolivia, 774, and Argentina, 1,143; total, 6,702. The distance from New York to the Guatemalan frontier is 3,700 miles, and thus the total from New York to Buenos Ayres is 10,471 miles. Links between the termini of the Argentine and Mexican systems: In Bolivia, 192 miles; in Peru, 151 miles; in Nicaragua, 31 miles; in Salvador, 20 miles; in Guatemala, 30 miles. This statement shows that about half of the distance between New York and Buenos Ayres was covered by railways then existing. On 27 Nov. 1901 the Pan-American Railway committee of the Second International Conference held in Mexico City stated that "some additional railroad has been built that could be utilized as a part of a continental system"; that not more than 5,000 miles of road would have to be constructed to establish railway communication between the systems of North and South America; that $200,000,000 would be ample for this work; and that the surveys made by the engineers of the commission demonstrated the practicability of constructing all of the missing links. The concluding assertion, however, should be received with caution. In Central America the proposed line runs along the volcanic coast; on entering South America it is continued among the enormous volcanic Andes, still paralleling the Pacific shore, but further inland. Recommendations made by the committee on 27 Nov. 1901 were that a permanent committee on Pan-American Railway should be appointed "to further the project after the adjournment of the conference"; also that the United States should take the lead in sending "competent and reliable persons whose duty it shall be to determine accurately the resources of the different countries and the condition of railway lines in operation . . . and the prospects for business for an intercontinental line . . . and also to ascertain what concessions or assistance each of the respective governments is willing to grant to the enterprise." The permanent committee appointed by the president of the conference comprised Ex-Senator Henry G. Davis and four others. A special commissioner was sent to the Latin-American republics, as suggested.

In'terdict, an ecclesiastical decree which forbids the performance of certain acts of public worship. When an interdict was laid upon a town, district, or country, all the churches were closed, the bells were silent, the sacraments, except infant baptism and extreme unction (and sometimes even these), were withheld, the rites of burial were not performed, and all the public ceremonies of religion were suspended. Interdicts may be general, as applied to a country or city; particular, as applied to a parish or diocese; personal, as applied to a person, or some class of persons. The bishops seem to have anciently exercised the right of publishing interdicts; for in 870 Hincmar, bishop of Laon in France, issued one against a parish in his diocese. One of the earliest censures of this sort on record was imposed upon the city of Rouen in the 6th century on account of the murder of the Archbishop Pretextatus by order of Queen Fredegonda. In 997 Gregory V. laid the kingdom of France under an interdict because King Robert had married his cousin, and the king was abandoned by most of his court. The same penalty was inflicted upon the kingdom of England under Stephen (1147) by Eugenius III., under John (1207) by Innocent III., under Henry VIII. (1535) with little effect by Paul III., and under Elizabeth (1587) by Sixtus V. Adrian IV. laid Rome under an interdict for the purpose of compelling the Romans to drive out Arnold of Brescia. Gregory IX. made use of the same instrument of compulsion in his quarrel with the emperor Frederic II. During the middle ages the interdict was a powerful engine of attack for the popes in their contests with sovereigns, as the popular dread of its effects was so great that kings were often forced by rebellions to submit to almost any conditions in order that it might be taken off. From the time of the reformation general and local interdicts have become rare. When Paul V. laid Venice under an interdict in 1606, the churches were not closed, and only a minority of the bishops submitted to it.

Interest ("it concerns"— the party in issue — originally an award of damages, later used to evade the anti-interest laws), a charge for the use of money, by custom computed annually, on a basis of so many out of each 100 units loaned; but without diminishing the capital. It is possible to pay interest without loss, because, under conditions now general, the borrowed money can be employed in productive industry, from which a return equal to or greater than the interest can be obtained; or because comfort, prestige, or moral advantages of many kinds are derivable, justifying the expenditure when enough is left. Such borrowing is now useful on the whole, because civilization has ingrained a self-restraint in the masses which makes them in most cases manage money soberly and prudently. But in the early ages this was not so, except in a few developed commercial cities: Babylon carried on business by interest loans, and even bottomry bonds on shipping. Tyre probably did so, the great Athenian commerce was built up entirely by it, as Demosthenes explicitly says, but the mass of people were not fit to have the use of money, had no remunerative employment for it, and borrowed it only to use in self-indulgence, or in desperation because any rate was a choice of evils. There was little property to pledge, and the security was mostly the debtor's person; foreclosure meant selling him for a slave, and the grievance which called for Solon's legislation was the debt-slavery of a large section of the citizens. Hence arose a violent prejudice against the system altogether, as immoral in itself; the law of Moses prohibited it between Jew and Jew; Aristotle says it is essentially immoral, because money cannot breed money (this in the age of Athenian commerce), and never was meant for any such use; the Christian Church inherited the reprobation from the Jewish, and for many centuries forbade its members to take "usury" (money for the use of money, that is, interest at any percentage), and the secular laws were correspondent. In England interest did not become legal till the time of Henry VIII., but had been actually practised for many generations, by legal fictions of partnership or breach of contract, etc.; previously it was in the hands of the Jews — who were so indispensable as financial agents that a Jew who was converted to Christianity had all his property confiscated — and later of the Lombards. The first English permissive statutes fixed 10 per cent as the legal limit that might be charged; early in the 17th century it was set at 5. No serious doubt of the power of governments to regulate the current rate of interest obtainable was entertained till Bentham wrote his 'Defence of Usury' in 1786, proving that the laws could not possibly have any effect; because if the legal rate fixed was equal to or greater than the current rate it could not work any change in it; and if less, holders of money would not lend without obtaining their price plus an insurance for the risk of legal punishment. The doctrine was violently disliked, and has not even yet overcome the determination of the mass to show their dislike of usury by statute, or their belief that they can affect rates; but in a few American States of late years the anti-usury laws have been abolished. Of course a legal rate is always provided in default of contract.

Interest is not a natural right, but a matter of law or contract. The holder of a note payable without stipulation of interest cannot claim any until the note has become due and remains unpaid: thenceforward it draws money at the legal rate. The United States pays no interest on its debts, except where bonds are issued specifying it.

Of the separate States and Territories there is no legal restriction on the rate allowable by contract in Arizona, California, Colorado, Connecticut, Maine, Massachusetts, Montana, Nevada, Rhode Island, Tennessee, Utah or Washington: the legal rate in each is 6 per cent except with Colorado (8), Montana (8), Nevada (7), Utah and Washington (8). The others have rates as follows, the legal rate coming first, then the contract rate permitted: Alabama, 8, 8; Arkansas, 6, 10; Delaware, 6, 6; Florida, 8, 10; Georgia, 7, 8; Idaho, 7, 12; Illinois, 5, 7; Indiana, 6, 8; Iowa, 6, 8; Kansas, 6, 10; Kentucky, 6, 6; Louisiana, 5, 8; Maryland, 6, 6; Michigan, 5, 7; Minnesota, 6, 10; Mississippi, 6, 10; Missouri, 6, 8; Nebraska, 8, 8; New Hampshire, 6, 6; New Jersey, 6, 8; New Mexico, 6, 12; New York, 6, 6; North Carolina, 6, 6; North Dakota, 6, 12; Ohio, 6, 8; Oklahoma, 7, 12; Oregon, 8, 10; Pennsylvania, 6, 6; South Carolina, 7, 8; South Dakota, 7, 12; Texas, 8, 10; Vermont, 6, 6; Virginia, 6, 6; West Virginia, 6, 6; Wisconsin, 7, 10; Wyoming, 8, 12. The rates in the District of Columbia are 6, 10.

That these provisions are more the result of tenacious tradition than of any very exact reasoning is shown by their terms. Only in three States — Illinois, Louisiana, and Michigan — has there been any recent attempt to keep down by law the rate of contractual interest to the rate actually current in the community; in the others, unspecified debts bear 6 to 8 per cent interest while the current rate is 5. As to the contract interest, 11 States stick to the attempt to forbid anything beyond the legal rate; but that assumed interest being above current rates, some leeway is left. One of these, moreover — New York — favors its peculiar interest by allowing any contract rate on "call loans" over $5,000. Sixteen make the rate so high — from 10 to 12 per cent — that any one with the least pretense of credit or security can contract freely; above that, we have to deal with pawnbrokers and 'fences,' the former protected by tacit allowance, the latter amenable only to criminal legislation.

The theories of interest, like most economic principles, are much disputed by economists. The chief theories are those of "abstinence," holding interest to be a reward of abstinence from using up the capital in enjoyment (a variant of this regards it as a result of the general appreciation of the present above the future); of "productivity," holding it to be the return for production by capital in the same way that wages are a return for production by labor; the combination of the two, regarding the return as fixed by supply and demand, the latter depending on productivity and the former on abstinence; and the "monopoly" theory, which considers it a toll levied on the product of labor by the capitalists who control the means of production.

Interest, in psychology, is a term by which at least two or three different things may be meant. On the one hand interest may be defined as the consciousness which accompanies mental tendencies of any sort so far as they are concentrated on mental objects. It is manifested by a certain amount of voluntary attention to which it may be considered a stimulus. The exploiting habit, curiosity, the desire to know, may be defined as primary forms of interest, as distinguished from custom and habit and one's way of regarding things, the former being regarded by Baldwin in the nature of a stimulus to the intellectual function, the latter as frequent performance of a process.

The word also, in the vulgar sense, applies loosely to what is meant by personal advantage; as, for instance, it is "to a man's interest" to obtain such and such.

In pedagogics interest is often looked upon as a form of amusement, a stimulus through the play-instinct to induce intellectual effort. In the science of teaching, the ideal is to awaken an interest in the ends for which pupils study, and that a permanent interest in the ends should be fostered through the means. Baldwin well says that when interest attaches to the end, but not to the means of reaching it, we have drudgery, as in the case of workmen who think only of the dollar, taking no interest in the labor that wins it; on the other hand, when there is interest in the means, but not in the end, we have play, we do not work. When, however, there is interest in the end to be obtained, and also in the means for reaching the end, the ideal of work desirable in education is reached. See Herbart, 'Science of Education'; 'Doctrines of Interest'; Baldwin, 'Story of the Mind'; 'Educational Review,' Vol. X.; Baldwin, 'Dictionary of Philosophy and Psychology,' Vol. I.

Interfer'ence, in physics, is a phenomenon exhibited by wave motion of all kinds, and consists in the coming together of waves having different phases, in such a way that the effects of the waves are either increased or diminished. Interference may be observed when two different trains of waves come together upon the surface of water or any other liquid. Where the crest of a wave belonging to one system coincides with the crest of a wave of the other system, the elevation of the water surface is sensibly equal to the sum of the heights that the separate waves would have if each existed in the same place alone. When a crest of one of the waves coincides with the trough of another, the disturbance of the water surface is reduced, and the elevation (or depression) which results is equal to the difference between the elevation of one of the component waves and the depression of the other one.

The kinds of interference that are of the greatest practical importance in physics are those which occur among sound waves, or among waves of light. The phenomena in these cases are ultimately of the same general sort as those observed upon the surface of water. In the case of sound, interference may even produce entire silence in certain regions, when two trains of sound waves, of equal intensity, are brought together in a suitable manner. A more familiar result of the interference of sound waves, however, is the production of "beats," when two or more trains of waves, having but slightly different wave-length, come together while the two are moving in nearly the same direction. This phenomenon is exhaustively treated in Helmholtz's 'Sensations of Tone,' and it also receives a more or less adequate treatment in all of the better works on physics.

The more familiar of the interference phenomena that are afforded by light are those which are observed in connection with soap bubbles and with very thin plates of transparent solids. Light, upon striking the soap bubble or the thin plate, is reflected toward the eye from both surfaces, and the trains of light waves that reach the eye from these two sources, since they have a slight difference of phase (which varies, moreover, from point to point of the bubble or the plate), interfere with one another so as to produce effects that are often very beautiful and striking. A soap bubble, when viewed by monochromatic light, often appears to be covered with dark striæ; the dark lines being due to the fact that at the points that appear dark the two trains of light-waves, coming respectively from the inner and outer surfaces of the soap bubble, nearly or completely neutralize each other. When the bubble is viewed by white light, we do not commonly see the dark striæ, their places being taken by bands of color. This is because the different colors that compose white light have different wave-lengths, so that at any given point in the bubble only a portion of the colors are destroyed by interference, leaving the remaining constituents of the white light to produce their full chromatic effect upon the eye. See LIGHT; SOUND; PHYSICAL CRYSTALLOGRAPHY.

Inte'rior, Department of the, one of the executive departments of the United States government whose heads are cabinet secretaries. The "home department," long existent in all European governments, was only constituted in this country by act of 3 March 1849. Its functions had previously been exercised by bureaus or officials of nearly all the other departments: patents, copyrights, public documents, and the census belonged to the State Department; public lands, mines, and judicial accounts, to the Treasury: Indian affairs, to the War Department; and pensions to the War and Navy, each for its own pensioners. By later laws the Interior was given charge of education, public surveys (including the geological survey; but the coast and geodetic survey belongs to the Treasury), subsidized railroads, Territories, national parks and reservations, returns of public contracts made by several other departments, some charitable institutions in the District of Columbia, and a number of other matters. The secretary makes an annual report of the number of public documents received and distributed. He has a salary of $10,000, and two assistant secretaries. His office has seven divisions: appointments, disbursements, lands and railroads, Indian affairs, pensions and miscellaneous, public documents, and stationery and printing. Although most of these are managed by commissions appointed by the President, their work is under the secretary's direction, and their reports are made through him. Most of the clerks and subordinate officers in the bureaus are appointed by him. All patents issued by the United States must be signed by him. The first secretary was Thomas Ewing of Ohio.

Interlaken, ĭn'tĕr'läн ĕn ("between the lakes"), Switzerland, village in the canton, and 26 miles southeast of the town of Berne, one mile southeast of Unterseen, beautifully situated near the left bank of the Aar, in the valley of Boedeli, between the lakes of Thun and Brienz. It contains a beautiful old castle and numerous hotels. It is visited annually by 80,000 to 100,000 tourists. Pop. about 2,500.

Internal Improvements, the construction and reparation of roads, bridges, canals, harbors, lighthouses, etc., at the expense of the United States government. The Constitution not having made any provision for such improvements, the execution of public works of this character became subject to the vicissitudes of party politics. Yet since 1789 funds have been perpetually appropriated by Congress for the carrying on of improvements throughout the country, so long as these lay strictly within Federal jurisdiction. Such would include lighthouses, buoys, beacons and public piers, rivers and harbors. The Federalist party, and after it the Democratic party, opposed all improvements on rivers and roads, the benefit of which passes to the several States. Yet in 1806 an appropriation was made for the construction of the Cumberland Road, which should penetrate the Western States and facilitate the mail service, as well as open up unsettled territory to the increasing tide of immigration, and serve for the transportation of troops and army supplies. The Federal Government, about the same time, undertook the construction of a road through Georgia toward New Orleans. In 1898 Congress passed a resolution in which it claimed the power to make appropriations for such internal improvements as the construction of roads and canals, and the maintenance and direction of water courses. Such roads and canals as the President should consider of Federal importance were ordered by Congress to be surveyed, and $300,000 was subscribed to stock of the Chesapeake and Delaware Canal. But there was a wide difference of opinion with regard to the constitutionality of such legislative action, and in May 1822, President Monroe vetoed the Cumberland Road bill. He supported this procedure by the declaration that Congress had acted *ultra vires*. That body, he maintained, had no right under the Constitution to carry out such internal improvements at Federal expense. President Jackson in 1830 followed Monroe's example and vetoed the Maysville Turnpike Road bill. Henceforth, the matter of such internal improvements was left to the legislation of the various States. Jackson had somewhat mitigated the force of his veto by advocating the distribution of the Treasury surplus among the various States, but when the Whigs tried to put this into execution in 1841, President Tyler by his veto put a stop to any such attempts, and they have never since been repeated. The introduction of railroads under the management of private corporations did away with the call for road appropriations, although something like a bonus was given to the projectors of new lines by the vast grants of lands which were made to them. Tracts of 40,000,000 and 50,000,000 acres were thus transferred to railroad companies. At present both the great political parties are inclined to reclaim so much of the public lands thus granted, as has not been earned by a strict fulfilment of the conditions on which the grant was made. The appropriations for internal improvements under the head Rivers and Harbors for the year 1903 was $32,540,199.50 as against $7,4[illegible]23.00 in 1902.

Internal Revenue System, of the United States, properly all taxation except that of foreign goods at customs offices; but in use restricted to what were formerly termed excises (q.v.), on internal trade and manufactures, through a bureau of the Treasury Department, organized 1862. Before that time, though excises had been imposed, they were unpopular and brief. An intense dislike to them had been inherited from England, where they traditionally connoted an independent revenue for the sovereigns to free them from popular control, and arbitrary interference with private business and persons by irresponsible officials, the raw state of trade and manufacture in this country made a general excise system very injurious; and the customs dues amply provided for the expenses.

The first occasion when they were resorted to was just after the adoption of the Constitution. The assumption of the State debts, and other expenses of the new government, compelled Hamilton to recommend an excise, though in the 'Federalist' and elsewhere he had strongly urged its impolicy; he was also anxious to test the power of the government to enforce taxation, which the Articles of Confederation could not. On 3 March 1791 a bill was passed taxing distilled spirits of domestic manufacture. In the then West (western Pennsylvania) the still was like the New England cider mill, but much more important, because the long distances and bad roads made corn unprofitable unless condensed into whiskey, hence there was open revolt, which had to be put down by national troops (1794). Direct resistance ceased, but the tax was largely evaded, and it was two years before it was extended to Kentucky and Tennessee, while the collections in North Carolina were poor. In 1794 the system was extended in fear of a war with England, but owing to unskilful choice of articles or provisions in detail, the only one which produced much was that on sugar, from the high import duty, which gave the home market to the domestic manufacturers, so that what went into excise came off customs. Stamp taxes were laid in 1797, but were of odious associations. With the election of Jefferson as President the whole system came under ban, the Democrats having always opposed it, and on 6 April 1802 the entire internal taxes were repealed, with nearly $700,000 outstanding and uncollected, and which remained so. The dislike was not to the taxes as such, but to the inquisitorial methods of collection involved; and this persisted. But the War of 1812 compelled a renewal of them: unfortunately they were laid so late that the war was over before they began to produce much. They were needed to pay off the war debts, however, and were retained till 23 Dec. 1817. Thence till the Civil War no internal tax of any kind was levied in the United States.

The first real "system" — for the others included but few articles — and which has become a standing part of our system of taxation, was inaugurated 1 July 1862, others followed, placing an enormous and very ill-distributed burden on the people, which they bore uncomplainingly for the end in view. It is almost too complimentary to call it a system, as it was an indiscriminate heaping of taxes upon every stage of every article, on labor and tools, raw materials and finished products, processes and professions. Articles paid sometimes a dozen taxes on the various stages, and another on the final one, before reaching even the wholesaler to begin a round of middlemen's profits. "The only principle recognized," says David A. Wells, 'if it can be called a principle, was akin to that at Donnybrook Fair, 'Wherever you see a head hit it.' "Wherever you find an article, a product, a trade, a profession, or a source of income, tax it!" Within the period 1861–7 no less than 25 revenue bills were passed by Congress. The incessant endeavor was to find new objects of taxation. The industrial effects of the sudden huge unequal burdens, and the political effects of the enormous revenue to spend at discretion, cannot be discussed here. The taxes did not begin to produce largely at once; in 1863 the receipts were $37,640,787.95; in 1864, $109,741,136.10; in 1865, $209,464,215.25; in 1866, the summit, $309,226,813.42. Then the items began to be stricken off, the total sinking by 1873 to $113,729,314.14; able business men have attributed part of the inflation, and consequent panic, to the sudden removal of burdens to which business had adjusted itself. The next year it touched bottom, $102,409,784.90. The taxes by this time had been reduced to about the present status, and tended to increase with the growth of the country, even rising somewhat through the bad years 1875–9. The income tax, though fairly productive — the height being $37,775,873 in 1870 — was dropped in 1872; no other tax was ever so unpopular, from its prying into private secrets, and its working through informers. It is also the one which bears hardest on the most heavily burdened class of the community, the moderately salaried men in various callings. Protection leaders have repeatedly urged or hinted at repeal of all internal taxes, to prevent any reduction of customs duties; but the moral feeling reinforces the economic sense of the people in insisting on liquors and tobacco being taxed. Attempts have been made to increase the revenue from liquors by raising the tax; but the result is the reverse, the premium on fraud being too great. In 1894 the income tax was re-established, but the Supreme Court decided it unconstitutional under its particular terms. On 1 July 1898, to provide for the expenses of the Spanish War, fresh internal taxes were laid; of which the most fertile were stamps on all mercantile papers, telegrams, etc., and on patent medicines, and wines, which yielded in the ensuing fiscal year $43,837,816.66. Special taxes on bankers and amusements, and some other things, yielded several millions. The total receipts in 1899 were $273,484,573.44. In 1901 and 1902 the new taxes were all abolished.

International Brotherhood of Maintenance-of-Way Employees, an American labor union, having a department of fraternal insurance. It was founded at Demopolis, Ala., in 1887, and had a membership in 1903 of 40,000. Since its organization the society has disbursed $500,000 in death and disability benefits. It has secured increased wages for maintenance-of-way employees to the amount of $6,000,000 annually. It was actively engaged in the great strike on the Canadian Pacific Railway in 1901. The strike was settled after a struggle lasting 11 weeks, with the understanding that all members of the brotherhood would be reinstated in their former positions within two weeks; the question of wages to be left to arbitration. Sir John A. Boyd, Chief Justice of Ontario, was chosen chairman of the Board of Arbitration and awarded the employees an increase of 20 per cent over previous wages. The brotherhood holds a charter of affiliation with the American Federation of Labor, and publishes the 'Advance Advocate,' a magazine devoted to the interests of maintenance-of-way employees. See RAILWAY LABOR ORGANIZATIONS.

International Councils of Women. See NATIONAL AND INTERNATIONAL COUNCILS OF WOMEN.

International Date Line, an imaginary line

Map of the world, showing the International date line.

drawn through the Pacific Ocean somewhat irregularly, but tending in a general northerly and southerly direction, and separating the islands of the Pacific Ocean in such a way that all those which lie to the east of it carry the same date as the United States, while all those on the west of it carry the same date as Japan and Australia. The nature of this line may be made clear by the following illustration: A traveler leaves New York city at noon on Sunday, and proceeds westward just as fast as the earth turns on its axis, so that he follows the sun in its apparent westward progress with such precision that he keeps it always directly south of him. It will be noon, therefore, at every place he passes. If, however, he asks the day of the week at every point of his journey, he will be told that it is Sunday at all points in the United States, and even as far west as Hawaii. This can not hold true indefinitely, however, because when he has gone entirely around the world, and has returned to New York, he will have been gone 24 hours, and will therefore be told that it is Monday noon. Everywhere in Europe, too, he would have been told that it is Monday noon.

Yet it has always been the same day to him, and there must have been some place on the journey where he was told, for the first time, that the day was Monday instead of Sunday. At this place, if he wishes to be in accord with the people that he meets, he must arbitrarily change the name of his day from Sunday to Monday. Mariners are in the habit of making the change upon crossing the 180th meridian from Greenwich, England; but this fact is of no service to us if we wish to compare the date carried on one of the Pacific Islands with the corresponding date (say) at New York, because the mariners pay no attention to the local dates on the islands that they pass. The ideal way to find out where the date actually does change would be to canvass the entire Pacific Ocean, so as to find out what date is actually in use on every one of its islands at some given instant. A line drawn from pole to pole in such a manner as to keep all islands bearing one date on one side and all islands bearing the other date on the other side, would afford a perfectly definite basis for the comparison of dates, and would be the true "International Date Line."

No such canvass has yet been made. As a general rule, it may be said that the date now in use upon most of the different islands or groups, is the date which results from the one carried there by the first European or American colonists; and this date will presumably be different according as the colonists came from the east or the west. This is not true universally, however, because arbitrary changes in the date are known to have been made in a number of cases. For example, Alaska was first colonized by the Russians, who brought with them the Russian date. When the American settlers moved there, they carried with them the date of the United States, and this led to some considerable confusion, the Sunday of the Americans being the Monday of the Russians, in spite of the fact that the Russians still use the Julian calendar. In 1867, when Alaska was purchased from Russia, the date in use there was made to conform to that used in the United States. Again, the Philippines were discovered by Magellan, in 1521, and Manila was founded by Lagaspi in 1571. Magellan brought his date from the east, and after the islands were colonized they kept the same date as the Spanish possessions on the opposite side of the Pacific; and they therefore carried a different date from that prevailing on the neighboring Asiatic coast. This was changed in 1844, by the omission of the 31st day of December in that year from the Philippine calendar; this change bringing the date in use in the Philippines into harmony with that prevailing at Hong Kong and other Asiatic ports. The best data at present available indicates that the date line follows substantially the course shown upon the accompanying map.

which is prepared from data furnished by the United States Naval Observatory. This date line is subject to modification, as our knowledge of the dates carried on the various Pacific Islands increases.

International Law. International law as embodied in the practice of states begins with the Peace of Westphalia (1648), which gave rise to modern international society. International law as a branch of jurisprudence begins with the publication in 1625 of the epoch-making treatise of Hugo Grotius entitled 'The Laws of War and Peace' (*De Jure Belli ac Pacis*), although the earlier works of Albericus Gentilis entitled 'De Legationibus' (1585) and 'De Jure Belli' (1588–9, enlarged ed. 1598) were important contributions to the subject, and furnished Grotius with the pattern for a portion of his great book. After the Peace of Westphalia the teachings of Grotius made rapid conquest, and in 1661 the first chair of the law of nations was founded at Heidelberg, with Samuel Pufendorf as the first incumbent. He afterward became professor of jurisprudence at Lund, in Sweden, and while there published his work entitled 'De Jure Naturæ et Gentium' (1672). During the 18th century the publications of Bynkershoek, Wolff, Vattel, Moser, and de Martens contributed to advance and popularize the subject in the schools and among statesmen and military leaders. The work of Vattel in particular became deservedly popular for its practical value as embodying the law of nations as it then was (1758): it has been translated into most of the languages of Europe, and is still frequently referred to and cited. The first half of the 19th century made numerous additions to the list of authoritative writers, among whom may be especially named Henry Wheaton in the United States and Robert Phillimore in England. Of more recent writers the works of Bluntschli, Heffter, Calvo, Pradier-Fodéré, Hall, Lawrence, and Taylor are especially worthy of mention. David Dudley Field drafted an 'Outline of an International Code,' which is interesting as an attempt to codify the whole field of international law.

The term "Law of Nations" was formerly used to denote the body of doctrines governing the relations of independent states or sovereignties. The modern term "International Law" was first coined by Jeremy Bentham, in 1780, and is now everywhere adopted; it has been extended to include both public international law and private international law, but is here employed only in the first and more accurate sense. The phrase "conflict of laws" is better adapted than "private international law" to describe the doubts that may arise in a local court as to whether, in a case involving private rights, the local, territorial law should govern or a foreign, exterritorial law should be applied.

International law consists of that body of rules by which states are habitually controlled in their relations with one another, and by which arbitrators are controlled when authorized to determine international disputes. While it has not all the sanctions of municipal law, it is, as one writer has well said, binding on states in their international relations with a force comparable in nature and degree to that binding the conscientious person to obey the laws of his country, and it is also enforceable by appropriate means in case of infringement. These means are diplomatic negotiations, arbitration, withdrawal of diplomatic relations, so-called pacific blockade, seizure of property, and actual war. In addition, some parts of international law are enforced in the courts. The Supreme Court of the United States has recently said: "International law is a part of our law, and must be administered by the courts of justice of appropriate jurisdictions, as often as questions of right depending upon it are duly presented for their determination. For this purpose, where there is no treaty, and no controlling executive or legislative act or judicial decision, resort must be had to the customs and usages of civilized nations; and, as evidence of these, to the works of jurists and commentators, who, by years of labor, research, and experience, have made themselves peculiarly well acquainted with the subjects of which they treat. Such works are resorted to by judicial tribunals, not for the speculations of their authors concerning what the law ought to be, but for trustworthy evidence of what the law really is." (Paquete Habana v. United States, 175 U. S., 677.)

Owing to the absence of a common superior or sovereign to declare or to enforce the rules of international law, a school of jurists, led by John Austin, and known as the analytical school, has denied that it is law at all and has relegated the system to the domain of international morality. The historical school of jurists, of whom Savigny and Sir Henry Maine are brilliant exponents, has combated this view and has made clear that there have been and still are systems of municipal law in which it cannot be said that there is either a sovereign or a sanction, and that international law corresponds to all systems of law at some stage of their development and to certain archaic survivals still to be observed among primitive peoples. English legal thought has been profoundly influenced by the Austinian conception of law, but on the Continent, and even among English and American jurists of to-day, the historical conception is generally accepted. With the assertion of the primacy of certain great powers and with the establishment of an international tribunal, international law is tending toward an analogue of the common superior and the definite sanctions that now characterize municipal law in the more highly civilized states. There are those who now dream of an authoritative international legislative body, compulsory arbitration, and the enforcement of arbital decrees; but it is doubtful whether these indicia of municipal law are adapted to the peculiar conditions of international relations. It is probable that the same ends will be worked out by international conferences and conventions, and by voluntary arbitration compelled and enforced by enlightened public opinion.

The early publicists sought the basis of international law in the so-called "law of nature," or those principles of justice in which the speculative philosopher affects to see an abstract body of doctrine written in the very nature of man and of society. But the law of nature of the international jurist rested upon a firmer basis than the concepts of speculative philosophy. The 'Jus Gentium' (Law of the Peoples) of the Roman jurists was "the sum of the common ingredients of the customs of the old Italian tribes." It was upon this storehouse of determined and common customs that Grotius and his successors drew for the definite and practical rules of international law, and added them to such customs of modern states as were generally accepted and acted upon in international affairs. Thus arose the law of nations which, under the influence of the revival of Greek thought and speculation, was philosophized into the law of nature. Modern international law has escaped from the domination of speculative philosophy and now speaks in the language of the practical jurist; it is regarded as a branch of jurisprudence and the business of lawyers rather than a branch of philosophy and the concern of schoolmen.

International law rests, then, upon custom, and in this respect differs not at all from municipal law. In the last analysis the practices of states is the authoritative test. As evidence of such practices resort is had to the decisions of courts upon points that may be brought before them for determination, to the decisions of international tribunes to which questions have been referred for arbitration, to treaties and conventions of general application, to the writings of jurists, and to the arguments of statesmen in diplomatic correspondence and state papers. In comparatively recent times there have been negotiated numerous international conventions which correspond to legislative acts and put into definite form the rules to be observed. These sometimes codify the customary law, sometimes change it, and sometimes add to it. Among such great international documents may be named the Declaration of Paris (1856), the Geneva Red Cross Convention (1864), the Declaration of St. Petersburg (1868), the Convention for the Protection of Industrial Property (1883), the Convention for the Protection of Submarine Cables (1884), the Convention for the Repression of the Slave Trade (1890), the Universal Postal Convention (1891), The Hague Convention for the Pacific Settlement of International Disputes (1899), The Hague Convention with respect to the Laws and Customs of War (1899), The Hague Convention to extend to Maritime Warfare the provisions of the Geneva Red Cross Convention (1899). This growing body of international conventions indicates the method by which, in the future, international law may be expected to progress. The common law of international law is not likely to expand beyond its present content; it has either been settled by concurrent custom or its disputed problems have given rise to conflicting schools. It remains for states by international agreement to codify, to reconcile, and to extend the doctrines of the customary law.

Independent, sovereign states are the parties to international law. States whose external sovereignty has been wholly yielded up, as is often the case with members of a confederation or union, cease to have any independent international status. States whose external sovereignty has been limited, but not wholly extinguished, have an international status subject to the limitation imposed, as for example Bulgaria or Cuba. Certain states, like Belgium and Switzerland, have been neutralized, and while still parties to international law are forbidden to engage in offensive warfare. Any limitation upon freedom of international action tends to reduce the state so restricted below the normal status of the parties to international law.

Of the independent, sovereign states only those whose municipal law is essentially similar to that originating in Europe can be said to enjoy to the fullest extent the rights and privileges of international law. With states whose law is of non-European origin, the European and American states have insisted upon treaties under which they exercise through their consular courts an exterritorial jurisdiction inconsistent with the full international equality of such states. Outside of Europe and America only Japan can be said to enjoy full international equality. In Europe the position of Turkey is anomalous. While admitted by the Treaty of Paris (1856) to participate in the advantages of the public law and system of Europe, the powers still maintain there consular courts with exterritorial jurisdiction, as they do in most Asiatic and African states. On the other hand, such exterritorial jurisdiction has been abandoned in Japan, whose municipal law is now modeled upon that of Europe. While other states like China and the Asiatic and African Moslem states, are dealt with in general upon the principles of international law, and are expected to observe the obligations imposed by it and are entitled to its privileges, there is a specific reservation as to some parts of the system, and an underlying, though often unrecognized, difference in the whole spirit of their international relations.

Theoretically the principles of international law rest upon the postulates of the independence and the equality of the states that are parties to it. Practically six states in Europe, one in America, and one in Asia are dominant, and can, and often do, impress their will upon the other states within the sphere of their influence. Great Britain, Germany, France, Russia, Austria-Hungary, and Italy constitute the concert of Europe and settle or leave unsettled questions of European law and politics. The United States occupies the same dominant position in America and has the final voice in the settlement of American questions. Japan has very recently assumed the same dominant position in Asiatic affairs, but it is yet too early to predict how potent or lasting her influence will be in that quarter. While international law may be said to have well defined principles throughout the greater part of its field of action, the play and counterplay of international politics, as practiced by these eight powers, must continue profoundly to influence its application in specific cases of general importance and to determine its progress through international conferences and conventions.

The normal relation of states is that which exists when they are at peace with one another. An abnormal relation is created when two or more of them engage in war, so far at least as their relation to each other and to the neutral states is concerned. If we assume a war to be going on between State A and State B, the normal relation continues among all other states, but the relation of State A to State B is governed by the laws of war, while the relation of each to all other states is affected by the laws of belligerency and of neutrality. There are, then, three situations: the relation of peaceful states to each other; the relation of enemy states to each other; and the relation of belligerent states to peaceful states. Each has its own special code of laws.

Peaceful Relations.—States in times of peace sustain toward each other a relation similar to that of well-disposed citizens in civilized societies. Each possesses and enjoys its own rights with a due regard to the corresponding rights of others. These rights if infringed call for appropriate remedies, the gravest of which is that of self-help or self-defense. Modern states tend more and more to the avoidance of this ultimate form of redress, and the past century, and particularly the past quarter-century, has shown an increasing resort to peaceful arbitration when diplomatic negotiations have proved ineffective. The establishment in 1899 of a permanent arbitration tribunal at The Hague marks a decisive victory for the principle of arbitration. See HAGUE CONFERENCE.

A state may be said to possess these fundamental rights: to preserve its independence and integrity; to determine its own form of government; to acquire and dispose of territory; to protect itself and its citizens or subjects from unjust aggression; to exercise jurisdiction over persons and property within its territory, unless they be exempted by law or by treaty; to exercise jurisdiction over its public and private vessels on the high seas; to exercise jurisdiction over its public vessels, over its legations, and over persons connected with its public vessels and legations, even within the territory of another state. A visiting sovereign or head of a state is also exempt from local jurisdiction.

Some of these rights may be limited by treaty, as in the case of the consular jurisdiction exercised in Oriental states, or by the doctrines of intervention as illustrated by the action of the concert of Europe in numerous cases involving the balance of power or of the United States in cases involving the Monroe Doctrine (q.v.). Especially has the right to acquire or dispose of territory been limited by considerations of international politics.

Intervention is a doctrine of vague limits. Although usually based upon the asserted right of self-preservation, it has been justified upon the grounds of humanity, as in the case of the intervention of the powers in behalf of Greece in 1827 and of the United States in behalf of Cuba in 1898. In such instances it is a moral rather than a legal right, and has been aptly described as "a high act of policy above and beyond the domain of law." The Monroe Doctrine has as one of its purposes the prevention of European intervention in the affairs of the independent American states. On the other hand, the United States has as a fundamental maxim of its diplomacy that of non-intervention in the political affairs of Europe.

The territorial jurisdiction of a state extends to three miles of open sea adjoining its coast. This limit was fixed when that was approximately the distance that could be defended from the shore. With the increase in the range of guns, a proposition to extend the limit to six miles, or even more has been advanced, but has not been acted upon. Such a change in the law could now be made only by a general international agreement. Bays and gulfs not more than six miles wide from headland to headland are within the jurisdiction of the state owning the shores, and some whose mouths are wider than this are conceded to be within the jurisdiction of the local state, especially where the indentation is deep, as in the case of Chesapeake and Delaware bays. Straits not more than six miles wide are within the jurisdiction of the state or states owning the shores; but if they connect waters open to free navigation other states are entitled to navigate them subject to reasonable regulations. The three-mile territorial waters are also free for the innocent navigation of other states, but not for fishing or for naval warfare. Interoceanic canals are regulated by treaty. The Suez Canal is regulated by the treaty of 1888, signed by the six great powers and by the local power, Turkey; the Panama or other possible isthmian canal is regulated by the Hay-Pauncefote treaty of 1901; both are by treaty to be open in time of war or peace to every vessel, public or private, without distinction of flag. River navigation is now, as to all the great rivers flowing through two or more states, also regulated by treaty; prior to such treaties many disputes arose as to the right of an upper riverian state to navigate through the territory of the lower owner to the sea.

Exterritoriality is the name applied to the exercise by one state of jurisdiction within the limits of another state. It extends to visiting sovereigns, diplomatic agents and their families and suites, and visiting public vessels. It is also by The Hague Convention extended to the judges of an arbitration tribunal organized under that convention. Consuls do not enjoy the privilege unless by treaty. In Oriental countries the citizens and subjects of European and American states are by treaty generally subject to the jurisdiction of their own consular courts. In all the above cases the persons concerned are exempt from all local judisriction both civil and criminal. Moreover, local process will not run upon the deck of a visiting public vessel nor within the gates of an embassy or legation. This gives rise to the right of asylum by which political offenders often escape, especially in South American and Oriental countries, by taking refuge in a legation or on board a public vessel. This is a right which is guardedly exercised and is, or should be, never extended to ordinary criminals.

Extradition is the delivery up by one country of criminals who flee to its territory from another. It is regulated by treaty; no state is bound, except under treaty stipulations, to deliver up criminal refugees, and it is doubted whether any constitutional power is lodged anywhere in the United States to do so except under a duly ratified treaty. Political offenders are not subject to extradition.

A state has jurisdiction over aliens within its borders, except those representing another state. It may exclude aliens, and if it admits them it may fix the conditions of such admission. When admitted they are subject to the local laws, except, perhaps, that they cannot be compelled to render military service. But if a state deals unjustly with an alien, or fails to use due diligence to protect him, the state to which he owes allegiance may seek or compel redress.

If a subject of one state is naturalized in another state, a question of double allegiance may be raised. Formerly European states asserted the doctrine of indelible allegiance and did not recognize that a subject could expatriate himself without the consent of the parent state. This seems to have been the common law and is so announced by American writers and judges. But Congress, in 1868, passed an act declaring expatriation to be a natural and inherent right and that any order or decision to the contrary by any officer is inconsistent with the fundamental principles of government. Great Britain in 1870 enacted that any subject who becomes naturalized in a foreign state shall be deemed to have ceased to be a British subject. The United States has treaties with some governments fixing the status of its naturalized citizens. Where there are no such treaties the matter often becomes a delicate and difficult one in case the naturalized citizen returns to his parent state and military service, or some other obligation of citizenship, is there demanded of him.

The high seas are free to all and no state can claim any exclusive jurisdiction in them. The struggle for the establishment of this principle has been a long and difficult one, but with the Bering Sea arbitration of 1893 it may be said to have ended, when the claim of the United States to a property right in fur seal beyond the three-mile limit was decisively rejected. Vessels on the high seas are free from interference in time of peace unless suspected of piracy or slave-trading. Piracy is justiciable everywhere. Slave-trading is not piracy and vessels engaged in it cannot lawfully be visited, searched, or seized by vessels of other nations unless such right be given by treaty. The international convention for the repression of the slave-trade gives such a right within a specified zone adjacent to the coasts of Africa. All neutral merchant vessels are liable to visit and search in time of war by a public vessel of either belligerent. If carrying contraband of war or intending to run a blockade, a neutral merchantman is liable to seizure and detention until a prize court has determined the validity of the capture and whether the vessel or any part of its cargo is subject to condemnation as prize of war.

Relation of Belligerents to Each Other.— War suspends all civil intercourse between states. Formerly the subjects of enemy states were regarded as enemies, but this doctrine is now confined to rendering illegal all contracts and commerce requiring any communication across the lines of hostilities. But a subject of one belligerent residing in the territory of the other is permitted to remain and to carry on business there so long as this does not embarrass the state of his domicile with reference to his protection or the conduct of hostilities. If required to depart or if desirous of doing so, the alien enemy is given a reasonable time in which to withdraw himself and his family and property. The last instance of the forcible detention of alien enemies who were non-combatants was the exercise of this now obsolete right by Napoleon against resident subjects of Great Britain in 1803.

War suspends all executory treaties between the belligerents except those negotiated with a view to hostilities. At the close of the war executed treaties or those of a permanent nature remain undisturbed, but those of a transient nature and subject to change or extinction do not revive unless by express stipulation.

The laws governing armed hostilities on land have been the subject of much codification. The first was that of Professor Lieber, prepared for the American Civil War and adopted in 1863 for the government of the armies of the United States. In 1874 an international European conference at Brussels framed and recommended a code for general adoption, but its work was not ratified. In 1880 the Institute of International Law recommended one prepared by M. Moynier In 1899 The Hague Conference adopted and recommended one based largely on the Brussels code, and this has been ratified by the United States and many other powers. The United States in 1900 promulgated a Naval War Code for the guidance of its naval officers and forces. No international naval code has yet been framed.

Modern warfare seeks to distinguish between combatants and non-combatants, and to give every possible immunity to the latter, while providing for the humane treatment of the former. To this end the laws of war define combatants, provide against unnecessarily cruel weapons or missiles, against the refusal of quarter, and for the proper care of prisoners and of the sick and wounded. The Geneva Red Cross Convention neutralizes hospitals, surgeons, and nurses in land warfare, and The Hague Convention extends the principle to naval hospital ships and their attendants. Non-combatants who refrain from all participation in the war are free from molestation, although when a territory is occupied by the enemy they are required to give a temporary war-allegiance to the conqueror. Non-combatants engaging in hostilities are liable to punishment.

Save in the case of a levy *en masse* to resist invasion, persons in order to be regarded as combatants and entitled to privileges as such, must be commanded by a responsible officer, wear a fixed distinctive emblem recognizable at a distance, carry arms openly, and conduct their operations in accordance with the laws and customs of war.

All weapons are forbidden which cause needless suffering. By the Declaration of Saint Petersburg (1868) no projectile of less weight than 400 grams that is explosive or is charged with fulminating or inflammable substances may be used. By a declaration of The Hague Conference (1899) the launching of projectiles or explosives from balloons was forbidden for five years, but this has now expired by time limitation. The Hague Conference also declared against projectiles the object of which is the diffusion of asphyxiating gases and against bullets which expand or flatten easily in the human body, but the United States delegates did not assent to these propositions.

It is forbidden to use poison, to kill treacherously, to refuse quarter, to make improper use of a flag of truce or a Red Cross badge or ensign, to bombard undefended towns, or to pillage a captured place. The United States Naval Code forbids the use of false colors, though such a deceit has been deemed to be allowable under the older practices.

Private property on the land is now regarded as exempt from capture except in case of military necessity. Pillaging and freebooting are strictly prohibited. Requisitions may be levied for the support of an invading army with a due regard to the resources of the country. It has been found difficult to reconcile the doctrine of the inviolability of private property with the right to levy contributions, and no satisfactory rules have yet been framed to limit the exercise of this right.

Naval warfare has partaken more of the character of freebooting than modern land warfare. Private property is liable to capture. Privateering was long permitted, and is now theoretically admissible unless the belligerents have by treaty agreed to forego it. The Declaration of Paris (1856), assented to by most civilized nations, forbids it. The United States is not a party to this, but in two wars in which it has been engaged since the declaration was issued, it has observed it. Mr. Marcy, secretary of state, offered to assent to it provided the declaration was amended to read. "Privateering is and remains abolished, and the private property of the subjects or citizens of a belligerent on the high seas shall be exempt from seizure by public armed vessels of the other belligerent, except it be contraband." This was not assented to by the other powers. Since that time the United States has frequently sought to secure such an exemption of private property from capture, but as yet without success. All private and public vessels and property of the enemy are liable to capture except hospital ships, coast fishing craft, vessels on voyages of science or discovery, and property devoted to science, education, religion, and art. It is usual to exempt also vessels on voyage to or from a port of the captor at the outbreak of the war and to permit those in its ports a reasonable time to depart. All enemy merchandise in an enemy vessel is liable to capture, but the Declaration of Paris exempts enemy goods in a neutral vessel and neutral goods in an enemy vessel except contraband of war.

Vessels and cargoes captured during the war are taken into a prize court for adjudication. But if the captor cannot spare a prize crew, or there is danger of recapture, they may be sold or destroyed if clearly enemy property, and the papers and other testimony sent to the prize court in order that a judicial decree may be entered. Title to captured property changes only by decree of a competent court. The personnel of a captured merchant vessel of the enemy may be detained as prisoners of war, or as witnesses, or they may be released. Passengers are released at the first convenient port.

Relation of Belligerents and Neutrals.— The doctrines of neutrality have received their chief application since the foundation of the American Republic, and foreign writers give to the early statesmen of that Republic the credit of having done most to ascertain and establish the sound principles upon which neutrals should act toward belligerents. Jefferson summed up the whole matter in one of his felicitous phrases: "It is the right of every nation to prohibit acts of sovereignty from being exercised by any other within its limits. It is the duty of a neutral nation to prohibit such as would injure one of the warring powers." The conduct of M. Genet, the French minister, in using our ports as a base of naval operations in 1793 and in setting up prize courts in them, called for the rigorous application of the doctrines of neutrality, and led to that attitude on the part of our government which has elicited the admiration of all publicists. In 1794 Congress passed an act forbidding American citizens to enlist in the service of a foreign state at war with another state with which the United States is at peace and prohibiting the fitting out of ships of war or armed expeditions within the territory of the United States. This and its amendments were consolidated into the Foreign Enlistment Act of 1818, and the latter has served as a model for similar legislation by other states.

On the one hand each belligerent must observe the inviolability of neutral territory and territorial waters, and on the other the neutral must observe a strict neutrality and impartiality in its attitude toward both belligerents. It may admit their war vessels to its ports, but must so regulate the length of the visit and the amount and nature of supplies as to preserve its neutral duties. The usual rule is a visit of 24 hours, or, if a vessel of the other belligerent is in the same port, 24 hours after the latter has departed. The supplies furnished must be only sufficient to take the vessel to the nearest home port and are not to be again furnished within three months. It cannot be said that the letter of these rules is universally accepted, but the principle involved in them is admitted. An international agreement may be necessary to define them with precision.

To permit a ship of war to be built and equipped by one belligerent in a neutral port is a breach of neutrality. This was so adjudged by the Geneva Arbitration Tribunal in the case of the Alabama, Florida, and Shenandoah, which were built or adapted in England by order of the Confederate government during the American Civil War, and their equipment sent out from England in transports. It has been contended that a ship of war is a legitimate article of commerce, as much so as guns, ammunition, and the like, and that it is merely contraband of war; but the distinctions are marked enough to lead to the rule that neutral states must use due diligence to prevent the fitting out, arming or equipping of such vessels within its jurisdiction.

A neutral state is not bound to prevent its citizens from engaging in contraband commerce with the belligerents; but they do so at the risk that the contraband articles may be captured and condemned. Non-contraband commerce between a neutral state and a belligerent state cannot be interfered with, except by the establishment of an effective blockade.

The right of a belligerent to cut submarine cables has been much discussed of late. Those between belligerent points may be cut anywhere, but it is contended that those between a belligerent and a neutral point can be cut only in belligerent territory, and that those between neutral points cannot be cut at all. This is the provision of the United States Naval Code, but it is likely that an international agreement may be necessary to secure uniformity of action.

Relation of Neutral Individuals to the Belligerents.— Citizens of a neutral state may engage in commerce with either belligerent, subject to the right of the other belligerent to capture neutral vessels carrying contraband of war or intending to run a blockade. But neutral citizens who render belligerent or unneutral service, such as carrying military dispatches, military officers or forces, transmitting signals, and the like, may be treated as quasi-belligerents and their vessels and property may be confiscated. When Messrs. Mason and Slidell, agents of the Confederate government, were taken from the British steamer Trent on a voyage between Havana and England, the British government contended that the act was unwarranted. The United States government, while contending that the agents might lawfully be captured, admitted that in case of capture the vessel must be taken to a prize court and the legality of the capture judicially determined, and as this was not done, released the captives. The penalty for unneutral service is the confiscation of the vessel engaged in it. It is usually stated that neutral mail vessels may be searched for belligerent dispatches, but this right is very cautiously exercised.

Contraband of war consists of goods having a belligerent destination and purpose. It is impossible to fix a definite list or a specific classification of articles deemed contraband. Some are clearly so because their sole purpose is for military operations. Some are clearly not so because their use is exclusively peaceful. Between these lie many important articles which may be used for military or for peaceful purposes, and these are classed as conditionally contraband. The United States Naval Code declares the following to be conditionally contraband: "Coal, when destined for a naval station, or a ship or ships of the enemy; materials for the construction of railways or telegraphs; and money, when such materials or money are destined for the enemy's forces; provisions, when actually destined for the enemy's military or naval forces." Such a list might be extended by including clothing, balloons, bicycles, barbed wire, or any other articles used in warfare and destined for a belligerent. A neutral vessel carrying contraband is liable to capture. If the vessel belongs to the owner of the contraband it also is condemned, but otherwise it is released and the contraband condemned.

The United States Supreme Court decided during the Civil War that contraband goods shipped from England to Nassau, W. I., but with the intent to tranship them there and send them into a Southern port were liable to capture. This is known as the doctrine of "continuous voyage," and has been condemned by some publicists who argue that the destination of the ship should be conclusive as to the destination of the goods. Great Britain seems to have acted upon the same principle, however, in the case of goods shipped to Delagoa Bay during the Boer War in South Africa

Neutral vessels destined for a blockaded port are liable to capture. Blockades in order to be binding must be effective, that is, they must be maintained by a force sufficient to render hazardous the ingress to or egress from a port. A neutral vessel must have notice of the blockade before being liable to capture. This may be given by a general notification to the government of the neutral; but if the vessel sailed before such general notification it is entitled to a special notification which is entered upon its ship papers. Neutral vessels in a port when it is blockaded are allowed a reasonable time to load and depart. The penalty for an attempt to run a blockade is confiscation of vessel and cargo. The officers and crew are not to be deemed prisoners of war but may be detained as witnesses for the hearing of the prize court.

When a vessel is captured it is the duty of the captor to take it into a convenient home port and deliver it into the custody of a prize court. In the United States the district courts are vested with admiralty jurisdiction. Any claimant may appear and contest the legality of the capture. If the vessel or cargo is condemned it is sold and the proceeds paid into the public treasury. Formerly the captors were by law entitled to a portion of the prize money, but by an act passed in 1899 Congress repealed this provision.

The right to capture contraband and to capture vessels bound for a blockaded port carries with it the right to visit and search neutral vessels. A neutral claim has been pressed in recent times to the effect that private merchant vessels under convoy of a public vessel of the same nationality are not subject to visit and search in case the commander of the public vessel certifies that the merchantmen have on board no contraband articles. While this is in some dispute, the United States Naval Code directs naval officers to accept such certificate. A neutral vessel is bound to submit to visit and search unless under convoy, and any attempt to escape or resist, or to destroy her papers or present fraudulent ones, renders her liable to capture. See ALIEN; AMERICAN DIPLOMACY; ARBITRATION; HAGUE CONFERENCE; HIGH SEAS; LAW, MARITIME; NEUTRALITY; UNITED STATES — *Diplomacy*.

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International Peace Conference. See HAGUE CONFERENCE.

International Workingmen's Association, an organization of the workingmen of all countries for the advancement of the interests of labor and the emancipation of the working classes. It grew out of a visit of French workingmen to the World's Exposition at London in 1862. In 1864 an organization was formed in London, and an 'Address and Provisional Rules' published; the rules provided for a general congress to be held annually and a central council appointed by that congress to sit in London; workingmen's societies were to join the International in their corporate capacity. The principles and policy were not then definitely announced; the first congress held at Geneva in 1866 passed resolutions favoring the limitation of the working day and the abolishing of child labor; at the next congress at Lausanne (1867) socialistic principles were first definitely announced; from this time the influence of Marx and his followers grew in the organization. In 1868 at the Brussels congress the International announced its opposition to war, and favored the general strike; at the Basel congress in 1869 Bakunin and the anarchists were admitted; but they were expelled from the association in 1872 at the congress at The Hague; this same congress transferred the seat of the General Council to New York. The anarchists held a separate congress at Geneva in 1873. In 1867 the International rendered substantial aid to the strike of the bronze workers in Paris, and the next year to the strike of the Geneva builders; it assisted the English workmen by preventing the importation of underpaid laborers from the Continent in time of strikes. The International was accused of complicity in the Paris Commune, and while the two had no official connection many of the leaders of the Commune were Internationalists, and its principles and aims were defended by the International. In the United States the Social Party, a socialist political organization, was affiliated with the International in 1868, and later some individual trades-unions were also affiliated; finally the North American Federation of the International was formed and held its first national congress in 1872; its organization was in local sections of at least ten members, with a Federal Council of nine elected by the annual congress. Shortly after the transfer of the General Council to New York the Internationalists took a prominent part in the eight-hour day demonstration in New York. The formal organization of the International was dissolved in 1875; in Europe the Social Democratic parties of the different countries grew out of it, and in the United States the Socialist-Labor party. The anarchist faction in the United States split into two organizations, the International Workingmen's Association and the International Working People's Association. The International was important in the history of the labor movement as being the first expression of the recognition of the common interests of labor in all countries, and as being the means of spreading widely the knowledge of the principles of the Marxian socialism. Consult: Ely, 'French and German Socialism,' and 'The Labor Movement in America'; Villetard, 'History of the International'; Zacher, 'The Red International.'

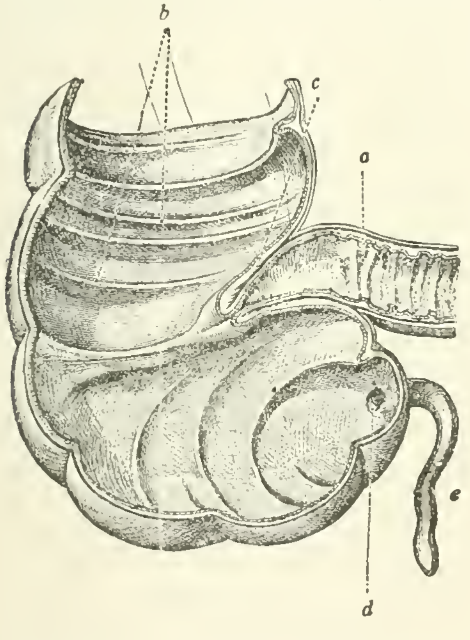
Interstate Commerce Commission. See COMMERCE, INTERSTATE.

Interstate Commerce Law. See COMMERCE, INTERSTATE.

In terval, in music, is the distance or difference of pitch, arithmetically expressed, between any two tones of a given scale. Occidental nations, including America, employ the diatonic scale (see SCALE), an octave comprising five tones and seven semitones, named after the first seven letters of the alphabet. The affix of a flat or sharp before a note denotes its quality but does not affect its name, and the eighth note being in unison commences a new octave. Taking the scale in the key of C major, the various intervals are: minor second = E–F or B–C; grave major second = C–D, F–G, A–B; grave minor third = D–F; minor third = E–G, A–C, B–D; major third = C–E, F–A, or G–B; perfect fourth = C–F, D–G, E–A, G–C′, or B–E′; acute fourth = A–D′; acute augmented fourth = B–F′; grave diminished fifth = B–F′; grave fifth = D–A; perfect fifth = C–G, E–B, F–C′, G–D′, A–E′; minor sixth = E–C′, A–F′, B–G′; major sixth = C–A, D–B, G–E′; acute major sixth = F–D′; grave minor seventh = D–C′, G–F′, B–A′; minor seventh = E–D′, A–G′; seventh = C–B, F–E′; octave = C–C′, D–D′, etc. By taking various notes of the diatonic scale as starting points, and measuring known intervals from these, we arrive at intermediate notes of the scale, of which the following are examples: C♯ minor third below E; D♯ minor second below E; E♭ minor third above C; A♭ minor sixth above C; B♭ minor seventh above C; B♯3 major third above C. The difference of pitch between C and C♯ or between D and D♭ is called a semitone, and an interval increased or diminished by a semitone is said to be augmented or diminished. This applies especially to the interval of a fourth or a fifth, which with the octave are said to be perfect, because any augmentation or diminution mars their consonance. The major sixth or third may, however, be diminished to a "minor" sixth or third without destroying the consonance; and the term "minor" is also applied to the diminished second or seventh. Intervals confined within the octave are simple, when they exceed it compound; the octave beginning a new series, the ninth is the octave of the second, and so forth.

Intes'tacy, the legal state of a person dying without having disposed of his property by last will and testament. In Great Britain intestacy does not affect real estate, which is disposed of in accordance with the rule of descent. The effect of intestacy in Great Britain is merely that no directions have been left for the distribution of personal property. The effect of intestacy in the United States varies in accordance with the laws of inheritance fixed by each of them. Intestacy may be complete, as when a valid will is not left by the dead proprietor; or partial, when the extant will only provides for the distribution of part of the property. In these cases the property passes to the heirs or next of kin of the decedent in accordance with the laws of the place where the property is. See DESCENT; HEIR; INHERITANCE.

Intestine, Bowel, or Gut, the alimentary tube, in the higher animals limited to that portion between the stomach and the outlet at the anus. The human intestine is divided into the small and large intestine, the two parts varying in structure, movement, and function. The small intestine starts at the pylorus of the stomach, as the duodenum, and the first eight or ten inches are so distinguished. This portion is the widest and most deeply placed of the parts of the small intestine. About three or four inches below the pylorus the ducts of the gall-bladder and pancreas open conjointly into the bowel. The duodenum emerges from the cover of the peritoneum and becomes the jejunum. The remainder of the small intestine constitutes the jejunum (about two fifths) and the ileum. Between these divisions there is little difference, except that the jejunum is more freely movable, occupies the upper left portion of the abdomen more than the lower and right, and has thicker walls. The lumen of the small intestine gradually grows less from the duodenum, where it is two inches and a half in diameter, to little more than an inch where the ileum empties into the large intestine. The ileum is inserted several inches above the actual beginning of the large intestine, so that a blind pouch is formed below the point of juncture; this pouch, called the cæcum, gives off the appendix vermiformis (see APPENDICITIS) from its lower and back part. From the cæcum the large bowel passes up to the under surface of the liver as the ascending colon (see COLON), thence across the abdomen below the lower border of the stomach as the transverse colon, turns down to the iliac fossa as the descending colon, forms a peculiar S-shaped curve, the sigmoid flexure, which passes over the brim of the pelvis, where it is called the rectum (q.v.). The large bowel is about six feet in length. Both bowels have four coats, the mucous coat, the submucous, the muscular, and over most of the bowel an investment of peritoneum forming the serous coat. In the small intestine the mucous membrane is thrown up into permanent folds, each extending over half-way around the inside of the bowel. In this way a large surface is exposed for the absorption of food. Furthermore, the inner surface is covered with finger-like projections called villi, each having a large absorbing vessel in its centre. At the bases of the villi are tubular (of Lieberkuhn) and branching glands (of Brunner) that dip down into the mucous membrane. Scattered over the surface there are tiny collections of lymphoid tissue, called solitary follicles, and here and there collections of these follicles into groups one to three inches long, called Peyer's patches. It is these spots that are attacked and ulcerated in typhoid fever. The muscular coat consists in an inner layer running around the bowel and an outer longitudinal coat. The large bowel differs from the small in the absence of the folds and villi, and is but slightly movable within the abdomen, being bound down to the abdominal wall posteriorly by the peritoneum. (See PHYSIOLOGY.)



Section of the Ileum and Cæcum: *a*, ileum; *b*, cæcum; *c*, ileocæcal valve; *d*, opening of the appendix; *e*, appendix.

Diseases of the Intestine.— These may be disturbances of the function of the bowels without actual inflammation, or they may be inflammations in different parts and of different kinds; but with inflammations there is necessarily a disturbance of the various functions, and differentiation frequently becomes a matter of difficulty. Diarrhœa and constipation (qq.v.) are symptoms of many different conditions, as are also deficiencies of secretion and absorption. The nervous mechanism of the bowels may be changed, giving rise to abnormal sensations and disturbance of all the functions. True inflammation of the intestines is the most common cause of abnormal action, and therefore is described in detail.

Acute Intestinal Catarrh is an inflammation of the mucous membrane that varies much in its symptomatology with the part of the bowel affected and the causative agent. Among the causes may be mentioned the eating of tainted fruits and other foods; the overeating of any food; overdrinking, particularly of very cold liquids; the injestion of chemical or mechanical irritants; "catching cold"; and the poisons of the infectious diseases. The bowel is inhabited by numerous forms of micro-organisms, many of which are entirely harmless; but when any of the various agencies mentioned above affect the mucous membrane, the micro-organisms are able to attack the damaged surface. Many forms of bacteria produce particular types of disease when they find such lodgment, because they invade the system with their peculiar products. (See CHOLERA INFANTUM; CHOLERA; DYSENTERY.) But to the growth of bacteria must always be ascribed some of the symptoms in any intestinal catarrh. The attack usually starts in acutely with fever, general bodily discomfort, and abdominal pain. If the inflammation be confined to the upper part of the small intestine there may be constipation; but this is uncommon, and diarrhœa is the rule. Inflammation of the small intestine is spoken of as enteritis, but this is usually associated with more or less inflammation of the large bowel, called colitis (q.v.), although it may occur alone even in its last portion, the rectum. The pain in colitis is apt to be confined to the sides of the abdomen, and when the inflammation is low down there is constant desire to defecate, pain accompanying the act. Passage of mucus alone also indicates an inflammation low down in the rectum. The stools in acute intestinal catarrh vary much with the cause of the trouble; in some observed cases of dysentery the discharges are like rice-water. Treatment of these conditions depends upon the severity and location of the inflammation. The mild cases, with ordinary loose movements, recover without medication with abstinence from food for 24 hours. Castor-oil or small doses of calomel will cleanse the intestine of irritating substances. The more severe cases are kept in bed and allowed small amounts of milk after the first day, and are given small doses of castor-oil or mixtures of bismuth, opium, and other sedative drugs. If the large intestine is found to be involved, irrigation with common salt in water (teaspoonful to the quart) is valuable. Great care must be used in the selection of diet for some time.

Duodenitis occurs associated with acute gastritis (q.v.), and has the same symptoms, except for the presence of jaundice due to the closure of the bile-ducts. The disease runs its course ordinarily in a few weeks without any treatment except rest in bed for a few days, simple diet, and mild cathartics to relieve the constipation. *Chronic intestinal catarrh* results from a severe attack of acute inflammation in which the mucous membrane is left with permanent changes, or from repeated attacks of inflammation. Cases of chronic inflammation may occur without previous evidence of acute attacks. The symptoms vary much in kind and intensity, but pain, flatulence, and disturbance of the bowels are usually complained of. There may be pronounced constipation, alternating constipation and diarrhœa, daily unformed movements not distinctly diarrhœal, or, what is most common, a constant diarrhœa. More or less admixture of mucus in the stools is usually observed. Sooner or later there is apt to be a loss of flesh and strength. When the large bowel is much involved in such a process there is usually a coating of the stools with mucus, or the passage of clear mucus.

In the treatment it is best to rely mainly on carefully regulated life — exercise, baths, fresh air, sufficient rest, avoidance of exposure, and properly selected diet. In diet the objects sought are the regulation of the bowels and the avoidance of irritation. When there is diarrhœa it is wise to avoid fruits, salads, cabbage, coarse-fibred breads, sugars, honey, pastry, sour and sweet wines, and carbonic beverages. In cases attended with constipation most of these may be allowed, but sausages, rich dressings, cucumbers, cabbage, and very coarse-fibred breads should be forbidden. Mineral waters are frequently used with success, such springs as Carlsbad and Vichy for the diarrhœal cases, and such as Marienbad, Hathorn, and Congress for those attended with constipation. Chronic catarrh of the large bowel is treated with small doses of castor-oil and irrigations of the bowel with water, to which may be added antiseptics or astringents.

Intestinal Hemorrhage, or blood passed from the bowel, may be due to piles, tumors, dysentery, colitis, typhoid fever, tuberculosis of the intestinal tract, ulcers of the duodenum, portal obstruction as in cirrhosis of the liver, hæmophilia, purpura, and the hemorrhagic forms of the infectious diseases. When blood coming from the stomach or high up in the small intestine is passed by rectum it is changed to a tarry appearance. This is due to the action of the digestive juices and bacteria. The farther down the intestine the blood starts, the brighter red is it found when passed.

Intestinal Obstruction.— This is a term that includes a great variety of conditions in the abdomen having the common feature of obstruction to the passage of the contents along the bowel; and in addition there is in the acute condition some injury to the bowel resulting in special symptoms. Two varieties are differentiated, the acute and the chronic. Acute intestinal obstructions are caused by foreign bodies, gall-stones, and hardened or large collections of fæces in the canal; by contracting scars, or tumors of the wall, twists of the gut (volvulus), intussusceptions (invagination of a portion above into the part below); by adhesions of the peritoneum, causing constricting bands; and by strangulations of portions of the bowel contained in hernia. Besides these causes, from local or general peritonitis there is apt to be a condition of paralysis of a portion of the bowel, giving rise to the same state. The symptoms vary considerably with the cause of the obstruction and the part of the bowel affected, but in general the symptoms are pain — frequently of a colicky sort — constipation, inability to pass gas — with resulting tympanites — vomiting, first from the shock, and later from reversed peristalsis, until at length the vomitus is bilious and finally even fæcal. Because of these symptoms and the injury to the nerves of the intestine resulting in "shock," there is a gradually increasing prostration. Certain features indicating that the obstruction is in the small intestine are early vomiting, the passage of fæces from the lower bowel, and the greater swelling of the centre of the abdomen. Absolute constipation from the first is apt to mean an obstruction low down in the large bowel. The cause of the obstruction may be indicated by the presence of a tumor, or by something in the previous history. Intussusception is the most common cause of the obstruction in children; a tumor may be felt on the outside, or the bowel may be felt in the rectum. Fæcal impaction is indicated by a long history of constipation, and rectal examination shows the hardened masses. If intestinal obstruction be not relieved, the patient may die of shock, with gradual exhaustion, from gangrene of the bowel — the blood-supply being usually shut off — and sometimes from peritonitis.

Medical measures for the relief of most forms of the malady are not successful, and temporizing is attended with danger; but rest of the body as a whole, and especially of the intestinal tract, must be absolute. Some authorities advise the use of opium for further quieting the intestine when the diagnosis is certain. Lavage of the stomach is of great value, and large enemata may be curative when the cause of the trouble is intussusception, foreign body, or hardened fæces. Most forms of obstruction require the opening of the abdomen, search for the cause of the obstruction, and attempts at removal. Results depend on the quickness with which operation is undertaken; death may ensue, in spite of the removal of the obstruction, if interference be too long postponed. Chronic intestinal obstruction is caused by about the same conditions as the acute variety. The symptoms include various digestive disturbances, flatulency, constipation, and, when due to malignant growths, the general loss of flesh and strength.

Intestinal Parasites.— Three principal forms of these affect man — tapeworms, roundworms, and pinworms (qq.v.) The list of symptoms attributed to the presence of tapeworms in the human intestine is long and varied, but even loss of nutrition from such a parasite's presence is usually slight. Finding the worms or their eggs in the stools is the only convincing symptom. Treatment of this condition consists first in the preparation of the intestine by light diet for 24 hours before the tænifuge is given and six or eight hours before, allowing a liberal diet of onions, salty herring, and garlic; this rather loosens the worm's hold. Mild purgatives may also be given at this time. Early on the following morning the selected drug is taken, and this may be either male-fern, pomegranate, pumpkin-seed, kousso, or kamala. After about 12 hours a brisk cathartic is taken and the worm is passed. Careful search must be made for the head, for unless it is passed treatment must be started again while the worm is yet weak. Santonin and purgatives effect expulsion of roundworms. In the treatment of pinworms it is customary to take advantage of the fact that the females deposit their eggs in the large intestine and rectum. Santonin

and cathartics aid in gathering the worms where they may be killed by injections of benzine (20 drops to the pint of water), or by solutions of quinine, though further catharsis may be necessary. DUDLEY D. ROBERTS, M.D.,
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Inton'ing, the practice of delivering prayers in the recitative form. Intoning differs little from chanting: in the latter case the cadence is more developed, the divisions more rhythmical, and the music in continuous harmony. In intoning the greater part of the prayer is recited on one note, and then sung by several voices in unison, the closing words of the sentence being sung to the proximate notes of the scale and in harmony. The practice of intoning prevails in the Greek, Roman, Anglican, and Lutheran Churches.

Intoxica'tion (literally poisoning, commonly restricted to poisoning by means of alcohol, for a discussion of which latter see ALCOHOLISM). Intoxication in the sense of poisoning may result from poisons having their origin outside of the human body (exogenous poisoning), or from poisons which may be developed within the body itself (endogenous poisoning, or auto-intoxication). Some of the most important problems connected with the infectious diseases concern themselves with the study of the intoxications that result from the formation of toxins by specific bacteria distributed throughout the human body during the course of a disease. From the same point of view many of the most complicated intoxications result from variations in the normal metabolism of the body. Thus in diabetes mellitus (q.v.) there is developed an acid intoxication (diabetic coma), which is due to the inability of the body properly to neutralize by its alkaline salts the excessive amounts of acid produced as a result of the perverted metabolism of this disease. Similarly in Bright's disease a type of intoxication (uræmic poisoning) results from failure of the kidneys to eliminate poisonous products from the human body. It seems not unlikely that a number of diseases such as migraine (sick headache), some forms of epileptic convulsions, different types of skin-eruptions, and some of the mild insanities result from auto-intoxication (q.v.). See TOXICOLOGY.

Introduced Species. A long catalogue might be made of species of animals and plants which have been transferred by accident or design from their native country or locality to other regions. Sometimes, as in the case of salmon in New Zealand, rabbits in Australia, the European house-sparrow in America and elsewhere, or western fishes in eastern waters, this is done by design; but in the great majority of cases the introduction is accidental and unwelcome, as in the case of the hundred and more species of injurious insects brought into the United States from foreign lands (or the fewer sent abroad from here), and the very many species of «weeds» naturalized on our and other shores. Such introductions are in the main accidental, the eggs or seeds or grown individuals passing from one region to another in ships or railway trains, or cargoes or discharged ballast; so many plants have been introduced by the latter means that botanists class the group of alien weeds as «ballast plants.» See ACCLIMATIZATION; ZOOGEOGRAPHY.

Intuba'tion, the introduction of a tube into an orifice or an organ, as the larynx, to keep it open. Specially designed tubes for such a purpose are sometimes used in cases of croup, diphtheritic obstruction, etc., as a substitute for tracheotomy.

In'ulin, a substance resembling starch, but intermediate in nature between that body and the gums. It occurs in the roots of elecampane, dandelion, and certain other plants, and also in the Jerusalem artichoke and the common potato. When pure it is a tasteless white powder consisting of spherical particles. Its chemical formula is probably a multiple of $C_6H_{10}O_5$, though $C_{72}H_{124}O_{62}$ has been suggested. It is insoluble in alcohol, and but slightly soluble in cold water, although it is very hygroscopic. It dissolves freely in hot water. It melts at 320° F., becoming thereby converted into a different substance known as «pyro-inulin.» It is not fermentable, and does not reduce Fehling's solution. Iodine renders it brown or yellow.

Invariants and Covariants. 1. These terms were introduced, and are still ordinarily employed, in connection with a special mathematical theory, namely, the theory of the linear transformation of algebraic forms developed by Cayley and Sylvester during the middle third of the nineteenth century. The central idea, however, is a very general one, which has been applied in recent years to almost all branches of mathematics. It deserves, in fact, to be ranked with such fundamental concepts as function and group. We therefore divide our sketch into three parts as follows: (1) The general concept of invariant; (2) The theory of algebraic forms, or invariants in the narrow sense; (3) Other invariant theories.

THE GENERAL CONCEPT.

2. The suggestion for the formation of the concept comes from the familiar observation, at the bottom of all science and philosophy, that, while the world about us is in a continual state of change, there are yet certain aspects or properties which are unaltered. To find the permanent in the changing is the most general statement of the problem of invariants. Abstractly, the idea may be explained more definitely as follows: Consider a set of objects or elements O of any conceivable kind, finite or infinite in number; and a set of operations or transformations T, each of which interchanges the objects in a definite manner. Then a property of an object O is said to be *invariant*, provided it holds for all the objects obtained from the given O by the transformations T. Similarly, any relation between a number of O's which holds for the transformed O's is said to be an invariant relation, that is, an invariant relation of the given objects with respect to the given transformations.

The idea of *covariant* involves nothing essentially new. An object $\overline{O}$ is said to be a covariant of a given number of objects O_1, O_2, etc., provided $\overline{O}$ is invariantly related to O_1, O_2, ... In this case, if any one of the transformations T converts $\overline{O}$ into $\overline{O}'$, O_1 into O_1', O_2 into O_2', etc., then the relations connecting $\overline{O}'$ with O_1', O_2', etc., are the same as those connecting $\overline{O}$ with O_1, O_2, etc.

3. The idea is best illustrated by examples from geometry. Consider a number of points P_1, P_2, . . . , connected with a solid body. When the body is displaced, its points take new positions, P_1', P_2', ... Many such positions are possible, since the displacement may be made in an endless number of ways. But in every case, of course, the distance between P_1' and P_2' is the same as that between P_1 and P_2. That is, distances between points are invariant with respect to rigid displacement.

Suppose next that the solid carrying the points is not only displaced but is magnified (or diminished) according to any scale. (We may, for example, picture such a change as produced by subjecting the homogeneous solid to a higher or lower temperature.) The solid is then converted into one of different size but of the same shape, that is, a similar solid. Distances are changed in the same ratio. Hence $P_1'P_2' : P_2'P_3' = P_1P_2 : P_2P_3$. That is, the ratio of any two distances is invariant with respect to similitude transformations.

4. In both examples, points on a straight line are converted into points on a straight line. Collinearity is then a relation which is invariant with respect to displacements and similitude transformations. A more general type of transformation for which this is true is the homographic or projective transformation. We consider, for simplicity, only the case of figures drawn in a plane M. From a fixed point (termed the center of projection) outside of M draw lines to the various points of M until they intersect a second plane M'. Thus, every point P in M is associated with a definite point P' in M'. The operation of passing from a figure in M to the corresponding figure in M' is termed projection. Concretely, we may think of the center of projection as a source of light and the figure in M' as the shadow of that in M.*

If we consider three points P_1, P_2, P_3 on a straight line in M, they are converted, by projection, into points P_1', P_2', P_3' on a straight line in M'. But in general the distances and also the ratios of distances will differ. In fact, three points have no invariant, since they may be converted into three points at arbitrarily assigned distances by a suitable projection. If, however, we take four points (on a straight line) it may be shown that, for any projection,

$$\frac{P_1P_3}{P_3P_2} : \frac{P_1P_4}{P_4P_2} = \frac{P_1'P_3'}{P_3'P_2'} : \frac{P_1'P_4'}{P_4'P_2'}.$$

In each member of this equation we have a combination of the distances between four points which is termed their cross ratio (anharmonic ratio). Hence the cross ratio of four collinear points is invariant with respect to projective transformation.

5. Let the figures considered be all the ellipses of a plane. With respect to displacement an ellipse has two invariants, the major and the minor axis. With respect to similitude transformation, there is one invariant, the ratio of the axes, or what is essentially the same, the eccentricity. Finally, in the projective theory there are no invariants, since one ellipse may be converted into any other (and even into any proper conic).

In this connection we may illustrate the notion of a covariant. The center of an ellipse is a covariant with respect to displacement and magnification, but not with respect to projection. For if the plane containing an ellipse E and its center C is displaced or magnified, so that ellipse E is converted into another ellipse E' and the point C is converted into a point C', then C' is necessarily the center of E'; while under projection this is not the case. A similar result holds for the center of gravity of any figure, plane or solid.

6. Another well-known type of transformation is that known as inversion. Take a fixed circle F with center C and radius r, and suppose that any point P of the plane is converted into the point P' situated on the line CP, so that $CP \cdot CP' = r^2$. The points P, P' are then said to be inverse with respect to the circle F. By the inverse of a curve is meant the locus of the points inverse to the points of the curve. The collinear relation of points is no longer invariant, for a straight line (not passing through C) is converted into a circle. An arbitrary circle is converted into a circle, but the center of the circle is not a covariant point. The most important property of the transformation is this: the angle at which any two curves intersect is equal to the angle at which the inverse curves intersect. Angles are invariant with respect to geometric inversion.

7. We pass now to a few simple examples of the general definition in No. 2, in which the objects and transformations are analytic instead of geometric.

Let the objects O be functions of any number of variables, and let the operations T performed on these functions be the permutation of the variables involved. A function written down at random, for example $x^2 - 2yz$, changes its form when say x and y are interchanged. There are exceptional functions, like $x^2 + y^2 + z^2$ and $xy + yz + xz$, which are not altered by interchanging the variables in any way, and are termed symmetric. The symmetric functions are invariant with respect to permutation of the variables.

In the differential calculus it is shown that the exponential function e^x has the property of being its own derivative. The only functions which are invariant with respect to the process of differentiation are in fact those of the form ae^x, where a is a constant. It is obvious that if the first derivative is equal to the original function, all the higher derivatives will also be equal to the function.

The trigonometric functions have a period of 2π or $360°$. Such a function $f(x)$ is unaltered in value when x is replaced by $x + 2\pi$. It is obvious that the double application of the operation, that is, the replacing of x by $x + 4\pi$, will also leave $f(x)$ invariant. The periodic character thus involves the invariance of the function with respect to all the operations $(x, x + 2k\pi)$ (this denotes the replacing of x by $x + 2k\pi$), where k is any integer. We note here that if one of these operations, say that of adding $2k'\pi$ to the angle, is followed by another, say that of adding $2k''\pi$, the result is the same as the single operation of adding $2(k' + k'')\pi$, which is a member of the set. The set of operations thus possesses the essential property of a GROUP.

8. In general, if an invariant is found with respect to certain operations, T_1, T_2, . . . , the

* It is, however, necessary to include the ideal shadow formed by producing the rays away from M.

invariance also holds for all combinations of these operations. Adding these combinations to the original operations, a set is finally obtained with the group property; this is then termed the group generated by the given operations.

Thus, in connection with No. 6, since angles are unaltered by inversion with respect to any circle, it follows that they are unaltered by successive inversion with respect to a number of circles. The inversions themselves do not constitute a group; but the totality of combinations is the important group of circular transformations which are expressed analytically by the linear transformations of a complex variable and of its conjugate.

9. The general problem of the mathematical theory of invariants may now be restated as follows: Given any group of transformations, and any set of configurations (mathematical objects) which are converted into one another by these transformations, to find the properties of the configurations which remain unaltered. There are thus as many types of invariant theories as there are types of groups and types of configurations. The distinction according to groups is the more fundamental.

10. The relation between the concepts invariant and group is thus very intimate. Suppose that instead of assigning transformations and seeking invariants, the question is inverted: Given a property or a function, find the transformations which leave it invariant.

Thus, if space is to be deformed so as to leave the distance between every pair of points unaltered, the deformation must be simply a displacement. The totality of displacements forms a group; for if one displacement is followed by a second, the effect is the same as that due to a single displacement. In general the totality of transformations defined by one or more invariants is a group. Many groups are defined in this way.

11. In connection with any group this question may be asked: Given two configurations, is it possible to convert the one into the other by a transformation belonging to the assigned group? If this is the case, the configurations are said to be *equivalent* with respect to the group.

Thus, two figures are equivalent with respect to the displacement group when they are congruent; they are equivalent with respect to the similitude group when they are similar. The study of equivalence with respect to the projective group is the main object of projective geometry; its systematic analytic treatment depends upon the theory of algebraic forms considered below.

The importance of the notion of equivalence depends upon the fact that equivalent configurations necessarily have the same invariant functions and properties. Thus in studying the projective properties of (proper) conics, it is sufficient to consider the case of a circle. The circle may thus be taken as the *type* or *canonical form* of the class of conics.

The Theory of Algebraic Forms.

12. This part of modern algebra deals with the invariants of algebraic forms with respect to the group of linear transformations. It has been variously termed the theory of forms, the algebra of quantics, the algebra of linear transformations, the linear or projective invariant theory. Traces of the idea may be found in papers by Lagrange, Gauss, and Cauchy; and simple results on quadric forms were given by G. Boole (1841); but the construction of the systematic theory begins with the memoirs of A. Cayley (1845–) and J. J. Sylvester * (1851–). The recent developments are due mainly to German and Italian mathematicians.

13. The objects considered are algebraic forms. A *form* or *quantic* is a rational integral homogeneous function of any number of variables. Forms are classified according to the number of variables and the degree in which they are involved. A *binary* form involves two variables; a *ternary*, three; a *quaternary*, four; in the general case of p variables the adjective p-ary is employed. The degree in which the variables enter is termed the *order* of the form; we denote it in general by n. If n is one, the form is linear; if two, quadric (or quadratic); if three, cubic; if four, quartic (biquadratic); etc.

Thus the binary cubic form is

$$ax^3+bx^2y+cxy^2+dy^3,$$

where x, y are the variables and a, b, c, d the coefficients. It is usual, however, to distinguish the variables and the coefficients by subscripts, a notation which has the advantage of generality and symmetry; also binomial coefficients are introduced. Thus the above form is written

$$a_0x_1^{\,3}+3a_1x_1^{\,2}x_2+3a_2x_1x_2^{\,2}+a_3x_2^{\,3}.$$

The ternary quadric is

$$a_{11}x_1^{\,2}+a_{22}x_2^{\,2}+a_{33}x_3^{\,2}+2a_{23}x_2x_3+2a_{13}x_1x_3+2a_{12}x_1x_2.$$

The general binary form is

$$(1)\quad a_0x_1^{\,n}+\frac{n}{1}x_1^{\,n-1}x_2 +\frac{n(n-1)}{1\cdot 2}x_1^{\,n-2}x_2^{\,2}+\ldots+a_nx_2^{\,n}.$$

14. The group employed consists of the totality of linear transformations of the variables. A linear transformation from the original variables $x_1, x_2, \ldots x_p$ to the new variables $X_1, X_2, \ldots X_p$ is defined by p equations of the first degree, as follows:

$$\begin{aligned} x_1&=l_{11}X_1+l_{12}X_2+\ldots+l_{1p}X_p,\\ x_2&=l_{21}X_1+l_{22}X_2+\ldots+l_{2p}X_p,\\ &\ldots\ldots\ldots\ldots\\ x_p&=l_{p1}X_1+l_{p2}X_2+\ldots+l_{pp}X_p. \end{aligned}$$

The determinant

$$\Delta=|l_{ij}|,$$

whose elements are the p^2 coefficients in these equations, is termed the *modulus* of the transformation. It is assumed that Δ does not vanish; for in the latter case the X's cannot be expressed in terms of the x's, that is, the transformation is not reversible.

We shall deal mainly with binary variables and then employ the simpler notation

$$(2)\qquad x_1=l_1X_1+m_1X_2,\quad x_2=l_2X_1+m_2X_2.$$

The modulus is $\Delta=l_1m_2-l_2m_1$.

* Most of the technical terms employed (including invariant, covariant, form) are due to Sylvester, who gloried in the title of "The Mathematical Adam."

15. When a linear transformation is carried out on a form, the latter is converted into a form of the same order containing the new variables. The coefficients of this transformed quantic depend of course upon the transformation employed. Thus if in the quadric

$$f \equiv a_0x_1^2 + 2a_1x_1x_2 + a_2x_2^2$$

we make the substitution (2), the result is a new quadric,

$$F \equiv A_0X_1^2 + 2A_1X_1X_2 + A_2X_2^2,$$

where

$$A_0 = l_1^2a_0 + 2l_1l_2a_1 + l_2^2a_2,$$
$$A_1 = l_1m_1a_0 + (l_1m_2 + l_2m_1)a_1 + l_2m_2a_2,$$
$$A_2 = m_1^2a_0 + 2m_1m_2a_1 + m_2^2a_2.$$

It is easy to verify that

$$A_0A_2 - A_1^2 = (l_1m_2 - l_2m_1)^2(a_0a_2 - a_1^2).$$

According to the general definition in No. 2, the function $a_0a_2 - a_1^2$ is not an invariant function, since it is not equal to $A_0A_2 - A_1^2$; but the relation $a_0a_2 - a_1^2 = 0$ is invariant, since its fulfillment necessitates $A_0A_2 - A_1^2 = 0$. This is sometimes expressed by saying that the function is a *relative* invariant.

It is usual, however, to modify somewhat the general definition as follows: A function of the coefficients of a quantic is said to have the invariant property when it is equal to the same function of the coefficients of the transformed quantic, except for a factor depending only upon the coefficients of the linear transformation. Thus if $\phi(a)$ is such a function, where a denotes the coefficients collectively, and if A denotes the coefficients in the new form, then

$$(3) \qquad \phi(A) = M\phi(a),$$

where M depends only on the transformation coefficients.

All such functions can be expressed in terms of rational integral functions with the same property. These are termed simply invariants. Thus an *invariant* is a rational integral function of the coefficients with the property expressed by (3).

16. A *covariant* of a quantic differs from an invariant only in that it involves both the coefficients and the variables. Its defining property is expressed by

$$(3') \qquad \phi(A, X) = M\phi(a, x).$$

Thus the binary cubic

$$a_0x_1^3 + 3a_1x_1^2x_2 + 3a_2x_1x_2^2 + a_3x_2^3$$

has the covariant

$$(a_0a_2 - a_1^2)x_1^2 + (a_0a_3 - a_1a_2)x_1x_2 + (a_1a_3 - a_2^2)x_2^2;$$

for when the cubic is linearly transformed, it is found that the corresponding expression

$$(A_0A_2 - A_1^2)X_1^2 + (A_0A_3 - A_1A_2)X_1X_2 + (A_1A_3 - A_2^2)X_2^2,$$

built from the new coefficients and variables, reduces to the original expression multiplied by $(l_1m_2 - l_2m_1)^2$.

17. Invariants and covariants are collectively termed concomitants or, more simply, *comitants*. We give now a few of their important general properties.

A comitant is homogeneous in the coefficients (a) and in the variables (x). Its dimension in the former is termed its degree (d); its dimension in the latter, its order (m). For an invariant, of course, $m = 0$.

The factor M produced by the linear transformation is for every comitant an entire power of the modulus Δ. Hence

$$(4) \qquad \phi(A, X) = \Delta^w\phi(a, x).$$

The exponent w is termed the *weight* of the comitant.

The proof of the first theorem depends on the use of linear transformations of the special type $x_1 = \rho X_1$, $x_2 = \rho X_2$; that of the second theorem depends on the group property of linear transformations and the fact that Δ is not factorable.

18. The weight w, order m, and degree d of any comitant of a binary n-ic are connected by the relation

$$2w = nd - m.$$

This holds in the example given in No. 16, where $n = 3$, $m = 2$, $d = 2$, $w = 2$.

Taking $m = 0$ and n odd, we have the corollary: A binary form of odd order cannot have an invariant of odd degree.

When n is even, so is m. Hence a binary form of even order cannot have a covariant of odd order.

19. The preceding definitions and theorems may readily be extended to *simultaneous* comitants, that is, invariants and covariants of two or more forms.

20. An important process for the formation of simultaneous comitants depends on this principle: If in an invariant $\phi(a_0, a_1, \ldots a_n)$ of a single form f, we substitute $a_0 + \kappa b_0$ for a_0, $a_1 + \kappa b_1$ for a_1, etc., and expand the result according to powers of κ, the first term is the original invariant $\phi(a)$, the coefficient of κ^d is the corresponding invariant $\phi(b)$ of a form g with coefficients $b_0, b_1, \ldots b_n$, and the remaining coefficients are simultaneous invaraints of f and g.

For example, when this principle is applied to the invariant $a_0a_2 - a_1^2$ of a quadric $f = a_0x_1^2 + 2a_1x_1x_2 + a_2x_2^2$, we have

$$(a_0 + \kappa b_0)(a_2 + \kappa b_2) - (a_1 + \kappa b_1)^2$$
$$= a_0a_2 - a_1^2 + \kappa(a_0b_2 - 2a_1b_1 + a_2b_0) + \kappa^2(b_0b_2 - b_1^2).$$

It follows that $a_0b_2 - 2a_1b_1 + a_2b_0$ is a simultaneous invariant of f and $g = b_0x_1^2 + 2b_1x_1x_2 + b_2x_2^2$.

The coefficient of the first power of κ, by Taylor's theorem, is

$$b_0\frac{\partial\phi}{\partial a_0} + b_1\frac{\partial\phi}{\partial a_1} + \ldots + b_n\frac{\partial\phi}{\partial a_n}.$$

Hence if the operation $b_0\dfrac{\partial}{\partial a_0} + b_1\dfrac{\partial}{\partial a_1} + \ldots + b_n\dfrac{\partial}{\partial a_n}$ is applied to an invariant of a single form, the result is an invariant of two forms. The operation is known as the *Aronhold process*.

21. In the domain of simultaneous comitants the distinction between invariants and covariants may be said to disappear. All the covariants of a form f may be obtained from the simultaneous invariants of f and a linear

form $u_1x_1 + u_2x_2$ by the substitution of x_2 for u_1 and $-x_1$ for u_2.

22. *Geometric Interpretation.*—If a binary form f of nth order is equated to zero, the resulting equation, by the fundamental theorem of algebra, determines n values of the ratio $x_1 : x_2$. Taking $x_1 : x_2$ as homogeneous coordinates of a point on a straight line, we thus obtain a definite set of n points corresponding to the form f. Conversely, if a set of n points is given, the form f is determined (except for a numerical factor).

Linear transformation of x_1, x_2 has the same effect upon the points of the line as the projection of the given line upon a second followed by the displacement of the second line upon the first. Hence an invariant of f equated to zero represents a projective relation between the corresponding n points, that is, a relation not altered by the process of projection. Similarly, a covariant of order m represents a set of m points projectively related to points defined by f.

Thus, the vanishing of the invariant $a_0a_2 - a_1^2$ of a quadric form means that the two root points coincide. Again, the vanishing of $a_0b_2 - 2a_1b_1 + a_2b_0$, derived in No. 21, means that the pairs of points represented by the two quadrics are situated harmonically.

The interpretation often suggests the invariant character of complicated algebraic functions. For example, the *resultant* of two equations, $f = 0$, $g = 0$ (that is, the expression which vanishes when and only when the equations have a common root), is a simultaneous invariant of f and g. The condition that the equation $f = 0$ shall have equal roots leads to an invariant termed the *discriminant* of f.

23. *Absolute Invariants.*—By considering fractional instead of integral functions of the coefficients, it is possible to obtain *absolute invariants*, that is, functions which are unaltered by linear transformation. The factor M in (3) is then unity. An absolute invariant is necessarily the ratio of two (relative) invariants having the same weight. We give an example in connection with the form of fourth order. Here there are two invariants I and J with weights 3 and 2 respectively. Linear transformation affects them as follows: $I' = \Delta^3 I$, $J' = \Delta^2 J$. Hence $I'^3/J'^2 = I^3/J^2$. That is, I^3/J^2 is an absolute invariant.

Geometrically, every absolute invariant of any number of forms is expressible in terms of cross ratios of the corresponding points.

24. *The Symbolic Notation.*—The most powerful method for attacking the general problem of our subject, the determination of all the comitants of any number of forms and their interrelations, is the so-called *symbolic* method. The origin of the method is to be found in Cayley's hyperdeterminants (1845), but the symbolic notation itself is due to Aronhold (1859). The general theory was developed by Clebsch and Gordan (1870–).

A binary form of nth order is represented by the nth power of a linear form,

$$f = (\alpha_1 x_1 + \alpha_2 x_2)^n.$$

Here the α's are merely symbols which have a real meaning only in the combinations

$$\alpha_1^n = a_0,\ \alpha_1^{n-1}\alpha_2 = a_1,\ \alpha_1^{n-2}\alpha_2^2 = a_2,\ \dots,\ \alpha_2^n = a_n.$$

The Roman letters denote real coefficients and the Greek letters symbolic coefficients. The latter were termed *umbrae* (shadows of quantities) by Sylvester.

A combination of α's of dimension $< n$ has no real meaning. On the other hand, if the dimension is a multiple of n, there are several corresponding real quantities. Thus $\alpha_1^{2n-2}\alpha_2^2$ represents both a_0a_2 and a_1^2. This ambiguity is removed by introducing several equivalent sets of umbral quantities, each entering in precisely the nth dimension. We abbreviate by writing $\alpha_1x_1 + \alpha_2x_2 = \alpha_x$, $\beta_1x_1 + \beta_2x_2 = \beta_x$, etc. The given form is then

$$f = \alpha_x^n = \beta_x^n = \gamma_x^n, \text{ etc.}$$

The fundamental theorem is as follows: Every comitant of binary forms f is expressible symbolically as a combination of determinants of the type $(\alpha\beta) = \alpha_1\beta_2 - \alpha_2\beta_1$ and linear factors of the type $\alpha_x = \alpha_1x_1 + \alpha_2x_2$. In the case of invariants, only the determinants are involved. Conversely, all combinations of these two types (in which each set of symbols is involved in the proper dimension) represent comitants.*

Thus the quadric $f = \alpha_x^2 = \beta_x^2$ has the invariant $(\alpha\beta)^2$. Expanding, we have

$$(\alpha_1\beta_2 - \alpha_2\beta_1)^2 = \alpha_1^2\beta_2^2 - 2\alpha_1\alpha_2\beta_1\beta_2 + \alpha_2^2\beta_1^2$$
$$= a_0a_2 - 2a_1a_1 + a_2a_0,$$

which is simply twice the discriminant $a_0a_2 - a_1^2$.

25. *Transvectants.*—Among the comitants of two forms, $f = \alpha_x^n$, $g = \beta_x^m$ (here α and β are non-equivalent symbols), those represented by $(\alpha\beta)^\kappa \alpha_x^{n-\kappa}\beta_x^{m-\kappa}$ are of special importance, since they are of the first degree in each set of coefficients. They are termed the *transvectants* of f and g and are denoted by $(f, g)_\kappa$. Gordan has shown that all comitants may be derived by the repeated application of the process of transvection.

The first transvectant of two forms is termed their *Jacobian*; its non-symbolic value is $\dfrac{\partial f}{\partial x_1}\dfrac{\partial g}{\partial x_2} - \dfrac{\partial f}{\partial x_2}\dfrac{\partial g}{\partial x_1}$. The transvectant $(f, f)_2$ is termed the *Hessian* of f; its non-symbolic value is $\dfrac{\partial^2 f}{\partial x_1^2}\dfrac{\partial^2 f}{\partial x_2^2} - \left(\dfrac{\partial^2 f}{\partial x_1 \partial x_2}\right)^2$.

26. *Complete Systems.*—In general, a set of forms has an infinite number of comitants. Thus any entire power of a comitant, or a product of powers of two comitants, is also a comitant. It is evident, however, that there cannot exist an infinite number of algebraically independent comitants, since all are functions of a finite number of coefficients and variables. The following result is fundamental in the systematic theory: For a given set of forms there exist a finite number of comitants such that every comitant of the forms is a rational integral function of the selected comitants. The latter constitute the *complete system* of the given forms.

The proof was first given by Gordan (1870) by means of the symbolic method. It has since been simplified and generalized by numerous investigators—in particular, Hilbert.

27. We now give the complete systems for the forms of order 1, 2, 3, 4:

* Sylvester observed certain formal analogies between this symbolism and that employed in chemistry and developed a so-called chemico-algebraic theory. See Grace and Young, (Algebra of Invariants,) Cambridge, 1903, p. 366.

Linear form. No invariant; the only covariant is the given form $f=\alpha_x$.

Quadric form. One invariant (the discriminant) $D=(\alpha\beta)^2$; one covariant $f=\alpha_x^2$.

Cubic form. The only invariant is the discriminant $R=(\alpha\beta)^2(\alpha\gamma)(\beta\delta)(\gamma\delta)^2$; in addition to $f=\alpha_x^3$, there are two covariants, $H=(\alpha\beta)^2\alpha_x\beta_x$ (the Hessian of f) and $Q=(\alpha\beta)^2(\alpha\gamma)\beta_x\gamma_x^2$ (the Jacobian of f and H).

Quartic form. Two invariants, $I=(\alpha\beta)^4$, $J=(\alpha\beta)^2(\beta\gamma)^2(\gamma\alpha)^2$; three covariants, the given form $f=\alpha_x^4$, its Hessian $H=(\alpha\beta)^2\alpha_x^2\beta_x^2$, and the Jacobian of f and H, namley, $T=(\alpha\beta)^2(\alpha\gamma)\alpha_x\beta_x^2\gamma_x^3$.

Every invariant of the quartic form is thus a rational integral function of I and J; every comitant is a rational integral function of I, J, f, H, T.

28. The systems given are *irreducible;* that is, no member of a system can be expressed as a rational integral function of the other members of the system.

Complete irreducible systems have been calculated for single forms up to the order 10, and for pairs of forms up to the order 4. The system of the quintic contains twenty-three members.

While the finiteness of the system is assured, no general formula for the exact number of irreducible comitants is known.

29. *Ternary Forms.*—Many of the results stated for the binary case apply with little change to ultrabinary forms. There are, however, certain aspects of the general theory which are disguised when only the binary case is studied.

Consider a ternary form $f(x_1, x_2, x_3)$ of nth order. (The symbolic representation is α_x^n, where $\alpha_x=\alpha_1x_1+\alpha_2x_2+\alpha_3x_3$.) If x_1, x_2, x_3 are taken as the homogeneous coordinates of a point in a plane, the equation $f=0$ defines a curve of nth order. The vanishing of an invariant denotes a projective property of the curve. A covariant defines a curve which is projectively related to the original curve.

The principle of duality suggests the introduction of line coördinates u_1, u_2, u_3. When the x's undergo a linear transformation, the u's undergo another linear transformation which is said to be *contragredient* to the first. A function involving the u's and having the invariant property is termed a *contravariant* of f. Geometrically it represents a curve considered as the envelope of its tangent lines. A *mixed* comitant is one involving both point coordinates and line coordinates; geometrically it defines a so-called *connex.*

The complete system of the ternary quadric $f=\alpha_x^2$ consists of the covariant f, the invariant $D=(\alpha\beta\gamma)^2$, the contravariant $F=(\alpha\beta u)^2$, and the so-called identical form u_x. (Here $(\alpha\beta\gamma)$ represents a determinant of third order $|\alpha_1\beta_2\gamma_3|$.) Geometrically, $f=0$ represents a conic considered as a point locus, $F=0$ represents the same conic regarded as line envelope, and $D=0$ denotes that the conic degenerates to a pair of straight lines.

30. *Quaternary Forms.*—Here the essentially new feature is that in addition to point coordinates (x_1, x_2, x_3, x_4) and the dual plane coordinates (u_1, u_2, u_3, u_4) it is necessary to consider line coordinates $(p_{12}, p_{13}, p_{14}, p_{34}, p_{42}, p_{23})$. Comitants may contain, besides the coefficients of the given form, any combination of these types of variables. Little advance has yet been made in the complete treatment of even the simpler cases.

31. Gordan's method for proving the existence of a complete system applies only to binary forms. The proof for forms of any kind (including multiple forms containing two or more sets of variables) was first given by Hilbert (1890). The basis of his method is the following theorem, which has many important applications:

In any assemblage containing an infinite number of forms it is possible to select a finite number of members F_1, F_2, . . . , F_r, so that every member can be written $F=P_1F_1+P_2F_2+\ldots+P_rF_r$, where the P's are forms not belonging necessarily to the given assemblage.

Other Invariant Theories.

32. *Special Linear Transformations.*—Forms have been treated with respect to linear transformations of special type. Thus the transformations $x_1=\alpha X_1+\beta$, $y_1=\alpha Y_1$ lead to the so-called *seminvariants* of binary forms.

Again, the formulas for passing from one system of rectangular coördinates to another,

$$
(5)\qquad \begin{aligned} x &= X\cos\theta - Y\sin\theta + h,\\ y &= X\sin\theta + Y\cos\theta + k, \end{aligned}
$$

constitute a special linear group. Invariants with respect to this group are termed Cartesian or metric or orthogonal. In the case of the conic $ax^2+bxy+cy^2+dx+ey+f=0$, there are three such invariants, $a+c$, b^2-4ac, and the discriminant. The latter is the only one which is invariant in the projective theory. If $a+c=0$ the conic is a rectangular hyperbola; if $b^2-4ac=0$, it is a parabola.

For any number of variables the linear transformations which leave a given quadric form unchanged constitute a type of group which arises in many applications (line and circle geometries geometry on a quadric surface, etc.).

33. The general method of finding the invariants of any continuous group involving a finite number of parameters is due to Sophus Lie. An r parameter group is generated by r independent infinitesimal transformations; these determine a set of r partial differential equations whose solutions are the invariant functions.

34. A *differential invariant* is one that contains the derivatives of the variables. Thus for the group (5) the expression $\dfrac{y''}{(1+y'^2)^{\frac{3}{2}}}$ is a differential invariant. It represents in fact the curvature of an arbitrary curve at a point; this is obviously independent of the system of axes to which the curve is referred.

35. Special theories of invariants have been constructed in connection with *differential equations.* Thus an ordinary linear equation,

$$
\frac{d^ny}{dx^n}+p_1(x)\frac{d^{n-1}y}{dx^{n-1}}+\ldots+p_n(x)=0,
$$

is converted into an equation of the same kind by the substitution $x=\phi(X)$, $y=Y\psi(X)$. The totality of substitutions here forms an infinite continuous group, since ϕ and ψ are arbitrary functions. By an invariant of the equation is meant a function of the coefficients p_1, p_2, . . . and their derivatives, which retains its value (except perhaps for a factor depending on the transformation) when formed from the coefficients of the new equation.

36. *Differential Forms.*—In the theory of surfaces the distance between two consecutive points of the surface is given by the formula

$$ds^2 = E(u, v)du^2 + 2F(u, v)du\,dv + G(u, v)dv^2.$$

The second member is a binary quadratic differential form. Such forms possess a theory of invariants with respect to arbitrary change of variables. Any change is expressed by $u = \phi(U, V)$, $v = \psi(U, V)$, where ϕ, ψ are arbitrary functions. The simplest example of an invariant is the expression, depending on E, F, G and their partial derivatives, which represents the Gaussian curvature.

37. *Arithmetical Theory of Forms.*—In this theory, inaugurated by Gauss, the coefficients and variables involved are supposed to be whole numbers. Attention has been confined mainly to the binary quadratic $ax^2 + 2bxy + cy^2$. The transformations are defined by $x = \alpha X + \beta Y$, $y = \gamma X + \delta Y$, where the coefficients α, β, γ, δ are integers such that $\alpha\delta - \beta\gamma \neq 0$. In this case, then, the group is discontinuous.

38. *Automorphic Functions.*—Such discontinuous groups arise also in the theory of functions. Thus in No. 7 it was seen that the trigonometric functions are unaltered by the substitutions $x = X + 2k\pi$. Similarly, a doubly periodic function (of a complex variable) is invariant with respect to $z = Z + k_1w_1 + k_2w_2$, where w_1, w_2 are the given periods and k_1, k_2 are arbitrary integers. The modular function is invariant with respect to the linear group $z = (\alpha Z + \beta)/(\gamma Z + \delta)$, where α, β, γ, δ are integers such that $\alpha\delta - \beta\gamma = 1$. The problem of finding all functions which admit an infinite discontinuous group of linear transformations is one of the most important in recent investigation. Such functions are termed *automorphic.* They have been classified by Poincaré into Fuchsian and Kleinian according as the defining group involves real or complex coefficients.

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Invasion, the entry into a country by a public enemy. As early as 1795 Congress provided by law for protection against the invasion of the United States by any foreign nation or Indian tribe. The act made it lawful whenever there should be an invasion, or imminent danger of one, for the President to call out such number of the militia of the State or States convenient to the place of invasion as he might think necessary to repel it. This, strengthened in some respects by amendments, has been in force ever since. An invasion has usually all the elements of war, and the invaders may be dealt with as persons at war with the country invaded, in accordance with usages of warfare without the declaration of war by Congress. The Supreme Court of the United States has decided that a State is invaded when there is a domestic rebellion within its territory, and that the same rules of law may be enforced as in the case of an invasion by external foes. This decision practically abolishes all distinction between invasion and insurrection, and the same rules which furnish a remedy for invasion can be applied in the suppression of an insurrection or local rebellion. In case the State militia is not sufficiently strong, or not easily available, the standing troops of the United States may be ordered out by the President, if indeed it be necessary to call upon the State troops before resorting to the regular troops of the United States. It is not necessary that actual armed violence shall be resorted to in order to constitute insurrection. Any combination of persons too powerful to be suppressed by the ordinary course of judicial proceedings is tantamount to insurrection, and warrants the use of the effective measures provided for by law for its suppression.

As regards the rights of the invader many rules have been laid down, carefully distinguishing between invasion and conquest, especially with respect to private and public property. It is now held that public money, military stores, and public buildings with their contents are lawful sources of plunder, and telegraph and rail way property may be used as needs require The unwarranted burning of the capitol and other public buildings in Washington by the British in 1814; the removal of the Palatine libraries during the Thirty Years' War; the confiscation of the astronomical instruments in the Observatory of Peking by the Germans during the operations of the Allies against the Chinese capital—all these were in direct violation of the accepted rules of invasion. The levying of supplies, labor, forage, transportation facilities, etc., upon the native people is strictly within the lawful confines of invasion; for example, during the wars of Frederick the Great, both the Austrians and the Prussians were mainly supported by these enforced contributions of supplies. Napoleon was probably the greatest exponent of the belief that a war should support itself, either during the conflict, or by imposing a large indemnity, or both; hence we see that he exacted of Prussia, after the battle of Jena, more than a hundred million francs, and Spain was also forced during the Peninsular War to pay a similar amount. The pillage of private property is strictly prohibited, but should the owners give aid to their country, the property may be sold at the discretion of the invading general.

Inventions. The progress of the world in its numerous vast industries and arts has been founded, to a very large extent, upon inventions and discoveries and their subsequent development. Under the American patent law and system, inventors all over the world are stimulated to make public their inventions by reason of receiving in exchange a monopoly in the form of a patent on the invention for a period of 17 years. The remarkable increase in the number of protected inventions is shown by the records of the United States Patent Office, as follows: At the end of the first year (1790) 3 patents were issued. In the year ending 1902, 27,13[illegible] patents were granted. The total number of patents issued from April 1790 to November 1903 was 75[illegible].

An invention is recognized to be any new or useful mechanical contrivance or article, method, discovery, composition of matter, or system not previously known or used, or any improvement on any known machine, art, method, or system. Below is given in chronological order a list of important inventions beginning with the 16th century, with the title of the invention, the year it was made, the name of the inventor and his nativity:

Inventions	Date	Inventor	Nativity
Discoveries of Electrical Phenomena. With the title of "founder of the science of electricity."	1580 1603	William Gilbert	England
Screw printing-press	1620	Blaew	Germany
Spirally grooved rifle barrel	1620	Koster	England
Iron furnaces	1621	Lord Dudley	England
The use of steam ... The first authentic reference in English literature to the use of steam in the arts.	1630	David Ramseye	England
Bay Psalm Book, first book published in the Colonies	1640		Mass.
Barometer	1643	Torricelli	Italy
Steam engine, atmospheric pressure	1705	Thomas Newcomen	England
Machine for generating electricity	1681-6	Otto von Guericke	Germany
First paper mill in America	1690	William Rittenhouse	Penna.
First steam engine with a piston	1690	Denys Papin	France
The manufacture of plate glass established	[illegible]		France
First [illegible] conductors and [illegible]	1700 172[illegible]	Stephen Gray	England
The first [illegible] steam [illegible]	1702	Thomas Savery	England
First newspaper in America [illegible] News Letter	170[illegible]	John Campbell	Mass.
First [illegible]	[illegible]	Dr. J. Wall	England
Thermometer	[illegible]	Fahrenheit	Danzig
[illegible]	[illegible]	[illegible]	England
T[illegible]	[illegible]	Benjamin Franklin	Utd. States
F[illegible]	[illegible]	[illegible]	France
S[illegible]	[illegible]	[illegible]	Scotland
F[illegible]	[illegible]	[illegible] d[illegible]	France
F[illegible]	[illegible]	[illegible]	England
R[illegible]	[illegible]	[illegible]	England
F[illegible]	[illegible]	[illegible]	Germany
S[illegible] for [illegible]	[illegible]	[illegible]	England
Lightning [illegible]	[illegible]	[illegible]	Utd. States
S[illegible]	[illegible]	[illegible]	England
Piano forte, played in public in England in	1767		England
Drawing rolls in a spinning machine	1769	Richard Arkwright	England
The introduction of the "Hollander" or beating engine for pulping rags in the manufacture of paper	1773		
The mule spinner	1774	Samuel Crampton	England
Cut nails	1775	Jeremiah Wilkinson	Utd. States
Circular wood saw	1777	Miller	England
Embryo bicycle	1779	Branchard & Magurier	France
Steam engine, the basis of the modern engine	1782	James Watt	Scotland
Gas balloon	1783	J. E. & J. M. Montgolfier	France
Puddling iron	1783-4	Henry Cort	England
Plow, with cast iron mold board, and wrought and cast iron shares	1784	James Small	Scotland
Power loom	1785	James Cartwright	England
First steam-boat in the United States	1786	John Fitch	Utd. States
Steam road wagon (First automobile)	1787	Oliver Evans	Utd. States
Grain thrashing machine	1788	Andrew Meikle	England
Uranium discovered	1789	Klaproth	Germany
Hobby-horse, forerunner of bicycle	1790		England
Rotary steam power printing-press, the first idea of	1790	Wm. Nicholson	England
Wood planing machine	1791	Samuel Bentham	England
Gas first used as an illuminant	1792	Wm. Murdoch	England
Cotton gin	1794	Eli Whitney	Utd. States
Art of Lithography	1796	Alois Senefelder	Germany
Machine for making continuous webs of paper	1800	Louis Robert	France
Steam coach	1801	Richard Trevithick	England
Wood Mortising Machine	1801	M. J. Brunel	England
Pattern loom	1801	M. J. Jacquard	France
First fire proof safe	1801	Richard Scott	England
Steamboat on the Clyde, "Charlotte Dundas"	1802	William Symington	England
First photographic experiments	1802	Wedgewood & Davy	England
Planing machine	1802	J. Branch	England
The application of steam to the loom	1803	William Horrocks	England
Steel pen	1803	Wise	England
Steam Locomotive on rails	1804	Richard Trevithick	England
A[illegible] of twin [illegible] propellers in steam navigation	1804	John Stevens	Utd. States
Process of making [illegible] iron castings	1804	Lucas	England
First life preserver	1805	John Edwards	England
[illegible]ing	1805	Luigi Brugnatelli	Italy
K[illegible] machine, the [illegible] in the	1806	Jeandean	France
S[illegible] the Hudson River	1807	Robert Fulton	Utd. States
[illegible]	1807	A. J. Forsyth	Scotland
[illegible] gas light [illegible]	1807	F. A. Winsor	England
[illegible] saw	1808	Newberry	England
[illegible], strontium and calcium	1808	Sir Humphry Davy	England
Polarization of light from reflection	1808	E. L. Malus	France

Inventions	Date	Inventor	Nativity
Voltaic arc	1808	Sir Humphry Davy	England
First steamboat to make a trip to sea, the "Phœnix"	1808	John Stevens	Utd. States
Homeopathy introduced	1810	S. C. F. Hahnemann	Germany
Revolving cylinder printing-press	1810	Frederick Koenig	Germany
Breech-loading shot-gun	1811	Thornton & Hall	Utd. States
Storage battery	1812	J. B. Ritter	Germany
Dry Pile (prototype of dry battery)	1812	Zamboni	
First practical steam rotary printing press, paper printed on both sides	1814	Frederick Koenig	Germany
First locomotive in Scotland	1814	George Stephenson	England
First circular wood saw made in this country	1814	Benjamin Cummings	Utd. States
Heliography	1814	Jos. N. Niepce	France
Discovery of Cyanogen	1814	Gay Lussac	France
Kalcidoscope	1814	Sir David Brewster	England
Miner's safety lamp	1815	Sir Humphry Davy	England
Seidlitz powder	1815		
Dry gas meter	1815	S. Clegg	England
Morphine, first organic alkaloid known	1816	Sertürner	Germany
Knitting machine	1816	Brunel	England
"Draisine" bicycle	1816	Baron von Drais	Germany
"Columbian" press, elbowed pulling bar, number of impressions per hour, 50	1817	George Clymer	Utd. States
Stethoscope	1819	Laënnec	France
Electro-magnetism discovered	1819	H. C. Oersted	Germany
Lathe for turning irregular wood forms	1819	Thomas Blanchard	Utd. States
The theory of electro-dynamics first propounded	1820	Andre Ampère	France
Quinine	1820	Pelletier & Caventon	France
Electroscope	1820	Bohenberg	Germany
The conversion of the electric current into mechanical motion	1821	Michael Faraday	England
Galvanometer	1822	Schweigger	Germany
Multi-color printing	1822	P. Force	Utd. States
Calculating machine	1822	Charles Babbage	England
Silicon	1823	James Berzelius	Switzerl'd
Discovery of thermo-electricity	1823	Prof. Seebeck	England
Liquefaction and solidification of gas	1823	Michael Faraday	England
Water gas, production of	1823	Ibbetson	England
Portland cement	1825	Joseph Aspdin	England
First passenger railway, opened between Stockton and Darlington, England	1825		
Electrical spur wheel	1826	Barlow	England
Bromine	1826	M. Balard	France
First railroad in United States, near Quincy, Mass.	1826		
The law of galvanic circuits formulated	1827	George S. Ohm	Germany
Friction matches	1827	John Walker	Utd. States
The reduction of aluminium	1827	Friedrich Wohler	Germany
Law of electrical resistance	1827	George S. Ohm	Germany
Improved rotary printing-press London Times, 5,000 impressions per hour	1827	Cowper & Applegarth	England
Hot air blast for iron furnaces	1828	J. B. Neilson	Scotland
Wood planing machine	1828	William Woodworth	Utd. States
Tubular locomotive boiler	1828	Séquin	France
Prism for polarized light	1828	Nicol	England
Spinning ring frame	1828	John Thorp	England
The "Washington" printing press, lever motion and knuckle joint for a screw, number of impressions per hour, 200	1829	Samuel Rust	Utd. States
First steam locomotive in United States, "Stourbridge Lion"	1829		
Double fluid galvanic battery	1829	A. C. Becquerel	France
Magnesium	1829	Adam Bussey	France
First portable steam fire engine	1830	Brathwaite & Ericsson	England
Magneto-electric induction	1831	Michael Faraday	England
Chloroform	1831	G. J. Guthrie	Scotland
First conception of electric telegraph	1832	Prof. S. F. B. Morse	Utd. States
First Magneto-electric machines	1832	Saxton	Utd. States
Rotary electric motor	1832	Wm. Sturgeon	England
Chloral-hydrate	1832	Justus von Liebig	Germany
Locomotive, "Old Ironsides" built	1832	M. W. Baldwin	Utd. States
Link-motion for locomotives	1832	Sir Henry James	England
Adoption of steam whistle for locomotives	1833	George Stephenson	England
Reciprocating saw-tooth cutter within double guard fingers for reapers	1833	Obed Hussey	Utd. States
"McCormick" reaper	1834	Cyrus H. McCormick	Utd. States
Rotary electric motor	1834	M. H. Jacobi	Russia
Carbolic acid discovered	1834	Runge	Germany
Horse shoe machine	1835	H. Burden	Utd. States
Constant electric battery	1836	J. P. Daniell	England
Acetylene gas discovered	1836	Edmund Davy	England
The revolver; a device "for combining a number of long barrels so as to rotate upon a spindle by the act of cocking the hammer."	1836	Samuel Colt	Utd. States
The screw applied to steam navigation	1836 1841	John Ericsson	Utd. States
The galvanizing of iron	1837	Henry Craufurd	England
Indicator-telegraph	1837	Cooke & Wheatstone	England
Photographic carbon printing	1838	Mungo Ponton	France
Babbitt metal	1839	Isaac Babbit	Utd. States
Vulcanization of rubber	1839	Charles Goodyear	Utd. States
The first boat electrically propelled	1839	Jacobi	Germany
Daguerreotype	1839	Louis Daguerre	France
First to produce a direct photographic positive in the camera by means of highly polished silver surfaced plate exposed to the vapors of iodine and subsequent development with mercury vapor.			
Making photo-prints from paper negatives (First production of positive proofs from negatives).	1839	Fox Talbot	England

Inventions	Date	Inventor	Nativity
Photographic portraits (Daguerreotype Process)	1839	Profs. Draper & Morse	Utd. States
Pneumatic Caissons	1841	M. Triger	France
Pianoforte automatically played	1842	M. Seytre	France
Steam hammer	1842	James Nasmyth	Scotland
Typewriting machine	1843	Charles Thurber	Utd. States
First telegram sent	1844	Prof. S. F. B. Morse	Utd. States
The use of nitrous oxide gas as an anæsthetic	1844	Dr. Horace Wells	Utd. States
The electric arc light (gas retort carbon in a vacuum)	1844	Léon Foucault	France
Automatic adjustment of electric arc light carbons	1845	Thomas Wright	England
Double cylinder printing-press	1845	R. Hoe & Co.	Utd. States
Pneumatic tire	1845	R. W. Thompson	England
Sewing machine	1846	Elias Howe	Utd. States
Suez canal started	1846	De Lesseps	France
Ether as an anæsthetic	1846	Dr. Morton	Utd. States
Artificial limbs	1846		
Gun cotton	1846	Schönbein	Germany
First pianoforte keyboard player	1846	Debain	France
Chloroform in surgery	1847	Dr. Simpson	Scotland
Nitro-glycerine	1847	Sobrero	
Time-lock	1847	Savage	Utd. States
Hoe's lightning press capable of printing 20,000 impressions per hour	1847	Richard M. Hoe	Utd. States
Match-making machinery	1848	A. L. Dennison	Utd. States
Breech gun-lock, interrupted thread	1849	Chambers	Utd. States
Magazine gun	1849	Walter Hunt	Utd. States
Steam pressure gauge	1849	Bourdon	France
Lenticular stereoscope	1849	Sir David Brewster	England
Latch needle for knitting machine	1849	J. T. Hibbert	Utd. States
"Corliss" Engine	1849	G. H. Corliss	Utd. States
Printing-press, curved plates secured to a rotating cylinder	1849	Jacob Worms	France
Mercerized cotton	1850	John Mercer	England
Collodion process in photography	1850	Scott Archer	England
American machine-made watches	1850		Utd. States
Electric locomotive	1851	Dr. Page	Utd. States
Self-raker for harvesters	1851	W. H. Seymour	Utd. States
Breech loading rifle	1851	Maynard	Utd. States
Icemaking machine	1851	J. Gorrie	Utd. States
The Rhumkorff coil	1851	Rhumkorff	Germany
Fire alarm telegraph	1852	Channing & Farmer	Utd. States
Reticulated screen for half tone photographic printing	1852	Fox Talbot	England
Soda process of making pulp from wood	1853	Watt & Burgess	Utd. States
Laws of magneto-electric induction	1853	Michael Faraday	England
Laws of electrostatics	1853	Michael Faraday	England
Electrolysis	1853	Michael Faraday	England
Duplex telegraph	1853	Gintl	Austria
Photographic roll films	1854	Melhuish	England
Diamond rock drill	1854	Herman	Utd. States
Four motion feed for sewing machines	1854	A. B. Wilson	Utd. States
Magazine firearm	1854	Smith & Wesson	Utd. States
Fat decomposed by water or steam at high temperature, since largely used in soap making	1854	R. A. Tilghman	Utd. States
Safety matches	1855	Lundstrom	Sweden
Iron-clad floating batteries first used in Crimean war	1855		
Cocaine	1855	Gaedeke	Germany
Process of making steel, blowing air through molten pig-iron	1855	Sir Henry Bessemer	England
Dryplate photography	1855	Dr. J. M. Taupenot	
Bicycle	1855	Ernst Michaux	France
Sleeping car	1856	Woodruff	Utd. States
Aniline dyes	1856	Perkins	England
Printing machine for the Blind (contains elements of the present typewriting machine	1856	Alfred E. Beach	Utd. States
Regenerative furnace	1856	Wm. Siemens	England
Refining engine in paper pulp making	1856	T. Kingsland	Utd. States
Coal-oil first sold in the United States	1857	Messrs. Stout & Hand	Utd. States
First sea going iron-clad war vessel the "Gloire"	1857		France
Ground wood pulp	1858	Henry Voelter	Germany
Inclined elevator and platform in the reaper	1858	J. S. Marsh	Utd. States
Cable car	1858	E. A. Gardner	Utd. States
Breech loading ordnance	1858	Wright & Gould	Utd. States
Feed injector for Boilers	1858	Giffard	France
Storage or secondary battery	1860	Gaston Planté	France
Singing telephone	1860	Philip Reis	Germany
Ammonia absorption ice machine	1860	F. P. E. Carré	France
Improved stereotyping process	1861	Charles Craske	Utd. States
Shoe sewing machine	1861	George McKay	Utd. States
Driven well, a tube with a pointed perforated end driven into the ground	1861	Col. N. W. Green	Utd. States
Passenger elevator	1861	E. G. Otis	Utd. States
Barbed wire fence introduced	1861		Utd. States
Calcium carbide produced	1862	Frederich Woehler	Germany
Revolving turret for floating battery	1862	Theodore Timby	Utd. States
First iron-clad steam battery, "Monitor"	1862	John Ericsson	Utd. States
Gatling gun	1862	Dr. R. J. Gatling	Utd. States
Smokeless gunpowder	1862	J. F. E. Schultze	Prussia
Pneumatic pianoforte player (regarded as first to strike keys by pneumatic pockets)	1863	M. Fourneaux	France
Explosive gelatine	1864	A. Nobel	France
Rubber dental plate	1864	J. A. Cummings	Utd. States
Automatic grain binding device	1864	Jacob Behel	Utd. States
Process of making fine steel	1865	Martin	Utd. States
Antiseptic surgery	1865	Sir Joseph Lister	England
Web-feeding printing press	1865	William Bullock	Utd. States
Automatic shell ejector for revolver	1865	W. C. Dodge	Utd. States
The Atlantic cable laid	1866	Cyrus W. Field	Utd. States
Open-hearth steel process	1866	Siemens-Martin	England
Compressed air rock drill	1866	C. Burleigh	Utd. States
Torpedo	1866	Whitehead	Utd. States
Dynamo electric machine	1866	Wilde	England
Sulphite process for making paper pulp from wood	1867	Tilghman	Utd. States
Disappearing gun carriage	1868	Moncrief	England
First practical typewriting machine	1868	C. L. Sholes	Utd. States
Dynamite	1868	A. Nobel	France
Oleomargarine	1868	H. Mege	France

Inventions	Date	Inventor	Nativity
Water heater for steam fire engine..	1868	W. A. Brickell	Utd. States
Sulky plow.........	1868	B. Slusser	Utd. States
Railway air brake...	1869	George Westinghouse	Utd. States
Tunnel shield (operated by hydraulic power)	1869	Alfred E. Beach	Utd. States
A curved spring tooth harrow	1869	David L. Garver	Utd. States
Dynamo-electric machine	1870	Gramme	France
Celluloid	1870	J. W. & Isaac Hyatt	Utd. States
Rebounding gun-lock	1870	L. Hailer	Utd. States
The Goodyear welt shoe-sewing machine	1871	Goodyear	Utd. States
Photographic gelatino bromide emulsion (Basis of present rapid photography).	1871	R. L. Maddox	England
Continuous Web printing-press	1871	Hoe & Tucker	Utd. States
Grain binder	1871	S. D. Locke	Utd. States
Compressed air rock drill	1871	S. Ingersoll	Utd. States
Positive motion weaving loom	1872	J. Lyall	Utd. States
Theory that light is an electric phenomenon	1872	Clerk Maxwell	England
Automatic air brake	1872	George Westinghouse	Utd. States
Automatic car coupler	1873	E. H. Janney	Utd. States
The photographic platinotype process Prints by this process are permanent.	1873	Willis	England
Quadruplex telegraph	1873	T. A. Edison	Utd. States
Twine binder for harvesters	1873	M. L. Gorham	Utd. States
Gelatino bromide photographic emulsion (Sensitiveness to light greatly increased by the application of heat)..	1873	Charles Bennett	England
Self-binding reaper..	1873	Locke & Wood	Utd. States
Barbed wire machine	1874	Glidden & Vaughan	Utd. States
Siphon recorder for submarine telegraphs	1874	Sir William Thompson	England
Store cash carrier...	1875	D. Brown	Utd. States
Illuminating water gas	1875	T. S. C. Lowe	Utd. States
Roller flour mills....	1875	F. Wegmann	Utd. States
Middlings purifier for flour	1875	Geo. T. Smith	Utd. States
Ice making machine	1875	R. P. Pictet	Switzerl'd
Speaking telephone..	1876	Graham Bell	Utd. States
Electric candle ..... (The first step towards the division of the electric current for lighting.)	1876	Paul Jablochkoff	Russia
Continuous machine for making tobacco cigarettes	1876	Russell	Utd. States
Steam feed saw mills	1876	D. C. Prescott	Utd. States
The first Portland cement plant in U. S..............	1876		Coplay, Pa.
Phonograph	1877	T. A. Edison	Utd. States
Gas engine..........	1877	N. A. Otto	Utd. States
Carbon microphone..	1877	T. A. Edison	Utd. States
Telephone transmitter of variable resistance	1877	Emil Berliner	Utd. States
Carbon filament for Electric lamp..... (Beginning of the incandescent vacuum electric light.)	1878	T. A. Edison	Utd. States
Rotary disk cultivator	1878	Mallon	Utd. States
Decided advance in the "Expression" of self-playing pianofortes........	1878	Gally	Utd. States
Automatic grain binder	1879	J. F. Appleby	Utd. States
Kathode rays discovered	1879	Sir Wm. Crookes	England
Steam plow.........	1879	W. Foy	Utd. States
Magazine rifle	1879	Lee	Utd. States
"Blake" telephone transmitter	1880	Blake	Utd. States
Hammerless gun.....	1880	Greener	Utd. States
Storage battery or accumulator	1880	Camille A. Faure	France
Typhoid bacillus isolated	1880	Eberth & Koch	Germany
Pneumonia bacillus isolated	1880	Sternberg	Utd. States
Button hole machine	1881	Reece	Utd. States
Improvement in "Expression" of self-playing pianofortes	1882	Schmaele	Utd. States
Hand photographic camera for plates..	1881	Wm. Schmid	Utd. States
Tuberculosis bacillus isolated	1882	Robert Koch	Germany
Hydrophobia bacillus isolated	1882	Louis Pasteur	France
Cholera bacillus isolated	1884	Robert Koch	Germany
Diphtheria bacillus isolated	1884	Loeffler	Germany
Lockjaw bacillus isolated	1884	Nicolaier	France
Antipyrene	1884	Kuno	Utd. States
Linotype machine ...	1884	Othmar Mergenthaler	Utd. States
The rear-driven chain safety bicycle.....	1884	George W. Marble	Utd. States
Chrome tanning of leather	1884	Schultz	Utd. States
Process of reducing aluminium	1885	Cowles	England
Gas burner	1885	Carl Welsbach	Germany
Hydraulic dredge ...	1885	Bowers	Utd. States
First electric railway in United States, Hampden and Baltimore, Md........	1885		
Contact device for overhead electric trolley	1885	C. J. Van Depoele	Utd. States
Graphophone	1886	Bell & Tainter	Utd. States
Electric welding	1886	Elihu Thompson	Utd. States
Combined harvester and thresher	1886	Matteson	Utd. States
Band wood saw.....	1887	D. C. Prescott	Utd. States
Cyanide process of obtaining gold and silver	1887	McArthur & Forrest	Utd. States
System of polyphase electric currents ..	1887	Nicola Tesla	Utd. States
Incandescent gas light .... The formation of a cone-shaped interwoven mantle of thread coated with a refractory rare earth and rendering the same incandescent by the heat rays of a Bunsen gas burner regardless of how the gas is produced	1887	Carl A. Von Welsbach	Austria
Process of annealing armor plate	1888	Harvey	Utd. States
"Kodak" snap-shot camera .... Constructed to use a continuous sensitized ribbon film.	1888	Eastman & Walker	Utd. States
Process of making artificial silk	1888	H. DeChardonnet	France
Hertzian waves or electric wave radiation	1888	Heinrich Hertz	Germany

Inventions	Date	Inventor	Nativity
First rotary cement kilns in U. S.	1889		Coplay, Pa.
Nickel steel......	1889	Schneider	Utd. States
Process of making aluminum	1889	Chas. M. Hall	Utd. States
Electric plow	1889	[illegible] Stephens	Utd. States
Improved linotype machine	1890	Othmar Mergenthaler	Utd. States
Bicycles equipped with pneumatic tires	1890		
Krag-Jorgensen magazine rifle	1890	Krag-Jorgensen	Utd. States
"Coherer" for receiving electric waves	1891	Edouard Branly	England
Rotary steam turbine	1891	C. A. Parsons	England
Cement lined paper pulp digester .. .	1891	G. F. Russell	Utd. States
Round bale cotton press	1891	Brown	Utd. States
Microphone	1891	Emile Berliner	Utd. States
Power loom	1891	Northrup	Utd. States
Commercial application of Formaldehyde	1892	J. J. A. Trillat	France
Shoe-last lathe, for different lengths ..	1893	Kimball	Utd. States
Kinetoscope	1893	T. A. Edison	Utd. States
Process for making carborundum	1893	E. G. Acheson	Utd. States
Calcium carbide produced in electric furnace	1893	Thos. L. Willson	Utd. States
Argon, a chemical element	1894	Lord Rayleigh & Sir Wm. Ramsay	England
Process for liquefying air	1895	Carl Linde	Germany
Electric locomotive, B. & O. Belt Tunnel	1895		Utd. States
X-Rays............	1895	Prof. W. C. Roentgen	Germany
Acetylene gas from calcium carbide ...	1895	Thomas L. Willson	Utd. States
System of wireless telegraphy	1896	G. Marconi	Italy
Foundation laid of science of radioactivity, i. e., emanation of penetrating rays from luminescent bodies....	1896	Henri Becquerel	France
Use of ultra-violet rays in treating diseases	1896	Niels R. Finsen	Denmark
Nernst electric light ..	1897	Walter Nernst	Germany
Method of rendering a city compound capable of conducting electricity and thence becoming brilliantly incandescent without a vacuum.			
Radium discovered..	1898	Madame S. Curie	France
Mercury vapor electric light	1900	Peter Cooper Hewitt	Utd. States
An [illegible]			
Air-ship	[illegible]	M. Santos-Dumont	France
[illegible]	1901	[illegible] Harvester Co.	Utd. States
The first [illegible] "[illegible] VII" ..	1901	[illegible] & [illegible]	[illegible]

Inventions	Date	Inventor	Nativity
The first oil burning steamship built in the United States, "Nevada"	1902		
English Pacific cable, Canada-Australia ..	1902		
American Pacific cable	1903		Utd. States

It is interesting to note that between the years 1872 and 1900 there were on what may be termed the honor roll of inventors 39 inventors each of whom had received over 100 patents. A few of the most important were:

Thomas A. Edison	742
Francis H. Richards	619
Elihu Thomson	444
Charles E. Scribner	374
Luther C. Crowell	293
Edward Weston	280
Rudolph M. Hunter	276
Charles J. Van Depoele (deceased)	245
George Westinghouse	239
Rudolph Eickemeyer (deceased)	171
Hiram S. Maxim	146
Philip Diehl	137
Hosea W. Libbey	127
Louis K. Johnson	114
Talbot C. Dexter	109
James H. Northrup	102

In the preparation of the foregoing statistics, credit is given to L. H. Campbell, of the United States Patent Office, for valuable assistance.

Frederick C. Beach, Ph.B.
Editor 'The Scientific American'

In'ventory, a written list or schedule of goods, chattels and other personal property of an individual or estate, whether for use in legal proceedings, or for commercial purposes. The term is also employed to designate lists of assets prepared in cases of insolvency and bankruptcy, and lists of property made out by guardians of estates or infants. These inventory lists are usually filed with the court for public examination. After an administrator or other officer of the court files his inventory he becomes personally accountable for the property or goods so listed. See also Executor.

Inver'sion, a change of order whereby the first becomes last and the last first. (1) In rhetoric, a reversal of the natural order of words for the sake of euphony, emphasis, or the like: also the turning of one's own argument against him by an opponent in discussion. (2) In chemistry, a change in molecular structure which is usually induced by fermentation or by heating with a dilute acid, as in the case of starch, sugar, etc. Thus starch and dextrine are changed into glucose, cane-sugar into invert sugar, and maltose into glucose. (3) In geology, the overturning or folding over of strata by igneous agency, so that the order of their succession seems reversed. (4) In mathematics, the operation of changing the order of the terms, so that the antecedent shall take the place of the consequent and the reverse, in both couplets. Thus, from the proportion $a : b :: c : d$, we have, by inversion, $b : a :: d : c$. (5) In music, the transposition of certain phrases having a common root. (*a*) The change of a chord by making one of the inner notes act as a bass note, by which means as many inversions can be made as there are actual notes in the chord, not counting the root, the harmony in such inversions remaining the same, though the order of component parts is changed; (*b*) alteration of intervals by making that which was the upper note the lower, and the reverse, the inversion of an interval within the octave being readily found in the difference between the figure 9 and the interval known; (*c*) the alteration of a subject produced by inverting the intervals of which it consists.

In'vertase, or **In'vertin,** an enzyme occurring in many fungi, notably in certain yeasts (for example, the saccharomyces), and also in the seed-plants. It transforms cane-sugar into a mixture of dextrose and levulose; this mixture being called "invert-sugar" because it turns the plane of polarized light to the left, while the cane-sugar from which it is obtained turns it to the right. According to some writers, a yeast cannot invert cane-sugar except by secreting invertase; but *Monilia candida* effects the inversion, and yet produces no invertase. In this case the action is probably due to some other enzyme, hitherto unidentified. Invertase probably plays a very important part in vegetable chemistry. Like other enzymes, it can apparently perform an unlimited amount of chemical work, without sensible diminution of its own substance. (See FERMENTATION.) Invertase is most active at a temperature of from 120° to 140° F., and in a slightly acid medium. It has been isolated in the form of a powder.

Inver'tebrates, a collective term for the lower divisions or phyla of the animal series, which agree in not having a vertebral column or back-bone, used in contradistinction to the highest group of the animal kingdom, to which the name *Vertebrata* or vertebrate animals is given. In the system of Cuvier the *Invertebrata* were divided into the *Radiata, Articulata,* and *Mollusca.* Further study revealed that these names did not distinguish natural groups; and the term *Invertebrata* has no longer any definite significance in classification (q.v.).

Inves'titure, in the feudal law, was the open delivery of a feud by a lord to his vassal, thus, by external proof, affording evidence of property. To use the words of Blackstone, "Investitures, in their original rise, were probably intended to demonstrate, in conquered countries, the actual possession of the lord, and that he did not grant a bare litigious right, but a peaceable and firm possession. At a time when writing was seldom practised, a mere oral gift, at a distance from the spot that was given, was not likely to be long or accurately retained in the memory of by-standers, who were very little interested in the grant." For this reason investiture was performed by the presentation of some symbol to the person invested, as a branch of a tree, etc. In the primitive church, after the election of a bishop, and his consecration, the early Christian emperors claimed a right of confirmation. Charlemagne is said to have introduced this practice, and to have invested the newly consecrated bishop by placing a ring and crozier in his hands. Gratian, indeed (Distinct. 63, cap. Adrianus), directly affirms that Pope Adrian positively conceded to the emperor the power of electing, even to the papacy, in 774; but neither Eginhard nor any other contemporary writer mentions this fact.

The custom, however, existed, nor does it appear to have been objected to or opposed during the lapse of two centuries from his reign. The disorderly state of Italy, which succeeded the death of Charlemagne, frequently interrupted the exercise of this right by the Carlovingians; but even so late as 1047, when the empire had passed to another line, Henry III. received an explicit admission of his prerogative, and repeatedly used it. The investiture in the lesser sees followed as a matter of course. Alexander II. issued a decree against lay investiture in general, which was revived by Gregory VII. (Hildebrand), who, having succeeded in annulling the prerogative of the emperors to nominate or confirm popes, sought to disjoin entirely the ecclesiastical from the civil rule. It was not, however, until the papacy of Calixtus II., in 1122, that the question was terminated, as it appears, materially to the advantage of the holy see. In France, even under the papacy of Hildebrand, the right of investiture does not appear to have been made a subject of open quarrel. In spite of the protests of the holy see, the kings exercised the power, but at length relinquished the presentation of the ring and crozier, and contented themselves with conferring investiture by a written instrument, or orally, upon which they were left in peaceable possession of the power. But in England Paschal II. was engaged in a contest little less fierce than that which he maintained with the emperor. Anselm, the primate, refused to do homage to Henry I. for his see. The king seems to have asserted an unqualified right of vestiture, which the pope, who was appealed to, as unqualifiedly denied. After a protracted struggle, and continued threats of excommunication, the controversy ended in England, as it did afterward in Germany, by compromise. Paschal offered to concede the objections against homage provided Henry would forego the ceremony of investiture. To this he agreed (1107).

Invin'cibles, an Irish secret society of 1882, an off-shoot of the Fenians. One of the objects of the Invincibles was to "remove" or assassinate government officers or others who might incur the displeasures of the association or its leaders. On 6 May 1882 the society succeeded in "removing" Lord Frederick Cavendish, who had just arrived from England as secretary for Ireland, and Thomas A. Burke, the under-secretary, in the Phœnix Park at Dublin. The plot was directed against the latter gentleman, and the former, interfering to protect his friend, shared his fate. On 20 Feb. 1883 20 persons charged with complicity in the Phœnix Park murders were put on trial; on 14 July, Joseph Brady, who had been convicted of actual perpetration of the murder of Mr. Burke, was executed, as were others subsequently. The leading witness, who revealed all the secrets of his fellow conspirators, was James Carey of Dublin. He was shot dead near Natal, on 29 July, by an Irishman, O'Donnell, who was subsequently tried, and executed for his crime.

Invocation of Saints. See SAINTS.

In'voice, a list or bill of goods; a detailed statement of merchandise in stock, or to be shipped. Very frequently an invoice accompanies a shipment of goods along with the bill of lading from the consignor to the consignee.

An invoice is a memorandum and is not a document of title nor a contract of sale, and has no value in law other than memoranda.

Io, ī'ō, in Greek mythology, a daughter of Inachus; according to others of Iasus or Peiren. Zeus (Jupiter) fell in love with her. Hera (Juno) perceived the infidelity of her husband, anl resolved to be revenged on both. Zeus, to protect Io from the jealousy of Hera, changed her into a beautiful white heifer. Hera was not deceived, and set a gad-fly to torment her, and persecuted her without a moment's rest through the world. The wanderings of Io in this condition were a favorite subject with the poets of ancient Greece. Also, in astronomy (1) the first satellite of Jupiter, discovered by Galileo in 1610. (2) The name of the 85th asteroid, discovered by Peters at Clinton, N. Y., 19 Sept. 1865.

Iodine, ī'ō-dĭn or -dīn, a non-metallic element, analogous in its general properties to chlorine and bromine. It was discovered by Courtois in 1811, in the mother-liquor of kelp that had been used for the production of sodium carbonate; occurring there in combination with sodium and magnesium. It is still obtained from the ashes of certain seaweeds, but the principal supply is now obtained from «caliche,» a crude nitrate of sodium that occurs in immense quantities in northern Chile. In the preparation of the commercially pure nitrate of soda from caliche, the mother liquors, after the removal of the nitrate by crystallization, are found to contain large quantities of iodine, chiefly in the form of iodate of sodium, $NaIO_3$; and it is from this substance that the iodine of commerce is now chiefly prepared. The richest caliche contains about 3.5 pounds of iodine per ton.

In its ordinary form, iodine is a solid substance, melting at 237° F., and boiling at about 380° F. In a vacuum, iodine sublimes without melting. Solid iodine is soft, and dark gray in color, with a metallic lustre. The vapor is violet in color, from which circumstance the element takes its name (Greek, «like a violet»). Chemically, iodine has the symbol I, and an atomic weight of 126.85 for $O = 16$, or 125.9 for $H = 1$. Solid iodine has a specific gravity of about 4.95 at ordinary temperatures, and a specific heat of about 0.05412. Its volume increases, on account of thermal expansion, by about 0.00013 of its own value for a rise of temperature of 1° F. At temperatures not far above its boiling point, the vapor of iodine has a specific heat (at constant pressure) of 0.03369; and in this same region of temperature the ratio of its specific heat at constant pressure to the specific heat at constant volume is about 1.294. Iodine shows an important change in its vapor density at high temperatures. Thus, below about 1,200° F. the vapor has a density about 126 times as great as that of hydrogen under the same conditions of temperature and pressure; but as the temperature rises the density of the vapor, relatively to hydrogen, falls off, until it is only about 68 at 2,700° F. It is believed that this change in density indicates that the molecules of iodine vapor split in two as the temperature rises; a molecule, just above the boiling point, containing two atoms, while at the higher temperature the molecules are monatomic. Iodine is freely soluble in alcohol, ether, carbon disulphid, chloroform, and glycerin. It is only slightly soluble in pure water, but dissolves readily in aqueous solutions of the iodides. It is also soluble in benzine, acetic acid, and numerous other organic fluids. Iodine is a non-conductor of electricity.

With hydrogen, iodine forms the important compound HI, known as hydriodic acid. (See HYDRIODIC ACID.) With the metals it forms binary compounds called «iodides,» which may also be regarded as salts of hydriodic acid. Of these the most important is potassium iodide, KI, which is largely used in medicine. It is prepared by dissolving iodine in a solution of caustic potash, evaporating to dryness, and igniting. This salt is very soluble, and crystallizes in cubes. The iodides of ammonium, sodium, strontium, and zinc are also used to a more limited extent. Iodoform, a yellow crystalline powder with a peculiar characteristic odor when warmed, is also much used as a dressing in surgery. It has the formula CHI_3, and is analogous in its chemical structure and deportment to chloroform. Iodoform may be prepared by dissolving iodine in an alcoholic solution of caustic potash, the iodoform that is produced separating out as a precipitate. It is also prepared in Germany, to a certain extent, by the electrolysis of a similar solution. (See Löb, 'Electrolysis and Electrosynthesis of Organic Compounds.') Iodine and its compounds are used to some extent in photography, and to a larger extent in synthetic chemistry, for the preparation of the coal-tar colors (q.v.), and other organic substances.

Iodine forms two important oxy-acids, known respectively as iodic acid, HIO_3, and periodic acid, $HIO_4 + 2H_2O$. These are analogous, in their chemical deportment, to chloric and perchloric acids.

Free iodine combines with starch to form a remarkable deep blue compound, whose production is a well-known test for the presence, in a given substance, of either starch or free iodine. To detect the presence of iodine in a solution, a few drops of thin, clear starch paste are added to the solution to be tested (which should be cold), and hydrochloric acid is added until the reaction is acid. A couple of drops of a concentrated solution of potassium nitrite are then added, when the dark blue color of iodide of starch will instantly be produced, if iodine is present. This test may readily be modified so as to serve for the detection of starch. The reaction is not given by dextrin, nor by other isomers of starch.

I'odine and Iodides in Medicine. Iodine and the iodides have been used in medicine since the Chinese are supposed to have introduced them, 2000 B.C. or earlier. The exact method of action of the iodides is not clear, but it would seem that iodine, being a normal constituent of the human body, is a very essential element in normal metabolism. It is found in comparatively large quantities in the thyroid gland, which is known to exercise a very important action in the general body-metabolism, and it is probably by means of the stimulation of the general metabolism of the body that the iodides manifest their beneficial action. The iodides are freely absorbed from watery solutions by mucous membranes throughout the body, particularly in the stomach and intestine. They are taken up into the blood, pass through the tissues, stimulating the lymph-flow, and are excreted in the urine in the form of salts. Iodine itself possesses a local irritant action. It is soon converted into the iodides when taken internally, and causes similar internal changes.

When the iodides are taken in large doses, or even in small doses for a long time, a form of chronic poisoning known as iodism results. In this the chief symptoms, found in the air-passages, consist of a catarrh, especially of the nose, with profuse watery secretion, sneezing, and sometimes bronchitis. There is usually swelling and irritation of the throat and tonsils, and salivation. Nausea and gastric discomforts are common, and skin-eruptions are frequent. There is usually loss of weight, and if the iodide has been taken for a very long period a condition of cachexia, characterized by a great loss of flesh, weakness, depression, and restlessness, may result. The chief use of the iodides in medicine is in the treatment of syphilis, on which it has a specific effect. It is also very useful in the various joint-pains of a chronic character, usually known as chronic rheumatism. Iodine is valuable in the treatment of those diseases known to result from thyroid insufficiency, notably in myxœdema (q.v.), and in cretinism, its allied form in children. For stimulation of the respiratory and nasal passages, as in chronic bronchitis, asthma, and dry nasal catarrh, the iodides are of great value.

Io'la, ī-ō'la, Kan.— The city of Iola, Allen County, Kan., is located on the left bank of the Neosho River, about 40 miles west of the Missouri line, and about 100 miles south of Kansas City. The town is reached by the Atchison, Topeka & Santa Fé, the Missouri, Kansas & Texas, and the Missouri Pacific railroads.

History.— It was laid out by the Iola Town Company in 1859. A post-office was located there the same year and a small village soon grew up. During the war the town made but little progress. In 1865 it became the county-seat of the county, and grew steadily, although very slowly until 1895, when its population was 1,565. In 1896 natural gas was discovered on the town site, and as soon as it was shown that a large gas field existed in and near the town it began to grow rapidly, the population in 1904 exceeding 11,000. This rapid growth followed the location in and near Iola of nine large zinc smelters, a number of brick factories, two Portland cement plants and other manufacturing enterprises attracted to the place by the cheap fuel which the large field of natural gas supplied.

Churches, etc.— The leading church denominations are the Presbyterian, Methodist Episcopal, Christian, Baptist, Episcopal, Reformed, and Catholic. The city is well supplied with schools, its high school being one of the best in the State. There are two daily papers, the 'Record' and the 'Register.'

Business, Population, etc.— The city is surrounded by a well-settled and prosperous agricultural community, but its chief business is derived from the manufacturing industries already named. The population is almost wholly American, the exceptions being a few Poles and Swedes employed in the manufacturing plants. An electric road connects Iola with a number of suburban towns, aggregating a population of about (1904) 5,000.

Charles F. Scott.

Io'na, or Icolmkill, an island on the west coast of Scotland, one of the Inner Hebrides, in the county of Argyle. Iona is about 3 miles long by $1\frac{1}{2}$ miles broad; area, 2,000 acres, of which 600 acres are under cultivation, the remainder being hill pasture, morass, and rock. The island derives its interest and celebrity wholly from its history and its ancient ruins, and especially from its connection with Saint Columba, who took up his residence here after the middle of the 6th century (565). The existing ruins are all, however, of a much more recent date. Forty-eight kings of Scotland, four kings of Ireland and eight kings of Norway are said to have been buried on Iona Island, among them being King Duncan, made famous by Shakespeare. About 1900 the Duke of Argyle conveyed the entire island to the Church of Scotland under certain conditions of preservation and restoration.

Ionia, ī-ō'nĭ-a, that part of the seaboard of Asia Minor which was inhabited by Ionian Greeks, a beautiful and fertile country opposite the islands of Samos and Chios, which also belonged to it. According to tradition, the Greek colonists came over from Attica about 1050 B.C., and founded 12 towns, which, though mutually independent, formed a confederacy for common purposes. These included Phocæa, Ephesus, Miletus, etc., and latterly Smyrna. Commerce, navigation, and agriculture early rendered them wealthy and flourishing, but the country was made tributary by Crœsus, king of Lydia, and later by Cyrus, king of Persia (557 B.C.). With an interval of independence they remained under Persia until this empire was overthrown by Alexander the Great, 334–1 B.C., when they became a part of the Macedonian empire. Ionia, at a later period, became part of the Roman province of Asia. It was afterward totally devastated by the Saracens, so that few vestiges of its ancient civilization remain.

Ionia, Mich., city and county-seat of Ionia County; on the Grand River, and the Detroit, G. H. & M., the Pere M., and the Grand T. R.R.'s; 34 miles east of Grand Rapids. It contains the State house of corection, the State asylum for the dangerous and criminal insane, large railroad repair shops, and manufactories of pottery, furniture, machinery, edged tools, and clothing. The industrial interests are greatly promoted by excellent power furnished by the river. The city has a public high school, library, several daily and weekly periodicals, and an assessed property valuation of about $2,500,000. Under the revised charter of 1897, the government is administered by a mayor and city council elected annually. Ionia was settled in 1833 and incorporated in 1873. Pop. (1890) 4,482; (1900) 5,209.

Io'nian Islands, a number of islands belonging to the kingdom of Greece, in the Ionian Sea, off the coast of Albania and the western and southern shores of Greece, the most southern, Cerigo, and its dependent islets being off the southeastern extremity of the Morea. The principal islands, seven in number, are, reckoning from north to south, Kerkyra (Corfu), Paxos, Levkas (Santa Maura), Ithaki (Ithaca), Kephallenia (Cephalonia), Zakynthos (Zante), and Kythira (Cerigo). To each of these larger islands a number of smaller, scattered along their respective coasts, are attached, and included in their several local jurisdictions. Area of the whole, 1,097 square miles. Pop. about 300,000. All these islands belong to the great calcareous formation of Greece. They are extremely mountainous, and do not contain enough arable land to produce the corn required by the population; and were it not for the vine, olive, and currant, all of which they produce, they could support but a small number of inhabitants. The climate is even more temperate than that of the neighboring mainland. Snow often falls in the winter, and lies on the mountains, but rarely on the plains. The staple exports are oil, currants, valonia, wine, soap, and salt. The few manufactures are chiefly textile and ornamental. The religion is that of the Eastern Greek Church, to which four fifths of the population belong. Each island has its own bishop, and at the head of the whole is an exarch or primate. The Ionian Islands, so called from lying in that part of the Mediterranean anciently known as the Mare Ionicum or Ionian Sea, often figure in the ancient history of Greece, but only singly, not collectively. In 1809–10 all the islands were overrun by the British troops except Corfu, which did not come into the hands of the British till it was assigned to them by the Peace of Paris in 1814, and the possession of the British was finally fixed and regulated by another treaty concluded at Paris in 1815. The seven islands were then formed into a republic, under the protectorate of Great Britain. In 1857 a wish was expressed by their representatives for reunion with Greece, and the islands, with the consent of the other European powers, were transferred to the kingdom of Greece in 1864.

Ionian Philosophy, the earliest school of Greek philosphy, a school which attempted to explain the phenomena of nature from the forces and attributes of matter itself. In order to do this the philosophers of this school followed two courses, some assuming a single original substance as the ground of all things, and explaining the development and formation of the phenomenal world by a process of condensation and rarefaction which they conceived as affecting the mode of existence of that substance; while others considered all things as formed by separation and combination out of a permanent and unalterable primitive form of matter. According to the view of the first class of Ionian philosophers, therefore, the original material principle was conceived as itself liable to change, and the changes which take place in it were held to give rise to the forms by which the world is known to us; while according to the view of the second class of Ionian philosophers the original material principle was looked upon as in its own nature and qualities unchangeable, and everything was explained by a change of external relations in space.

Ionian School, the school of philosophy which started from the Ionian city of Miletus. The leader of the school was Thales, who started from a disbelief in the current mythological fables of his day. Thales was born about 636 B.C. He was a man of political activity as well as of deep meditative habits. He was proficient in mathematical knowledge and founded the Ionian school which was principally concerned in an inquiry as to the constitution of the universe. He propounded the axiom that the basis of all phenomena was water, and perhaps he was just as near the truth as Huxley when he declared that everything came out of what he called, by a question-begging term, protoplasm. The next philosopher of the Ionian school was Anaximenes 529 B.C. He also was a materialistic philosopher and like Liebig believed that the origin and substance of everything was air. Diogenes of Apollonia went farther than his predecessor and taught that the basis of phenomena was mind. The Ionian school found its highest development in Anaximander of Miletus 610 B.C., who taught what has been the profoundest discovery of all philosophy ancient or modern that the basis of being was *τὸ ἄπειρον*, the Infinite.

Ionian Sea, that part of the Mediterranean communicating with the Gulf of Venice by the Strait of Otranto, and having Greece and part of European Turkey on the east; Sicily and the most southern part of Italy on the west. Its greatest breadth is between Cape Matapan in the Morea, and Cape Passaro in Sicily, which is about 400 miles.

Ion'ic Order. See ARCHITECTURE (*Greece*).

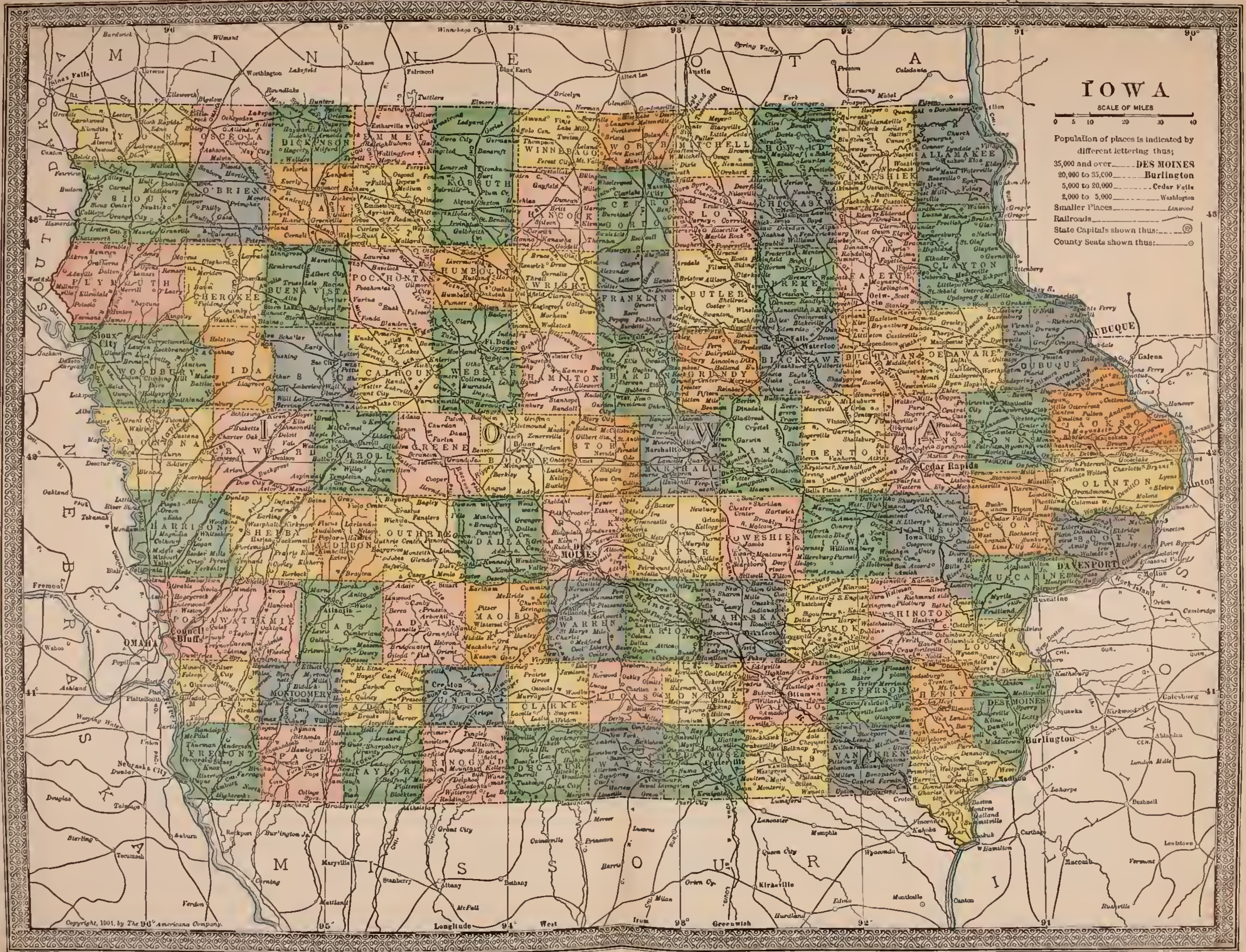
Ioniza'tion. See ELECTROLYSIS; ELECTRON; SOLUTION.

Ios, ī'ŏs, an island in the Ægean Sea, said to have been the birth-place of Homer. According to the ancients his mother was born here, and the poet's grave was likewise located here.

I O U, a written acknowledgment of debt, usually made in this form:—"To A. B. I O U Ten Dollars.—C. D. May 12, 1891." In Great Britain when the name of the creditor is stated such a document is evidence of a debt of the amount stated due to him by the person whose signature it bears. In the absence of the name of the creditor the document is *prima facie* evidence of such a debt being due to the holder of the document. It is not negotiable. The letters I O U are of course used instead of the words "I owe you," on account of the similarity of sound. The I O U is seldom used in the United States.

Iowa, ī'o-a ("the Hawkeye State"), a north-central State extending from the Mississippi River to the Missouri River, and occupying three and one sixth degrees of latitude. It is bounded on the north by Minnesota, on the east by Wisconsin and Illinois, on the south by Missouri, and on the west by Nebraska and South Dakota. Area, 56,025 square miles; 550 water; it is 310 miles east and west, and 210 north and south. Capital, Des Moines. Pop. (1900) 2,231,853. It is the sixteenth State in order of admission to the Union.

Topography.— Iowa is a part of the great central plain, and is chiefly undulating prairie, rising in gentle swells from the Mississippi River to a divide running diagonally, from a height of 1,694 feet in the northwest to a slight elevation in the southeast, with a parallel subdivide in the southwest. There are now no swamps and few natural forests. The only rough spots are the sharp bluffs where the rivers have cut their paths through the glacial drift; the only woods, those along the streams,— altogether about 7,000 square miles of woodland, with oak, elm, hickory, black walnut, maple, cottonwood, linden, ash, box-elder, pine,


IOWA
SCALE OF MILES
0 5 10 20 30 40
Population of places is indicated by different lettering thus;
35,000 and over — DES MOINES
20,000 to 35,000 — Burlington
5,000 to 20,000 — Cedar Falls
2,000 to 5,000 — Washington
Smaller Places — Linwood
Railroads
State Capitals shown thus:
County Seats shown thus:
MINNESOTA
SOUTH DAKOTA
NEBRASKA
MISSOURI
ILLINOIS
WISCONSIN
IOWA
DUBUQUE
DAVENPORT
Cedar Rapids
Burlington
OMAHA
Sioux City
Longitude West from Greenwich
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cedar, etc. The eastern watershed, two thirds of the whole State, is drained to the Mississippi by a series of streams, nearly all of which are parallel and have a southeastward course. The western part is drained to the Missouri by shorter and swifter rivers, flowing first southwest and then south as the Missouri turns eastward. The chief Mississippi affluents are the Upper Iowa, the Turkey, the Maquoketa, the Wapsipinicon, the Iowa, and the Cedar (the "main" stream, the Iowa,— 375 miles, its "tributary," the Cedar, 400 miles, the two forming the second largest interior system of the State and joining not far from the mouth of the Iowa), the Skunk, and lastly the Des Moines with its numerous affluents, far the greatest and commercially the most important as well as the finest scenically, rising in Minnesota and running diagonally across the entire State in a course of 550 miles, with a basin of 14,500 square miles. The State is prolonged by a southeastern corner to include the entire channel of the Des Moines. The northern part of the State has a continuation of the many small, clear, pebbly lakes of Minnesota in glacier-scored pits; some of them — the Walled Lakes — surrounded each by a natural wall of loose stones. The largest are Spirit Lake and the two Okoboji lakes in Dickinson County, and Clear Lake in Cerro Gordo County, all popular summer resorts. West Okoboji, of great depth, lies between wooded hills, and is indented by several picturesque "points" or promontories.

Climate.— The winter climate is somewhat severe, owing to the influence of the great uninterrupted plains to the northwest; but like all this region, the severity is tempered by freedom from excessive moisture. The State is one of the healthiest in the Union, several of the streams in the northeast having rocky channels, and none having the miasmatic bottom-lands found farther south. The dry, pure air of its rolling prairies affords a valued sanatorium for consumptives. The extreme temperatures range from 110° above to 40° below zero; but the average range is from 95° above to 20° below. The average rainfall during the years from 1890 to 1903 inclusive was 31.4 inches — two thirds of it between April-October, and more than half during the critical crop months, May, June, July, and August.

Geology.— No less than five separate sheets of drift cover the State, giving a remarkable variety of productive soil, as well as many different clays for industrial purposes. The watershed shows the inclination to the underlying palæozoic rocks, in lines from northwest to southeast. The oldest formation is Sioux quartzite in the northwestern corner. Cretaceous deposits overlie the older formations through the northwest part generally; along the eastern side from north and south are Cambrian, Silurian, Devonian, and Carboniferous in succession. The most valuable mineral beds are the vast fields of bituminous coal, covering more than one third of the entire area of the State, and turning out in the year ending 30 June 1903, 6,185,734 tons, valued at $8,016,274; employing 13,192 persons, of whom 9,169 were miners. It is the leading coal State west of the Mississippi except Colorado, and a great factor in all the northwestern industries. Its limestone, the finest grade of building stone, near Marshalltown, Anamosa and other points, is quarried to the extent of about $800,000 a year. Its gypsum from the rocky hills in the vicinity of Fort Dodge is the basis of a fast increasing manufacture of stucco, hard-wall plaster, and paint, also clays for pottery, fire and building brick, tile, and terra-cotta. Iowa ranks eighth in the value of its clay products. Considerable mineral water is also exported, that from the Colfax springs being in the lead.

Agriculture.— Iowa is unsurpassed in the quality and extent of cultivated land. It presents mainly a friable black loam on the top, from one to five feet deep; is easily worked, is in the main free from stumps and stones, and requires little or no commercial fertilizers. It has three main varieties, the principal being the alluvial mud of the river bottoms, the glacial drift of the prairies, covering most of the State, a sand and clay loam, and the loess, a rich yellow deposit containing much carbonate of lime, found at great depth on the Missouri slope and along the streams in the central and eastern portions. There is now almost no waste land in the State. In 1900 it presented the unparalleled record of 86.5 per cent improved farm land. A large part of the remaining 13.5 per cent yields income as timber and pasture land. With this fertility and a steady and sufficient rainfall, the State has for many years been first in the Union in value of products derived exclusively from the soil. The total value of its farm products in 1900 was $365,411,528, of which over a hundred million was fed to its own live stock. Its great crop is corn; it varies, in bushels, from 129,104,930 in 1894 to 383,453,190 in 1900, with an average value of $100,000,000 to $150,000,000. A fourth of its surface is covered with cornfields. Its second crop is oats (of which it was second in the United States), with a total in 1900 of 168,364,170 bushels; third, barley, 18,059,060; wheat, 22,769,440; rye, 1,170,970; and buckwheat, 151,120. Its cereals altogether occupy nearly half of its area. It also raises considerable flaxseed. Its hay product is surpassed only by New York; in 1902 it was 5,211,232 tons, most of it used for feeding its own stock. The vegetable crops are also of great importance: in potatoes it was second in 1900, producing 2,662,660 bushels, also 224,622 bushels sweet potatoes, altogether realizing $3,870,746; other vegetables, $3,332,039. It has a considerable fruit crop, especially of apples; in 1900 the value of orchard products was $1,849,767, besides $878,446 of small fruits and berries. The average of Iowa's chief products during the 13 years, 1890–1902, in bushels, is: Corn, 261,200,750; wheat, 16,130,339; oats, 117,118,483; rye, 1,907,482; barley, 12,503,051; flax, 2,182,950; potatoes, 12,198,347; hay, tons, 5,517,884. Iowa leads all the other States in the value of the implements on its farms, namely, $57,960,660.

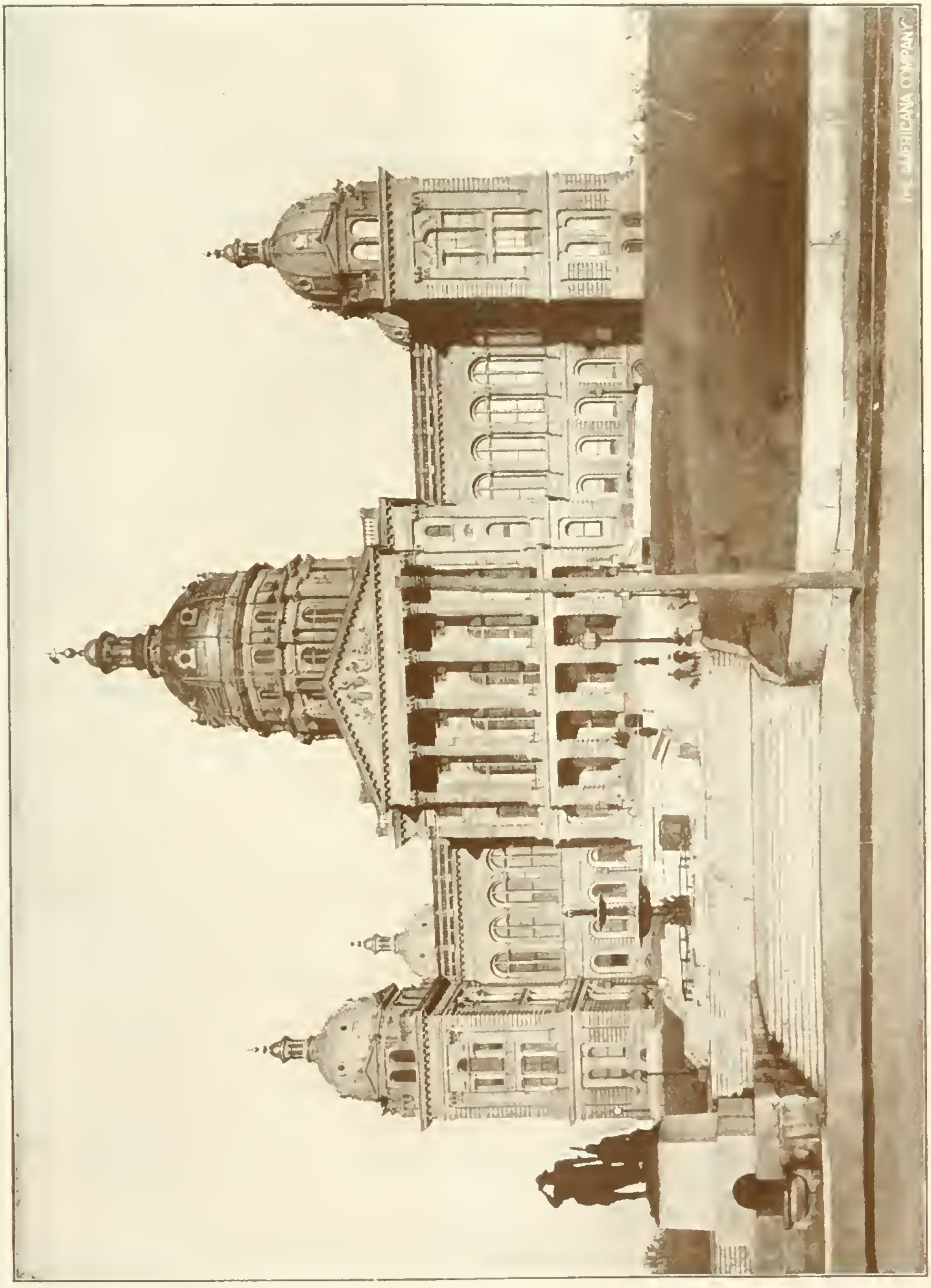
Stock-Raising.— Iowa stands near the top in the value of live stock, $278,830,096 in 1900; and it is significant that while one State, Texas, surpassed it in number of neat cattle,— 9,428,196 to 5,367,630 — the difference in values was only as $163,228,904 to $142,518,902; the average Iowa animal being worth $26.55 against the Texan's $17.31. In dairy cows New York alone takes precedence, and the value of dairy products in 1900 was $18,810,000. That of poultry and eggs was $10,508,000. Great care is taken to have the best breeds of stock, and this alone accounts for the difference in value of the Iowa and the Texas cattle. The richness of the milk is due largely to the breed. In the number of horses (1,268,016) and swine (9,723,791) Iowa led all the other States in 1900; and from 1850 to the last census there has been a steady increase in the number of swine, cattle, and horses.

Manufactures.— The State's fast-growing population and prosperity and its abundant and almost inexhaustible supply of bituminous coal have, together, within the last decade given a rapid impetus to manufacturing. Small factories have enlarged and many new factories have sprung up. Not a few of these are assuming large proportions. In 1900 Iowa manufactured 7,800 cultivators, 5,000 equalizers, 7,560 harrows, 34,500 hoes, 13,638 plows, 2,021 seeders, 100 drills, 3,720 harvesters, 3,775 hay-carriers, 10,980 dozen hay-forks, 5,809 horse hay-rakes, 79,296 scythes, 58,003 separators, etc., representing a total value of $1,343,455 — a gain of over $400,000 in a single year. In the same year Iowa's product of metal-working machines was valued at $273,501. There is but one manufactory of typewriters in Iowa (Des Moines), but it is fast becoming one of the foremost in the country, exporting largely to Great Britain, France, and the colonies. The output of carriages and wagons in 1900 was $4,087,400; product of paints was $336,867; chemical industries paid $70,022 in wages. A curious industry has sprung up in and about Muscatine — the manufacture of pearl buttons from mussel shells found in the beds of streams. Almost unknown, it has grown to huge proportions, and now that the manufacturers have united in the protection of the sources of supply, the future of this industry is assured. The value of its products in 1900 was $866,538, more than one fourth of which went for wages. The industry is now chiefly confined to the cutting of blanks for the eastern market. Iowa has 702 flouring and grist mills, two with a capacity of 100,000 barrels annually. The output of its mills in bushels is: wheat, 12,521,953; corn, 6,352,045; rye, 458,763; buckwheat, 277,593; barley, 538,740; other grain, 5,859,842. Cedar Rapids, Fort Dodge, and Muscatine have extensive oatmeal mills; the one at Cedar Rapids is said to be the largest in the world. The grand total of food products in 1900 was $142,000,000. The slaughtering and meat-packing industry represented in 1900 a total product amounting to $25,695,044. Cheese, butter and condensed-milk factory product in 1900 was $15,846,077 — an increase of nearly 50 per cent in 10 years. The fruit and vegetable canning product in 1900 was $1,350,958 — a gain of over $800,000 in 10 years. Iowa ranks third in the canning of corn. The starch product in 1900 was $806,831 — a gain of over $500,000 in 10 years; product of boots and shoes in 1900 was $7[illegible],141, a gain of over $200,000 in 10 years; product of gloves and mittens in 1900 was $142,600; product of planing mills in 1900 was $[illegible]. A fact not generally understood is that there is more timber in Iowa to-day than at any other time in its history. The clay products, which were $175,165 in 1890, had increased in 10 years to $2,224,920; to this should be added brick and tile products, which in 1900 aggregated $1,97[illegible]; also pottery, terra-cotta and fire-clay products, $192,702. The paper product in 1900 was $[illegible]43,776. Dubuque has the only ship-building plant in the interior. Among the larger cities Des Moines leads in brick-making (over 25,000,000 annually), proprietary medicines, book and job printing and binding, typewriters and hosiery; Sioux City, Ottumwa, Cedar Rapids, and Des Moines in meat-packing; Davenport, Dubuque, Burlington, Des Moines, and Ottumwa in foundries and machine works; Dubuque, Council Bluffs, and Grinnell in carriages; Burlington, Davenport, Des Moines, Dubuque, Ottumwa, Keokuk, and Oskaloosa in cigars; Sioux City, Des Moines, Cedar Rapids, Fort Dodge, Mason City, in flour and other food products; Des Moines, Ottumwa, Grinnell, Newton and Fort Madison in farm and other machinery; the principal river cities in malt products. The total value of manufactured products in 1900 was $164,617,877 — an increase of over 31 per cent in 10 years; the capital represented in 14,819 factories was $102,733,103 — an increase of over 32 per cent; the wages paid the 58,553 employes was $23,931,680 — an increase of over 17 per cent. These figures, showing enormous growth in the last decade, are a surprise to those who regard Iowa as distinctively an agricultural State.

Transportation and Commerce.— Several of the interior rivers are navigable for small boats, the Des Moines for 100 miles, the Missouri for fair-sized steamers its whole length, and the Mississippi for large ones. But the first named are not used to any extent; they have been superseded by railroads; the shifting channel, sandbars and snags of the Missouri make its navigation dangerous and slow. Only the Mississippi remains in practical use. The State, lying in the main path of transcontinental commerce, and originating much well-distributed local traffic, is a vast network of railroads, seven of the great trunk lines crossing it. Every one of the 99 counties has at least one railroad. The farthest distance between railroads at any point in the State is 13.79 miles. In 1903 it had 9,855 miles of road, exclusive of electric lines.

Banking and Insurance.— Iowa has the greatest number of banking institutions of any State in the United States. In August 1903, it had 1,482, divided into 258 national banks, 245 State banks, 350 savings banks, and 561 private banks. The State banks had capital of $10,445,800; deposits, $45,268,974.73; surplus, $1,718,832.41. The savings banks had capital $11,565,500; deposits, $87,620,377.34; surplus, $2,173,462.88. Total capital of all banks in the State, $53,435,020; total deposits, $264,803,000. Iowa is rapidly gaining prominence in the insurance world. In life insurance it promises soon to become a formidable competitor with the Eastern States. In 1902 there were 42 life insurance companies having headquarters in the State, and of this number 24 were located in Des Moines, "the Hartford of the West." Of the 42, 10 were "old line" life companies, carrying insurance to the amount of $36,972,257; 8 were assessment companies, carrying $209,955,500; 16 were fraternal benefit associations, carrying $168,418,000. Total of insurance carried by Iowa companies, $415,345,757.

Education.— Iowa stands second in the literacy of its population; 99.63 per cent of those from 10 to 14 years were, in 1900, able to read and write, although there was no compulsory attendance law prior to 1902. In 1902 it ex-



STATE CAPITOL AT DES MOINES

pended $9,556,890 on its schools, there being 18,513 schoolrooms with 22,708 teachers holding certificates. The enrollment of children in the public schools in that year reached 560,173. There has been a liberal increase in the wages of teachers during the school year of 1902 and 1903. About one third of the schools are located in towns and cities and two thirds in the country. Relatively few of the teachers have had normal training. One State normal school and several private normal schools were in operation in 1900. In 1902 the State normal school had 28 professors and 28 other teachers, with 2,065 students. Under a law passed in 1902, 16 private schools have become accredited for the training of teachers under State supervision. For higher education there are about 200 public high schools and a number of private academies. The courses of study pursued are of high standard and generally uniform. The State University, the head of the public school system, is at Iowa City, the former capital, with law, medical, dental, and other colleges, which in 1902 had 48 professors, 111 other teachers, and 1,512 students. There is also a State College of Agriculture and the Mechanic Arts, located at Ames, which in 1902 had 32 professors, 43 other teachers, and 1,480 students. In 1902 a "Memorial University," at present a military academy, was opened at Mason City by the national order of the Sons of Veterans. Connected with certain of the public secondary schools there are 20 training classes for teachers. Among the private schools of the State there are 16 business colleges and 26 academies. Under the auspices of the Roman Catholic Church there are in the State 25 schools for higher education (academies and colleges), with an attendance of 4,040 pupils, 3 normal schools, 167 parish schools, with an attendance of 22,529 pupils. Iowa was one of the first States to pass a township school law. This law has enabled a number of towns to better their school facilities. In 1895 Buffalo Centre township, for example, was organized into a school township, and within four years all the district schools except two were closed and the pupils were transported to a central graded school. The law makes provision for the transportation, at public expense, of children living remote from the central school. The State report for 1901 shows that consolidation has been tried in 28 counties, transportation in 35, and both in 19. Good results were reported in 27 counties, doubtful in 5 counties. Bad roads are the chief obstacle in the doubtful counties, but a vigorous "Good Roads" movement is minimizing this obstacle. Ninety-five per cent of the county superintendents for 1901 favored the plan.

Libraries.— In 1893 there were 83 public libraries in Iowa, as follows: Supported by the State, 12 (volumes, 118,974); college and academic, 24 (volumes, 95,114); association and subscription, 16 (volumes, 81,234); free public, 15 (volumes, 68,809); miscellaneous, 7 (volumes, 46,176); public school, 5 (volumes, 7,850); total, 418,157 volumes. In 1903 the number of libraries had increased to 248, as follows: Supported by State, 22 (volumes, 236,953); college and academic, 36 (volumes, 179,261); association and subscription, 32 (volumes, 52,080); free public, 70 (volumes, 336,305); miscellaneous, 11 (volumes, 89,159); public school, 77 (volumes, 75,982); total, 969,740 volumes.

Churches.— In the number of church societies in the State the denominations rank as follows: Methodist, Lutheran (three branches), Roman Catholic, Baptist, Christian (Disciples), Presbyterian, Congregationalist, United Brethren, Evangelical Association, Protestant Episcopal, Friends, Reformed, Adventist. There is one Roman Catholic archdiocese, with two dioceses. The non-polygamous Mormons or "Latter-day Saints," and the Amana Colony community of Christian Socialists, have a large and prosperous membership.

Charities and Penal Institutions.— The State charitable institutions are managed by a board of control appointed by the governor with the consent of the senate. There are four insane retreats: at Clarinda, Mt. Pleasant, Independence, and Cherokee; besides four private asylums; a school for the deaf at Council Bluffs; a school for the blind at Vinton; an institution for feeble-minded children at Glenwood; a soldiers' home at Marshalltown; and a home for soldiers' orphans at Davenport. There are State penitentiaries at Anamosa and Fort Madison, both have adopted the graded system; an industrial school for boys at Eldora, and one for girls at Mitchellville. L. S. Coffin has established a home for ex-convicts on his farm near Fort Dodge.

State Government.— The constitution was adopted in 1857. By law, the electors must vote once in 10 years on calling a convention to revise the constitution, which convention the legislature must call if so voted. All amendments must receive a majority vote of both houses at two successive legislatures, and then be passed by popular vote. The Senate has 50 four-year members, the House 100 two-year; legislative sessions are biennial. Bills must have a majority of all members elected to both houses — not merely present. A two-thirds vote overcomes the governor's veto. Executive officials are elected for two years — half in one year and half in the alternates, with the exception of the railway commissioners, who are elected for three; the railroad commission has power to regulate rates, etc. The judiciary consists of a supreme court, with a chief justice who is such by reason of priority of election, and five associate judges, one chosen every year; also 53 district judges in 20 districts, each serving four years. Women may vote only on school questions involving the expenditure of money. All incorporated towns of 2,000 people and over are ranked as cities; all platted but unincorporated towns are villages. In 1902 there was a militia of 2,474 officers and enlisted men. The number of representatives to Congress is 11. In politics the State has been Republican since the organization of the party, except in the years 1890–4, when the advocacy of prohibition drove it into retirement. The prohibitory amendment adopted in 1882 was pronounced unconstitutional by the supreme court of the State, and was succeeded by prohibitory laws which after several years' trial were in turn succeeded by a local option law, under which 54 of the 99 counties were reported in 1903 as wholly free from saloons.

Finances.— The State has no debt except one of $10,936 to its own school fund, which debt by provision of the constitution is a permanent one. It had a balance in the treasury 1 Jan. 1903, of $926,916.65. Local taxation is limited to 1 per cent of valuation for current expenses, but this may be exceeded for waterworks, sewers, schools, etc. The State as a whole cannot incur a debt greater than $250,000 except for war purposes, and cannot loan its credit to any person or association: counties and towns cannot run in debt to over 5 per cent of their actual valuation. The average income is about $3,000,000 a year.

Population and Divisions.— Iowa ranks tenth among the States in population. The population was 43,112 in 1840; (1850), 192,214; (1860), 674,913; (1870), 1,194,020; (1880), 1,624,615; (1890), 1,911,896; (1900), 2,231,853. The original population was part of the great Free-State movement which peopled the central States except Indiana. Of the entire population (1900), 305,920 were foreign-born. Of these 123,162 were from Germany; 72,611 from Scandinavia, or nearly two thirds from the Teutonic nations; besides several thousands from German Austria and Switzerland. From England and English Canada were 35,195, French Canadians 14,168, Ireland 28,321, Holland 9,388. Colored, 12,693. There were 81,845 more males than females. There are no great centres of population. The capital, Des Moines, on the river of the name, is the largest, with 62,139. On the same river to the north is Fort Dodge, an old frontier fort and settlement (12,162), and below it Ottumwa (18,197) and Keokuk (14,641). The Mississippi River business is chiefly represented, from north to south, by Dubuque (36,297 — the first settled site in the State), Clinton (22,698), Davenport (35,254), Muscatine (14,073), Burlington (23,201), Fort Madison (9,278), and Keokuk, the "Gate City," at the mouth of the Des Moines. Sioux City (33,111), in the extreme west near the mouth of the Big Sioux, and Council Bluffs (25,802), opposite Omaha, the old terminus of the Union Pacific, represent the Missouri River; Cedar Rapids (25,656) and Waterloo (12,580), the valley of the Cedar River; and Marshalltown (11,544), the valley of the Iowa River.

History.— The territory now included in Iowa was originally inhabited by the Ioway and Illinois tribes of Indians, which were driven out by the Sacs and Foxes. In 1761 the 'Ioway' or Iowa tribes were on the east side of the Missouri River and near the headwaters of the Des Moines; but in 1805 they were occupying land on the south side of the Des Moines River. Later they left the vicinity of the Des Moines, some going to the reservation of the Foxes and Sacs (now Oklahoma), others to a reservation in Kansas. The missionary, Father Marquette, and Joliet, the fur trader, were the first white men known to have traveled in this section. In 1673 they visited the tribes of Indians along the Mississippi River, and first landed on Iowa soil near the mouth of the river now known by the name Iowa. In 1788 a party of 10 white men under Julien Dubuque established the first white settlement at the place now occupied by the city of Dubuque. They were attracted to this locality because of the lead deposits in the vicinity. They opened mines, but how successful they were may be conjectured from the fact that after the death of Dubuque, in 1810, his associates abandoned the settlement. All that portion of country drained by the Mississippi was claimed by France because of the explorations made by Marquette and some of his companions, and because of settlements made by other Frenchmen. France's claim to this territory was ceded by treaty to Spain in 1763, but the country was returned to France in 1800-1. In 1803 all the territory now known as the "Louisiana Purchase" (q.v.) was bought of France by the United States government. The territory now the State of Iowa was part of the Territories of Louisiana in 1805; of Missouri in 1812; of Michigan in 1834; of Wisconsin in 1836. Iowa became an independent territory in 1838, and was admitted as a State in 1846. The Indian claims to lands within the boundaries of the State were purchased by the United States government before its admission as a State. The last purchase was made in 1843. Remnants of the Sacs and Foxes occupy a reservation, 419 acres, in Tama County, and still receive annuities from the government. In 1832 a settlement was made at Fort Madison, an abandoned government post, and soon after Burlington was founded, and in 1830 a settlement was again made at Dubuque. In 1857 the Indians attacked the settlers living near the Okoboji lakes and Spirit lake, in Dickinson County, and about 30 whites were killed and nearly all the houses burned. This action on the part of the Indians retarded for some years the growth of that section of the State. Iowa City was first selected for the Territorial capital (it became the State capital in 1846), but in 1857 the capital was changed to Des Moines. Iowa had in the Federal army during the Civil War 75,839 men, which was about one tenth of her population. Some of this number were in regiments belonging to other States. Consult: Aldrich, 'Annals of Iowa'; State Historical Society publications; Shambaugh, 'Documentary Material Relating to the History of Iowa'; Monette, 'History and Discovery of the Mississippi Valley'; Iowa Geological Survey publications; Shambaugh, 'History of the Constitutions of Iowa' and 'Messages and Proclamations of the Governors of Iowa'; Gue, 'History of Iowa.'

JOHNSON BRIGHAM,
Librarian, Iowa State Library.

Iowa Central Railway Company.— *History.* — The Eldora Railroad and Coal Company was organized in 1866 to build a railroad from Eldora northward to a junction with the Dubuque and Sioux City Railroad at Ackley, Iowa, a distance of about 17 miles, and to engage in the business of mining and selling coal. The company received about 1,200 acres of coal lands (about 600 acres thereof in fee simple and the rest by ground lease) as a consideration for completing the work within a specified time. The road was opened in July, 1868. It was then decided to extend the line 28 miles southward to a junction with the Chicago and Northwestern Railway at Marshalltown, Iowa. This necessitated a reorganization of the company, which was effected in August, 1868. In the reorganization, the coal interests were turned over to the Eldora Coal Mining Company and the railroad property to the Iowa River Railway Company. The capital stock of the latter was limited to $30,000 per mile and the first mortgage bonds were issued at the rate of $16,000 per mile, about $400,000 of them being used to retire an issue of bonds of the Eldora Railroad and Coal Company. The extension to Marshalltown was completed in December, 1869, the line being formally opened from Ackley to Marshalltown on 7 Jan. 1870. At about the same time the Saint Louis and Saint Paul Railway Company was organized under the auspices of the Iowa River Railway Company, to build a railroad from Ackley to the Minnesota State Line, and an independent corporation, the Iowa Central Railroad Company, was organized to build a north and south line, starting from the Missouri State Line at a point near the boundary of Appanoosa and Davis Counties and running northerly and northeasterly through Albia, Eddyville, Oskaloosa, Grinnell, Toledo and Cedar Falls to the Minnesota State Line. In 1870, the Iowa River Railway Company, the Saint Louis and Saint Paul Railway Company and the Iowa Central Railroad Company were consolidated under the name of Central Railroad Company of Iowa. The Iowa River Railway Company had in operation at the time 45.92 miles of railroad which was turned over to the consolidated company under an even exchange of $30,000 in stock and $15,000 in first mortgage bonds per mile. The entire issue of bonds of the Iowa River Railway Company was retired and the mortgage cancelled. A contract was made with the Iowa Valley Construction Company to complete and equip the road from Marshalltown to the Missouri State Line and from Ackley to the Minnesota State Line in consideration of receiving $30,000 per mile in stock and $16,000 per mile in first mortgage bonds, together with local aid guaranteed at $2,500 per mile. The entire line from Albia to Mason City, Iowa, a length of 178.72 miles, was completed and opened for traffic on 7 Feb. 1871. On 15 June 1871, the company made final settlement with the construction company for the 132.8 miles of new road, and was released from any obligation to build the rest of the projected line. The extension from Mason City to Northwood, 20.73 miles, was commenced on 1 Aug. 1871, and completed on 10 Oct. 1871. The total length of line in operation on 1 Jan. 1872, was 202.11 miles, the cost of the road being represented by $4,644,630 of capital stock, $3,700,000 of the first mortgage bonds and $609,000 of second mortgage bonds. Default having been made in payment of second mortgage interest due 15 April 1873, and of first mortgage interest due 15 July 1873, the property was placed in the hands of a receiver. The company was reorganized on 4 June 1879, under the Central Iowa Railway Company and took over the property after foreclosure sale on 18 June 1879.

In 1880–1882 the company constructed the following lines: Montezuma branch, 13.61 miles; State Centre branch, 25.64 miles; Story branch, 34.5 miles; Belmond branch, 22.20 miles; Keithsburg branch (Oskaloosa to west bank of Mississippi River), 97.16 miles, and Newton branch, 27.75 miles. The Peoria and Farmington Railroad, extending from Iowa Junction, Ill., to the east bank of the Mississippi River, a distance of 88.65 miles, was purchased in May, 1883, the company at the same time securing the right to run its trains into Peoria, Ill., over the tracks of the Peoria and Pekin Union Railway. First mortgage bonds to the amount of $1,531,000 were issued on the Keithsburg and Newton branches, and to the amount of $1,200,000 on the Montezuma, State Centre, Story and Belmond branches, both issues being dated 1 April 1882, and payable 30 years thereafter, with interest at the rate of 7 per cent. per annum, payable semi-annually. Also, $1,517,000 6 per cent. 45-year bonds dated 1 June 1879, secured by first mortgage on the Illinois division, were assumed from the Peoria and Farmington Railroad Company. Default was made in payment of interest due 1 Oct. 1884, and was followed by defaults under the main line and Illinois mortgages. A receiver was appointed 1 Dec. 1886. In pursuance of a plan of reorganization the road was sold under foreclosure of the several divisional mortgages, the sales taking place in September and November, 1887, and in March, 1888. The present company was organized by the purchasers taking over the property on 15 May 1889.

Lease of Iowa Central and Western Railway.— The company leases for 50 years from 1 July 1901, with rights of purchase at any time during the continuance of the lease, the Iowa Central and Western Railway, from Belmond to Algona, Ia., a distance of 37 miles, upon condition that it shall maintain the property, paying, in addition to all taxes lawfully assessed, 20 per cent. of all gross earnings accruing from the operation of the property. The earnings are to be applied to the payment of interest and principal upon the bonds of the Iowa Central and Western Railway Company as the same may become due and payable, and the Iowa Central Railway Company guarantees to make good any deficiency that may arise.

Traffic Agreement with Chicago, Burlington and Quincy Railroad Company.— Under an agreement effective 16 Jan. 1905, this company's freight business between Oskaloosa and Des Moines, Ia., is handled by the Chicago, Burlington and Quincy Railroad Company at an agreed rate per loaded car.

F. H. Davis,
Vice-President.

Iowa City, Iowa, city and county-seat of Johnson County, on the Iowa River, and the Burlington, C. R. & N., and the Chicago, R. I. & P. R.R.'s; 54 miles west of Davenport. The city is pleasantly built on a succession of plateaus, rising one above another from the river banks, which are here high. The first plateau is laid out as a public promenade, and the third, which is about 30 feet higher than the first, is crowned by a handsome Doric edifice 120 feet long and 60 feet wide, of a beautifully marked stone quarried in the vicinity called "bird's-eye marble." This building was originally intended for the State capitol, but, on the removal of the seat of government to Des Moines, was appropriated to the State University. From 1839 to 1854, this was the seat of the Territorial and State governments. It is the seat of the State University of Iowa, the Iowa State Academy, the State Historical Society and Library, the Homœopathic, Allopathic, and Mercy hospitals. It is the farming trade centre for Johnson, Cedar, and Iowa counties, with an annual trade exceeding $1,000,000; has excellent power provided by the Iowa River; and has manufactories of flour, iron, woolen goods, perfumery, gloves, jewelry, fencing, and linseed oil. The city has electric light and street railroad plants, waterworks on the Holly system, numerous churches, and an assessed property valuation of about $6,500,000. Besides its manufacturing interests the city has an extensive stock-raising and meat-packing industry. Pop. (1890) 7,016; (1900) 7,987.

Iowa College, a coeducational institution founded in 1847 at Grinnell, Ia.; under the auspices of the Congregational Church. In 1901 it had 33 professors and instructors, 411 students, 27,000 volumes in the library; productive funds, $470,000; grounds and buildings valued at $150,000; and an income of $49,000.

Iowa River, a considerable stream in the State of Iowa rising in Hancock County, near the Minnesota State line and flowing southeast into the Mississippi River, north of Burlington. It is 300 miles in length, and is navigable to Iowa City, 80 miles from its mouth.

Iowa State College of Agriculture and Mechanic Arts, a coeducational institution for technical education at Ames, Iowa. It received a grant of land from Congress under the law of 1862, and was first opened in 1868. Regular courses are offered in agriculture, mechanical engineering, civil engineering, electrical engineering, mining engineering, technology, science as related to industry, and general and domestic science; special shorter courses are given in the fall and winter in dairying, agriculture and mechanics, horticulture and mechanics, and domestic science. The State Agricultural Experiment Station is also allied with the college. The annual income in 1902, including the Federal appropriation, was $120,000; there were 1,220 students in attendance, and 84 professors and instructors.

Iowa, State University of, an educational institution forming an integral part of the public school system of the State, situated at Iowa City. It was first opened in 1847, receiving control of lands given by the Federal government. (See COLLEGES, LAND GRANT.) The university is controlled by a board of regents of 2 ex-officio members and 11 elective members. Its work is organized in the following departments: the college of liberal arts (including the summer session), which offers courses leading to the degrees of A.B., B.S., and Ph.B.; the graduate college; the Iowa school of political and social science, with both undergraduate and graduate courses; the college of law; the college of medicine; the college of homœopathic medicine; and the college of dentistry. The library, which [illegible] by fire in 1897, now contains nearly [illegible] volumes; the university issues the following publications: 'Natural History Bulletin'; 'The Transit,' an engineering journal; 'The Law Bulletin'; 'The Bulletin of the [illegible] Medical College'; 'The University of Iowa Studies in Psychology'; 'The State University of Iowa Studies in Sociology, Economics, Politics and History.' The State appropriates over $125,000 annually to the university, and the total income amounts to over $[illegible] annually. In 1902 the number of students was [illegible]; the number of professors and instructors, [illegible].

Iowa Wesleyan University, a coeducational institution founded in 1844, at Mount Pleasant, Iowa; under the auspices of the Methodist Episcopal Church. In 1901 it had 20 professors and instructors, and 380 students. There are 5,000 volumes in the library. It has productive funds, $75,000; grounds and buildings valued at $150,000; benefactions, $32,000; and an income of $14,000.

I'owas, a tribe of American Indians of the Algonquin family. In 1800 the Iowas lived in Minnesota and soon after moved southward. They were called Palinchas, or "Dusty Noses," in their own tongue. Lewis and Clark, the explorers, designate them as the Ayanways, and the early French traders called them the Ajowes. In 1836 they moved to the Wolf River region west of the Mississippi, and in 1861 ceded 16,000 acres of land to the United States. The remnants of the tribe, some 1,000 in number, at present live on reservations in Oklahoma and Kansas. See also INDIANS, AMERICAN; IOWA.

Ipecac, or **Ipecacuanha**, a South American plant of the order *Rubiaceæ* variously called by botanists *Cephaelis ipecacuanha* and *Psychotria ipecacuanha*. The plant, which is found mainly in moist shady forests in Brazil, is a creeping herb or sub-shrub with mostly bare stems, only the extremities producing leaves. The small white blossoms, which are borne in heads with long stalks, are followed by dark purple berries. The rather fleshy more or less divided roots were in medicinal repute among the South American Indians, and gradually found their way into European medicine under the name "ipecacuanha." They have been considered emetic, nauseant, diaphoretic and expectorant, and in large doses are reputed poisonous. They appear in commerce in various grades (gray, brown and red), which are dependent mainly upon the season at which they are gathered, the way they are dried, the age of the plants, etc. The chief supplies are collected during January, February and March by the Indians. Owing to the slow growth of the plant and the low price the roots command, ipecac is not cultivated commercially; it has, however, been successfully grown in various parts of the world. The roots of several other plants are substituted for those of true ipecac, among the best known being those of *Tylophora asthmatica* and *Sarcostemma glaucum* (Venezuelan ipecac), both of the natural order *Asclepiadaceæ*. Other species of *Psychotria* and certain species of *Richardsonia* are similarly but unofficially employed.

Wild or American ipecac (*Gillenia stipulacea*) of the rose family, is a common plant in the southeastern United States and as far north as western New York. It is a perennial herb about three feet tall, bearing paniculate corymbs of white or pale rose colored flowers. It is hardy, of simplest culture and being graceful is frequently planted for ornament in flower borders where the soil is of good quality.

Iphicrates, ī-fĭk'ra-tēz, Athenian commander: b. and d. in the 4th century B.C. Of humble origin, he raised himself to eminence by his courage and talents. In the war of Corinth (393–2 B.C.) he opposed with success Agesilaus, the warlike king of Sparta. He was sent to the Hellespont to act against Anaxibius, but in spite of his victory was unable to prevent the conclusion of the shameful Peace of Antalcidas (387 B.C.). In 369 B.C. he was appointed to the command of the troops sent by the Athenians to the assistance of Sparta, on the invasion of Epaminondas, but allowed the Theban general to retreat from the Peloponnesus. In the Social War (357–5) he was one of the commanders of the fleet fitted out by the Athenians for the recovery of Byzantium. Being accused of treachery and neglect of duty in the battle at the Hellespont, by one of his colleagues, Chares, and put on trial, he was acquitted, while his colleague Timotheus was fined 100 talents; but though he lived to a great age, did not again engage in active service. Iphicrates was the author of some improvements in Greek arms and accoutrements. He was accustomed always to fortify his camp in the field even in a friendly country; "Because," he said, "if, contrary to probability, I should be attacked, I may not be obliged to make the disgraceful excuse that I did not expect it."

Iphigenia, ĭf-ĭ-jē-nī'a, in Greek legend, a daughter of Agamemnon and Clytemnestra (according to some an illegitimate daughter of Theseus and Helen), who was to have been sacrificed to Artemis (Diana) at the advice of the prophet Calchas, when the goddess, enraged with Agamemnon, detained the Greek fleet in Aulis by a calm. Under pretense that she was to be married to Achilles, Iphigenia was led to the altar. But in the moment when the priest was about to give the death-blow Iphigenia disappeared, and in her stead a beautiful hind was substituted, whose blood gushed out on the altar. Artemis had relented, and conveyed her in a cloud to Tauris, where she became the priestess of the goddess. Conformably with the law of the country, she was obliged to sacrifice every Greek that landed there. While serving as priestess her brother Orestes came to take away the image of Artemis, as he had been advised by an oracle to do, that he might get rid of the madness to which he had been subject since the murder of his mother. Iphigenia having recognized him as her brother, the two contrived a means of escape, and carried off with them the image. The story of Iphigenia was dramatized by Euripides (who composed two plays upon the subject — 'Iphigenia in Aulis' and 'Iphigenia in Tauris'), and Goethe, and it is also the subject of two operas by Gluck, 'Iphigenie en Aulide' (1774); and 'Iphigénie en Tauride' (1779).

Ipomæa, ĭp-ō-mē'a, a genus of plants, including several hundred species, of the order *Convolvulaceæ,* consisting mostly of twining prostrate herbs, widely distributed in warm regions. The species of most importance is *I. Purga,* which yields the jalap of commerce. Some are cultivated for the beauty of their flowers, and are known to gardeners as convolvuli. *I. purpurea* is the best known garden species. See JALAP.

Ips'wich, Mass., town in Essex County, on the Ipswich River near its mouth, and on the Boston & Maine railroad, 27 miles northeast of Boston, and 9 miles south of Newburyport. As Agawam, it was settled in 1633 by John Winthrop and 12 others. The name was changed to Ipswich (after Ipswich, England), in the following year, by resolution of the Massachusetts General Court. As early as 1634 it had a meeting-house, while in 1642 the first free school in the town was established. Ipswich was among the foremost towns of Massachusetts in resisting the arbitrary taxation introduced under Gov. Andros in 1687, and a number of its citizens suffered punishment in consequence of this action, which foreshadowed the stand to be taken later, by this town and the colonies generally, against similar policies on the part of the British government. Among the distinguished persons who at some time lived at Ipswich were Anne Bradstreet, Nicholas Easton, William Hubbard, John Norton, and others. The town has various industries, among the articles manufactured being grist-mill products, hosiery and underwear, bricks, lumber and boxes, carriages, cabinet-work, soap, isinglass, heels, etc. The Manning High school, the Ipswich Historical Society, and the excellent public library give the town rank and influence in educational and literary affairs. Pop. (1900) 4,658.

Iquique, ē-kē'kā, Chile, a seaport in the province of Tarapacá, till quite recently merely a small fishing village, but now a town of about 34,000 inhabitants. It owes its prosperity to the export of nitrate of soda and borax, the former of which especially is found in great quantities in the pampa of Tamarugal. The annual export of nitrate amounts to about 350,000 tons, and that of borax to about 1,500 tons. Iodine is also exported. The pampa of Tamarugal still contains, it is estimated, about 60,000,000 tons of soda niter. In 1868, and again in 1877, the town was almost entirely destroyed by an earthquake. In 1879 it was bombarded and captured by Chile from Peru; and in 1891 it was much damaged by insurgents.

Iquitos, ē-kē'tōs, a native tribe in Peru, residing at Loreto, on the left bank of the Marañon, about 75 miles above the mouth of the Rio Napo. The settlement has an active trade, valued at $2,000,000 annually; the imports are exchanged mostly for india rubber. In 1900 they numbered about 12,000.

Irade, ĭ-rä'dĕ, a Turkish decree or command of the Sultan, directed to his grand vizier, whose duty it is to announce it to the public.

Iran, ē-rän', the name given by the ancient Persians to their native land, in opposition to Aniran (that is, Not Iran), the land of the barbarians, by which term were meant principally the Turco-Tartaric tribes bordering on the north. The Persian rulers of the dynasty of the Sassanidæ call themselves, in inscriptions on monuments and elsewhere, kings of Iran and Aniran. At the present day the name is used in contradistinction to Turan, the name applied to the more depressed regions of Asia inhabited by the Turco-Tartaric tribes, to designate the great table-land of Asia, which has a mean elevation of from 3,500 to 4,000 feet. The central portion of this table-land consists of an extensive salt-desert.

Iranian (ī-rā'nĭ-an) **Languages**, a family of the Indo-European languages, closely allied to the Indian group, and called by some philologists Persian, from the best known member of the family. The two oldest known Iranian languages are the Old Persian and Zend. The former — that of the cuneiform inscriptions of the Achæmenian dynasty, and the language of the Persians proper — has only become known in its chief traits at a comparatively recent date through the deciphering of those inscriptions. The Zend is the language in which the Zend-avesta, the sacred writings of the Parsees, are composed. By the term Middle Iranian languages the Huzvaresh or Pehlevi and the Parsi principally are understood, which are preserved in the commentaries to the Zend-avesta. The latter approaches to the modern Persian. The dialect of the Pehlevi coins, as well as the inscriptions of the time of the Sassanian dynasty, also belong to this section. The most important of the New Iranian languages is the Persian. The Afghan, or Pashtu, and the dialects of the Kurds, form separate branches of the Iranian family. The isolated Ossetes of the Caucasus also speak an Iranian language. The Armenian is a branch of the same stock, and contains many peculiar elements.

Irawadi, ĭr-a-wăd'ĭ, or **Irrawady**, one of the great rivers of Southern Asia, traversing Burma in a southerly course. One branch of it rises near the eastern extremity of Assam, another branch rises in East Tibet, the two branches uniting about lat. 26°. It has generally a south course, being deflected west, and its total length has been estimated at 1,200 miles. There are three rocky defiles in which its channel is suddenly contracted, the lowest near Mandalay; but from that point downward to its delta it has generally a breadth of from 1 to 4 miles. About 140 miles from the Indian Ocean, which it enters by numerous mouths, the delta commences. The current of the Irawadi is commonly gentle — even in its upper part being no more than at the rate of two miles an hour; except during the inundations, when it flows so rapidly that no sailing vessels could navigate it but for the assistance of the southwest monsoon. It is navigable from the sea upward for steamers of five feet draft to the Chinese frontier, 900 miles from the sea.

Iredell, īr'dĕl, **James**, American jurist: b. Lewes, Sussex, England, 5 Oct. 1751; d. Edenton, N. C., 20 Oct. 1799. He was appointed comptroller of customs at Port Roanoke, now Edenton, where he arrived in 1768, retained this office several years, and meanwhile studied law. He was appointed by the attorney-general his deputy in 1774, and in 1777 was placed by the legislature on the bench of the supreme court, then just organized under the State constitution. In 1787 he was designated by the general assembly sole commissioner to collect and revise the acts of previous assemblies, which were to be considered in force in North Carolina. This collection of the laws, now referred to as "Iredell's Revisal," was published in 1791. In February 1790 he became one of the justices of the Supreme Court of the United States, and held that office till his death. The 'Life and Correspondence' of Iredell was published in 1857.

Iredell, James, American lawyer, son of the preceding: b. Edenton, N. C., 2 Nov. 1788; d. Raleigh, N. C., 13 April 1853. He was graduated at Princeton in 1806, and was bred to the bar. He served for 10 years in the house of commons of his native State, and twice as speaker in a house of which the majority were politically opposed to him. In 1827 he was governor of North Carolina, and from 1828 to 1831 a member of the Senate of the United States. He afterward resumed the practice of his profession at Raleigh, where he was also for many years reporter of the decisions of the supreme court of North Carolina. In 1833 he was appointed by Gov. Swain one of three commissioners to collect and revise all the statutes in force in North Carolina. The result was the work known as the 'Revised Statutes.' He afterward published a 'Treatise on the Law of Executors and Administrators.'

Ireland, īr'land, **Alleyne**, American author and lecturer: b. Manchester, England, 19 Jan. 1871. He was educated at the University of Berlin, traveled widely, lectured on tropical colonization at Cornell University in 1899, and in 1900 was appointed lecturer in politics at the University of Chicago, where his subjects were tropical colonization and Chinese foreign relations. Besides contributions to periodicals, he has written: 'Georgetown, Demerara' (1897); 'Tropical Colonization' (1899); 'The Anglo-Boer Conflict' (1900); 'China and the Powers' (1901).

Ireland, John, American Roman Catholic prelate: b. Burnchurch, County Kilkenny, Ireland, 11 Sept. 1838. He came to America in 1849 and attended the Cathedral school at Saint Paul, Minn., and in 1853 went to France and studied theology in the seminary of Meximieux and subsequently in that of Hyeres, remaining there till 1861, when he returned to Saint Paul and was ordained priest on the 21st of December. During the early part of the Civil War Father Ireland tendered his services as chaplain of the 5th Minnesota regiment and later became rector of the cathedral, Saint Paul. An ardent advocate of temperance, he devoted much time and energy to promoting the cause, organized temperance societies and traveled about the country lecturing on the subject. For a time he was secretary to Bishop Grace of Saint Paul, whom he represented at the Vatican Council, Rome, 1870–71, and later became his coadjutor, being consecrated Titular Bishop of Maronea, 21 Dec. 1875. He was likewise very diligent in advancing Roman Catholic colonization in the northwest and not only founded colonies but became a director in the National Colonization Association. Later, in 1887, Bishop Ireland accompanied Bishop Keane to Rome to consult with Pope Leo XIII. upon the necessity of erecting a Catholic university in Washington, D. C., and on returning from Europe in 1888, he was made first archbishop of Saint Paul. He is a distinguished lecturer and pulpit orator, a contributor to the leading magazines, and a member of the American Federation of Labor. At present (1905) his diocese includes about 230,000 Catholics; 258 priests; 252 churches; 1 theological seminary; 90 parochial schools; 3 orphanages; 3 hospitals, and various other religious and educational institutions.

Ireland, Mary E. Haines, American translator and author: b. Calvert, Cecil County, Md., 9 Jan. 1834. In addition to serials and numerous other contributions to the periodical press, she wrote 'What I Told Dorcas' (1895), and 'Grandma Elliot's Farmhouse' (1900).

Ireland, William Henry, English literary forger: b. probably London 1777; d. there 17 April 1835. He imposed spurious Shakespearian

JOHN IRELAND,

ARCHBISHOP OF ST. PAUL.

MSS. upon his father, Samuel Ireland, a bookseller and engineer, who was a Shakespeare enthusiast, and also upon other men of letters, and produced two "Shaksperian" plays, 'Vortigern' and 'Henry II.,' the former of which was purchased by Sheridan and acted at Drury Lane, but was a complete failure. The criticisms of Malone led to the exposure of the fraud, which was acknowledged by Ireland in 1796. He wrote various novels, poems, etc., besides his 'Confessions' (1805), containing an account of his forgeries.

Ireland, the most westerly and smaller of the two principal islands of which the United Kingdom of Great Britain and Ireland is composed, extends from lat. 51° 26′ to 55° 21′ N.; its average width is about one fourth its length; area, 32,583 square miles. It is separated from England by Saint George's Channel and the Irish Sea, and from Scotland by a narrow passage, the North Channel. Ireland is on the continental shelf, or sub-marine plain, which borders the continental land mass of Europe, hence it is physically a part of Europe.

Topography.— The coast line is irregular; from Dundalk Bay to Wexford Harbor on the east there are less indentations than on any other part of the coast; Dublin Bay, an arm of the Irish Sea, is the only indentation of any size on this part of the island. Galway, Sligo and Donegal Bays are the largest on the western coast. The Atlantic currents, which beat against the western coast, have worn away the land in many places, thus causing fiords such as exist on the coasts of other countries subject to similar wave-action. Some of the many islands which fringe the coast have been formed by the washing away or the submergence of the land. The capes, promontories, and peninsulas have been formed largely by submergence. Some of the islands, all small, are Aran, Achill, Clare, and Rathlin. The chief ports are Cork, Dublin, Belfast, Waterford, and Londonderry. There are 14 harbors which will accommodate the largest ocean steamers.

The highlands are chiefly along the coast; the greater part of the interior is a plain. The mountains, more rounded hills than mountains, are short ranges with little or no connection except the several ranges in the southwest. Some of the mountains are Mourne, in County Down, the Wicklow Mountains, Knockmealdown and Galty in the south; Caha, Stack and other ranges in Kerry; Slieve Boughta in Galway, a number of short ranges in the counties of Mayo, Leitrim, Donegal, and Londonderry, and the Slieve Bloom between Queens and Kings counties. The majority of the peaks are less than 3,000 feet in height; Carrantuohill (Carrantual), in Kerry, near the Lakes of Killarney, is 3,404 feet, and Galty Mountains, in Limerick, are 3,015 feet. The plain in the interior is about 500 feet above sea-level.

Hydrography.— The rivers of Ireland, like those of England and Scotland, are small streams. The Shannon, the largest river in the British Isles, has its rise in the northeastern part of the province of Connaught, flows east, south, and west, forming quite a curve before entering the Atlantic Ocean, between the counties of Kerry and Clare. It passes through several lakes, the largest of which are Ree, Allen, and Derg. The estuary at the mouth is about 70 miles long; the whole length of the river is about 250 miles, 130 of which are navigable for large steamers. Its importance for transportation has been increased by the canals Royal and Grand, which connect it with Dublin. In the southwest, in County Kerry, is a short mountain stream called Roughly River, with a long, broad estuary called Kenmare River. The Liffey, which flows into the Irish Sea at Dublin, the Lee which flows into Cork Harbor, the Boyne with its tributary, the Blackwater, are all short streams which have been made famous in history and literature. The Foyle, Erne, Lagan, Moy, Slaney, and others reach the ocean through broad estuaries or bays. Lough Neagh in the northwest is the largest lake of the British Isles. A number of the lakes of Ireland occur along the river courses, but are really basins, and not merely expansions of the rivers. Lakes Corrib, Conn, Foyle, Belfast, Strangford, Carlingford, and others on the coast are estuaries or fiords, but the land-locked mouths entitle them to be called lakes, like Maracaibo in South America. The famous Lakes of Killarney are in County Kerry, in the southwestern part of the island. There is scarcely a place in Ireland that is more than 25 miles distance from water communication with the ocean.

Geology.— A limestone stratum belonging to the basal portion of the Carboniferous system underlies a large part of the interior plain. The upper Carboniferous rock has been destroyed by erosion except in a few places. Silurian rock underlies nearly all of the northern part, but the Cretaceous, Triassic, and Permian formations exist and appear at the surface in several places. Some of the cliffs of the north are of basaltic formation. The Giant's Causeway (q.v.) on the north coast of Antrim is basaltic. Its 40,000 or more, perfectly formed polygonal columns constitute remarkable specimens of this formation. Crystalline rocks form the axis of the mountains of the province of Connaught, and the highlands of Leinster. Old red sandstone and carboniferous limestone are found in the southwestern counties. Marble exists in large quantities in the county of Kilkenny and in parts of the adjacent counties coal of an anthracite variety is found, but not in large quantities; iron-ore exists in nearly every county. Copper of an excellent quality is in the western mountains, also gold and silver in small quantities.

Soil.— The erosion of the limestone rock which has been going on for ages has contributed largely to the fertility of the soil of Ireland. The igneous rocks, the red marls, and other mineral formations, have added to the richness of the soil, and all has been distributed, by the gradual removal of the ice-covering, over a large area of the plain. After deducting the area, about one fifth of the whole, which is covered by bog, mountain, and moorland, there is left a vast extent of arable surface covered with a deep friable loam of remarkable richness. In addition to the decomposed trap and the calcareous matter derived from the limestone, there is a large amount of vegetable mold which forms one of the most important ingredients of the soil. The bogs, useless for tillage, furnish peat for fuel. The Bog of Allen is the largest one in Ireland.

Climate.— The warm moist winds from the Atlantic blowing over Ireland affect its climate more than any other cause except its latitude.

The mean temperature is from 20° to 30° F. higher than other places in the same latitude on the eastern coast of America or the interior of Europe, and a few degrees higher than places in the same latitude on the west coast of America. The summer temperature is modified by the surrounding waters, being lower by a few degrees than inland places of the same latitude. The moisture brought by the winds from the ocean causes a heavy annual rainfall, and much fog, mist, and general dampness. The low mountains serve to some extent as condensing agents, so that the greatest rainfall is near the coast. The average rainfall on the west and south coasts was, in 1879, 43.56 inches; in 1896, 30.30. The averages for the interior were in 1879, 34.39 inches; in 1896, 34.07 inches.

Vegetation.— The climate and soil are very favorable for vegetation. Its mild temperature and humid atmosphere enable several delicate plants, which usually in the same latitude can be cultivated only in sheltered gardens, to flourish here with vigor in the open air; and frequently forest trees continue to retain their foliage after similar trees have lost their leaves in the warmest parts of England. The conditions would naturally indicate forests, and it seems that in early times, large tracts of magnificent timber were spread over its surface; but the grossest waste and mismanagement have prevailed, trees have almost disappeared except from the parks of the wealthy land-owners, or the "gentry"; and what ought to be among the best is about the worst wooded country in the middle latitudes of Europe. More attention is now being given to the subject of forestry; in 1901 there were 309,741 acres in Ireland under forest, a portion of which was a new growth. During the year, 1,740 acres were planted with trees, mostly fir, spruce, and larch. Grass grows luxuriantly in nearly all parts of the island.

Animals.— The fauna of Ireland consists now of birds and small rodents. Animals once found here and mentioned in the ancient literature, as the deer, bear, wildcat, wolf, beaver, cattle peculiar to the island, and certain birds (including the garefowl), have all disappeared. There are no snakes nor toads in Ireland. Fish are plentiful in the streams and on the coasts.

Fisheries.— The salmon fisheries are very valuable, and are increasing in value every year. With an increased supply of fish, high prices are maintained owing to the improved means of communication from remote districts with the best markets. In spite of this, however, these fisheries are not cultivated to anything like so high a degree as they might be. Still, the number of men engaged in the salmon fisheries in Ireland is over 13,000, the estimated value of the salmon exported being from $700,000 to $[illegible]50,000 annually. The principal sea fisheries of Ireland are those of herring and mackerel. The herring fisheries in the Irish waters are prosecuted chiefly on the east coast by Irish boats from Howth, Arklow, and other places on the Irish coast, and by a fleet of vessels from Cornwall, Scotland, and the Isle of Man. The number of boats engaged in this branch of the sea fishery is much smaller than in Scotland, from which considerable quantities of cured herrings are imported. The total number of vessels engaged in the sea fisheries is now about [illegible],525, the number of men and boys employed being about 26,200. The native fishermen, it is said, are now successfully competing with their rivals, yet the sea fisheries of Ireland on the whole have much declined, as shown by the decrease from 55,630 hands and 13,483 boats employed in 1860, to the figures just given.

Agriculture and Stock-raising.— The chief occupation is agriculture. The richness of the soil, its lightness that makes tillage easy, the large percentage of arable land, the amount of rainfall, the mildness of the climate, all combine to make Ireland an agricultural country. Despite the great extent of moorland-wastes and the large amount of bog-land, few countries raise, in proportion to the area, such a large amount of food products year after year. But with natural advantages above the average, agriculture as a system has not progressed as in many other countries. The wholesale confiscation of estates by the English gave the absentee landlord a large portion of the farm land of Ireland. The new owner usually cared only for his rent and gave little heed to improving the land, and showed no regard for the welfare of the man who tilled the soil. The holders and laborers received no encouragement to improve methods or make progress; on the contrary, they were handicapped in many ways, especially in the 18th century, when the English markets were closed to their products, and Ireland was excluded in a large measure from the commercial advantages given to the British possessions in other parts of the world. The holdings, or farms, originally too small to be occupied by farmers of capital and enterprise, were in many cases subdivided until they were reduced to the smallest patches, on the produce of which a family could barely subsist. One result of this poor policy was that the holders were obliged to raise as much as possible each year, for immediate use, without regard to the ultimate effect of this mode of farming upon the land. Competent authorities say that this over-cropping has had a most deleterious effect upon the land. Yet the soil must have been restored to some extent, by rotation of crops or by the use of fertilizers, for the average produce of the soil per acre, in 1902, was found to have increased over the years 1850 and 1860. In some cases the holdings were enlarged during the last years of the 19th century. Statistics show that a change in the kind of crops has been gradually taking place; a decrease in the acreage under cereals and green crops and an increase in the area under meadow and clover. The following table shows the distribution of the cultivated area, given in acres, the first years of the present century:

Year	Cereals	Green crops	Flax	Clover and hay	Pasture
1900	1,347,189	1,[illegible]8,377	47,451	1,218,717	11,510,370
1901	1,317,574	1,079,443	55,442	1,233,770	11,522,060
1902	1,306,398	1,070,440	49,7[illegible]6	1,228,498	11,375,592

The number of acres of farm land not under crops, but "resting," was, in 1900, 12,589; in 1901, 10,886; and in 1902, 9,558.

Between 1851 and 1881 the farms of 1 to 15 acres decreased in number by 66,363. The total number of holdings in 1891 was 486,865, or 12,244 less than in 1881. Of these 18,243 (1,364 more than in 1881) did not exceed 1 acre, 55,584 (decrease of 6,197) were from 1 to 5 acres, 130,-1[illegible]5 ([illegible]8,[illegible]28 decrease) from 5 to 15 acres, 120,472 (2,045 decrease) from 15 to 30 acres, and 139,401 (3,2[illegible]2 increase) above 30 acres. Each province


IRELAND
SCALE OF MILES
Population of places is indicated
by different lettering, thus:
100,000 and over.......DUBLIN
50,000 to 100,000.......Cork
10,000 to 50,000.......Kilkenny
1,000 to 10,000.......Mallow
Smaller Places.......Milford
Railroads
Canals
BELFAST
and Vicinity.
NORTH CHANNEL
IRISH SEA
ATLANTIC OCEAN
SCOTLAND
ULSTER
CONNAUGHT
LEINSTER
MUNSTER
DUBLIN
BELFAST
Cork
Limerick
Galway
Londonderry
DONEGAL BAY
GALWAY BAY
DINGLE BAY
Dundalk Bay
Dundrum Bay
Longitude West from Greenwich
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shows a decrease in the total number of holdings, but in Munster the number is very small. Between 1841 and 1899 there was a total decrease in holdings "above 1 acre" of 25 per cent.

The Land Act of 1870 greatly improved the conditions of tenure in Ireland. The chief aims of the act were to provide compensation to tenants for arbitrary eviction, and especially for improvements effected by them on their holdings in case of their being disturbed in their possession by the landlords, and to afford facilities to tenants for the purchase of their holdings. The act legalized what is called the Ulster tenant-right custom in all the districts in which it prevailed, and decreed the amount of compensation to be awarded in absence of such custom. In 1881 it was supplemented by a more thorough and comprehensive measure. The benefits conferred on Irish tenants by this act were briefly summarized under the terms "fair rent," "fixity of tenure," and "free sale." By the first of these every tenant who objected to his rent, or the rent the landlord wished to exact, was entitled to have a "fair rent" fixed for him by a court. The rent was to remain unaltered for 15 years, at the end of which period it might be readjusted, and raised or lowered. By the principle of "fixity of tenure" the law recognized that the tenant had a certain right in his holding in virtue of which he was not to be arbitrarily removed from it without compensation, and which enabled him on leaving his farm to obtain the best price he could for yielding up his possession. The "free sale" of this right of tenancy was restricted only in so far as that it must be to one person only (except under agreement with the landlord) that the landlord might object on sufficient grounds to the person purchasing, and that he also had the right of preemption. At the expiration of the 15 years the landlord might resume possession of the holding on paying the tenant compensation for improvements effected by him, and also paying him the value of his tenant-right, both being determined by the court should the parties be unable to agree. A tenant who sold his tenant-right on quitting his holding was not to be entitled to compensation for disturbance, or if he had received compensation he was not entitled at that time to sell his tenancy. A tenant holding under the Ulster tenant-right might sell under that or under this system, but not partly under one and partly under the other. The scale of compensation for disturbance of tenancy was fixed as follows: Where the rent was $146.70 or under, a sum not exceeding 7 years' rent; rent from $146.70 to $244.50, not exceeding 5 years' rent; from $244.50 to $489, not exceeding 4 years' rent; from $485 to $1,467, not exceeding 3 years' rent; from $1,467 to $2,445, not exceeding 2 years' rent; above $2,445, not exceeding 1 year's rent. The act also empowered the land commission to advance loans to tenants not exceeding three fourths of the value of their holdings, to enable them to become proprietors, and such loans were repayable by an annual payment of 5 per cent for 35 years. Provision was also made for assisting emigration. A tenant whose holding, or the aggregate of whose holdings, were valued at not less than $733.50, was entitled by writing to contract himself out of any of the provisions of this act, or of the act of 1870. Another act passed in 1887 extended the privileges conferred by the act of 1881, and a third act passed in 1896 went farther in the same direction. The Purchase of Land (Ireland) Act of 1891 supplied the Land Commission with further funds for advances to tenants to enable them to purchase their holdings. But the Land Purchase Act of 14 Aug. 1903, whereby the tenants may buy the farms and become independent of the landlords, is a great beginning toward a readjustment of agricultural conditions. The new law provides that the actual tenants or persons, or persons who have been tenants within 25 years, may purchase all the land they occupy or desire at prices varying according to the condition of the property, to be paid for upon the installment plan, the seller accepting a mortgage for a term of years, the government guaranteeing the payment at the ruling rate of interest. See GREAT BRITAIN—THE LAND LAWS; AGRICULTURE.

Stock-raising has increased in importance during late years. Statistics show that there are now in Ireland more cattle, in proportion to area, than in any other country of Europe. The following table will show the changes which have taken place since 1900:

YEAR	Horses	Cattle	Sheep	Pigs
1900......	491,156	4,608,550	4,386,876	1,268,521
1901......	491,430	4,673,323	4,378,750	1,219,135
1902......	509,284	4,785,204	4,215,740	1,372,592

England is the principal market for the cattle raised in Ireland. The breeds of horses vary with the locality; ponies are numerous in Connaught; hunters in the north of Leinster; and draft horses in nearly all the counties on the eastern coast. Much good has been effected by co-operative societies. The number of co-operative organizations in 1901 were as follows: 106 agricultural societies, 187 dairy and agricultural societies with 81 auxiliaries, 29 poultry societies, 103 co-operative banks, 46 miscellaneous societies, and 2 federations. The membership of the whole was 51,000.

Manufactures and Trade.— The linen manufacture early took root in Ireland, and still continues to be its most important staple; and in every article, except lace and cambric, competes successfully with all other countries. It has increased in a remarkable manner within the last 40 or 50 years, and Belfast, its centre, has now become the first city of Ireland in population as well as in manufacturing industry. The linen manufacture, indeed, is of importance; a large number of the factories are in Ulster. The cotton manufacture has had a very different history, the number employed in this industry having declined from 4,000 in 1868 to 800. The woolen manufacture appears at the outset to have outstripped that of linen. It had at least made such progress as to alarm the woolen manufacturers of England, who, in a spirit of petty jealousy, petitioned the English parliament for its discouragement, and succeeded. The Irish were prohibited from sending their woolens abroad, and could not even send them into England without paying an oppressive duty. Had the manufacture been suited to the country it might have surmounted all this absurdity and injustice; and, at all events, when these ceased to operate, would have revived. But the woolens of Ireland continue to be of very secondary importance, and indeed the manufacture seems to have much decreased in recent years. The tweed has retained its popularity. The manufacture of Irish poplins (of woolen and silk, or woolen and flax or cotton is very flourishing. The number of textile factories in 1890 was 203, which employed 71,788 persons. There are about 20 mills engaged in paper-making. The brewing of porter and distillation of whiskey form important items in the national production. The making of shirts and other clothing for men is becoming prominent. Ship-building was begun several years ago, and during the last of the 19th century it became quite prominent. The largest ship-building yards are in Belfast, where about 10,000 men and boys are employed. The ships of the White Star line are all built in Belfast. Ship-building is carried on to some extent at Dublin, Londonderry, and Haulbowline. Home work still flourishes; and the Irish hand-made laces and embroideries are still popular.

Commerce.— That of Ireland is not at all proportioned to her natural capabilities, and to the admirable facilities afforded by the excellent harbors situated on her coasts. The laws made by the British government to destroy the commerce of Ireland account in a large measure for the present condition of trade. The most important articles of export find a market in Great Britain. They consist chiefly of grain and flour, live stock, salt and fresh meat, eggs and butter. Manufactured articles, particularly linen, rank next in importance; but as the bulk of such articles is very small in comparison with their value, the trade, or at least the shipping connected with them, holds only a secondary place. The trade with foreign countries is also inconsiderable. The principal imports are colonial produce, woolen and cotton goods, wheat, wool, coal, and salt. Of the shipping employed in this trade only a mere fraction is Irish. Belfast and Dublin are the chief shipping ports. The value of the exports direct from Ireland to foreign ports was about $4,533,090 in 1883, of imports from foreign parts $53,166,020; in 1900 they were $6,560,240 and $50,072,985, respectively. In 1900 the number of vessels entered from the colonies and foreign parts was 1,048 (1,032,109 tons); and cleared 448 (473,758 tons); entered coastwise 31,0[illegible]0 (6,401,172 tons); cleared 31,026 (6,746,[illegible] tons). See GREAT BRITAIN—COMMERCE.

Transportation.— The rivers of Ireland form excellent navigable channels. In several of them, however, when the water was low, the navigation became seriously impeded by rocky shoals. In removing these, or in making artificial cuts for the purpose of avoiding them, vast sums have been expended. Improvements of equal importance have been made by the construction of canals; but since the introduction of railroads, canals have in Ireland, as elsewhere, sunk to a position of secondary importance. The principal canals are the Grand Canal, 1[illegible]¾ miles in length; the Royal Canal, 90¼ miles; the Barrow Navigation, 42¼ miles; the Newry Navigation, 35 miles; the Lagan Navigation, 2[illegible]¼ miles. With the exception of the Barrow Navigation, the Grand Canal, and the Lagan Navigation, the dividends paid by the Irish canals in the possession of public companies are almost nominal. The Royal Canal yields a profitable return, but it is merged in the Midland Great Western Railway. The Grand and Royal canals connect the important systems of the Shannon Navigation, in all 158 miles in length, with Dublin. The railroad system of Ireland has attained a considerable development. The roads are all constructed on a gauge of 5 feet 3 inches, which is compulsory. The average cost of construction, including carrying stock, is about $80,000 per mile. The principal railroads are the Belfast and Northern Counties Railway, with a total length of 180 miles; the Dublin, Wicklow, and Wexford Railway, 135 miles in length; the Great Southern and Western, 478 miles; the Midland Great Western Railway, 425 miles (including the Dublin and Meath, Great Northern and Western, etc.); the Great Northern of Ireland, 503 miles (including the Dublin and Belfast Junction, 63 miles, and the Ulster Railway, 140 miles); and the Waterford and Limerick Railway, 141¾ miles, or including the lines of other companies worked by it, 209 miles in length. Few of the Irish railroads pay any dividend at all; but those that do pay represent a large proportion of the capital invested in railroads in Ireland, and some of them are very remunerative concerns. The most profitable of them are a short one connecting Dublin with Kingstown, the Belfast and Northern Counties, and the Ulster Railway. The total length of railroads completed and open for traffic 1 Jan. 1902 was 3,208 miles. The total number of passengers for that year was about 28,000,000, the total amount of minerals and general merchandise carried, about 5,300,000 tons; the total receipts from the carriage of passengers and goods amounted to nearly $20,000,000.

Public Works.— Large sums have been advanced in loan by the sanction of the imperial parliament under various acts for public works and improvements in Ireland. The Irish board of public works has charge of such grants and their expenditure; the objects to which they are applied include landed improvements and drainage, fishery piers and harbors, roads, bridges, and public buildings, tramways, light railways, and certain lines of inland navigation, and the preservation of ancient monuments. The commissioners have authority to lend for the purpose of any work for which county or borough councils are authorized to borrow. Of $121,141,190 of loans advanced for purposes that have not yet been fully carried out ("current services"), $67,655,395 have been repaid, besides interest amounting to $35,707,115, while the sum of $7,985,250 has been remitted. The largest item of this expenditure, namely, $26,196,100, has been spent on the improvement of lands; river drainage and navigation have absorbed some $14,837,500, while on lunatic asylum buildings there has been spent $13,101,925; in schemes for the improvement of public health, $13,451,390; under the Laborers' Acts, $9,150,940 (to provide employment, etc.); on railways, $6,000,635; in advances to occupants for improvement of holdings, $5,355,530; roads and bridges, $5,041,220. Other sums have been spent on harbors and docks, reclamation of lands, dwellings for the poorer classes, teachers' residences, dispensaries, and in advance to tenants for the purchase of their farms. The recent Land Purchase Bill has made available a large sum of money to be used in aiding tenants in purchase of holdings (1903).

Money, Weights, Measures.— The standard of value is gold. Silver is legal tender up to 40 shillings; bronze up to 12 pence; and farthings only to 6 pence. Bank of England notes are legal tender. The names of the coins used are sovereign, half-sovereign, crown, half-crown, florin, shilling, sixpence, threepence, penny, half-

1. Albert Memorial, Belfast. 2. St. Stephen's Green Park, Dublin.

penny, and farthing. The standard units are: of weight, the pound, 7,000 grains; of length, the yard; of capacity, the gallon, containing 10 pounds avoirdupois of distilled water at 62° F., the barometer at 30 inches. On these units all other legal weights and measures are based.

The sovereign weighs 123.274 grains, and contains 113.001 grains of fine gold. The shilling weighs 87.27 grains, and contains 80.727 grains of fine silver. Bronze coins consist of a mixture of copper, tin, and zinc. The penny weighs 145.83 grains.

Banks.— The institution known as the Bank of Ireland has a royal charter and unconditional liability. This bank manages, free of charge, all the public debt of Ireland, and, like the Bank of Scotland, it loans money to the British government, for which, since 1865, 3 per cent is paid. In 1902 there were in Ireland nine joint-stock banks with 625 branches, all of which had adopted limited liability. Six of the nine banks were note-issuing. See GREAT BRITAIN — BANKING.

There are two kinds of savings banks in Ireland: one the trustee savings bank, which has been in existence since the first years of the 19th century; the other, the postal savings bank, which was begun in 1861. The annual amounts which may be deposited by each person are regulated by the Savings Bank Act. According to the act for 1893 the amount which may be deposited in one year by one person is £50, or $244.50, and not £30, or $146.70, as was the law under a former act. The amount of stock which may be purchased was raised from £100, or $489, to £200, or $978, and the increase in the stock-holding limit was changed from £300, or $1,467, to £500, or $2,445. The post-office savings banks are considered more secure than the trustee savings banks, and the deposits in the former are some larger than in the trustee savings banks. The trustee savings banks received in 1897 about $23,044,180, and in 1902 about $23,547,910. The postal savings banks received in 1897 about $10,869,735, and in 1901 about $12,298,705.

Charities.— The Poor Law, which regulates the system of public charities, is about the same for Ireland as for England and Scotland. It provides for relieving the needy in their own homes or for placing them in charitable institutions. The law is administered by the local government board through boards of guardians elected for the purpose. The number of indoor poor who received assistance for the year 1902 was 43,531; the number of outdoor poor for the same year was 57,813; and those in asylums, 1,427. A large amount of aid is dispersed through private means; but a strong effort is being made to remove the causes, which are about the same in all countries, and which usually result in poverty. Efforts have been made to improve the methods of work, and to foster habits of economy.

Government.— Ireland, by the Act of Union, became an integral part of the United Kingdom, and shares in its legislation by means of 28 representative peers in the House of Lords, and 103 representatives in the House of Commons. The representative peers are elected for life by the whole body of Irish peers. The Lord-Lieutenant, who represents the sovereign, holds his court in the castle of Dublin. Since 1898 great changes have been made in the manner of administering the local government. Previous to that date the chief authority in the county was the grand jury, and all local affairs pertaining to the government and local laws were attended to by the grand juries and presentment sessions. The act of 1898 provides for a council, elected by the people, for a term of three years. The government of the boroughs, rural and urban districts, is also vested in an elective council. The unincorporated boroughs are governed by commissioners. See GREAT BRITAIN.

The government of the incorporated boroughs is vested in a mayor, aldermen, and council. The large cities are now county boroughs. The chief secretary, the under-secretary, and four commissioners, who are appointed by the Lord-Lieutenant, constitute the local government board, which has supervisory authority over the local council. This board approves or rejects nominations made by the local authority, decides upon salaries, and has the whole local government in charge to a certain extent.

The judiciary of Ireland is similar in many respects to that of England. The highest tribunal is the Supreme Court of Judicature, composed of the High Court of Justice and the Court of Appeal. Other courts are the Court of Bankruptcy, the Land Commissioner's Court, and the High Court of Admiralty. The English municipal law is administered by the courts of Ireland.

Finances.— In addition to local indebtedness Ireland assists in the liquidation of the national debt of the kingdom. The amount which has been apportioned to Ireland, it is claimed, is larger, in proportion to the wealth of the island, than the amount apportioned to England and Wales. The imperial revenue collected in Ireland for the fiscal year ending 31 March 1902 was about as follows: Customs, $15,500,000; excise, $15,850,000; estate and duties, $317,300; stamps, $15,740,000; income tax, $5,822,000; post-office, $3,697,000; telegraphs, $876,200; crown lands, $163,400; miscellaneous, $574,200; making a total, together with the non-tax revenue, of $46,792,000. The local taxation revenue for the same year was about as follows: Customs, $74,850; excise, $635,000; estate and duties, $995,000. The expenditures for the same year were about as follows: Against exchequer, for the civil government, $22,200,000; for collection of taxes, $1,215,000; post-office, $5,435,000. For local taxation accounts paid the same year, $5,275,000. The whole makes a grand total of about, for imperial revenue, $284,125,000; for local revenue, $1,045,000. The total amount raised for local expenditure was distributed about as follows: For water, gas, electric lights, $12,270,820; tolls, dues, $1,013,560; rents, interest $1,229,225; government contributions, $7,810,780; loans, $2,365,800; miscellaneous, $2,103,685. The chief local expenditures were about as follows: Town and municipal authorities (police, sanitary works, etc.), $8,025,450; unions, poor relief, $5,502,420; county, rural sanitary, and road authorities, $9,591,165; harbor authorities, $2,422,620. GREAT BRITAIN—FINANCE.

Population.— Since the census of 1841, when the inhabitants of Ireland numbered fully 8,000,000, the population has almost steadily decreased. In 1846–7 a frightful famine, occasioned by the potato disease, broke out, and was followed by a visitation of fever and cholera. The population was in consequence greatly reduced, and since then emigration has taken the place of famine and disease in reducing it further. The extent of this emigration will be gathered from the following statement of the numbers that left the country between 1851 and 1899:

Provinces	Number of Emigrants between May 1, 1851, and Dec. 31, 1898.		
	Males	Females	Total
Leinster	355,104	320,706	675,810
Munster	673,106	640,092	1,313,198
Ulster	590,314	475,761	1,066,075
Connaught	282,532	306,616	589,148
Not specified	61,766	48,902	110,668
Total	1,962,822	1,792,077	3,754,899

From the causes just referred to the total population of Ireland, which might by natural increase have amounted to at least 10,000,000, had dwindled away to 4,425,597 in 1902.

The population by provinces in 1901 was as follows: Leinster, 1,152,829 (150.1 per square mile); Munster, 1,076,188 (112.3 per square mile); Ulster, 1,582,826 (183.8 per square mile); Connaught, 646,932 (94.5 per square mile). In that year the average population per square mile for Ireland was 136.7. In 1901 there were six county boroughs with populations as follows: Dublin, 290,638; Belfast, 349,180; Cork, 76,122; Limerick, 38,151; Londonderry, 39,892; Waterford, 26,769.

Education.— The present difficulties in establishing a public system of education in Ireland had their origin in the times following the efforts to make the people abandon the Roman Catholic Church. As a consequence, the parents refused to patronize the government schools. The laws of the time of William III. and Queen Anne made it a crime for Catholics to teach or to have their children taught by Catholics, or to send them abroad where they would be educated in Catholic schools. The rigid enforcement of these laws resulted in a large proportion of illiteracy among the Roman Catholics, although they had established schools abroad which were attended by those with wealth sufficient to live in a foreign country. (Consult, 'History of Irish Schools and Scholars of the Middle Ages.') The principal educational institutions in Ireland are Dublin University and the three Queen's Colleges. The Queen's Colleges were formerly connected with an examining and degree-conferring body, Queen's University, for which the Royal University of Ireland was substituted in 1882, in pursuance of the University Education (Ireland) Act, 1879; $100,000 being yearly granted from the surplus funds of the Irish Church (q.v.). The Queen's Colleges, however, are not directly affected by this act. The Royal College of Science for Ireland was established under the authority of the Science and Art Department, London, in August 1867. Its object is to supply a complete course of instruction in science applicable to the industrial arts, and to aid in the instruction of teachers for the local schools of science. There are professors of physics, chemistry, botany, zoology, agriculture, mining, geology, applied mathematics, etc. The course of instruction extends over three years. There are also the General Assembly's Theological College, Belfast; the Magee College, Londonderry, a Presbyterian college opened in 1865, and embracing in its curriculum literature, science, and theology; the College of St. Columba, near Dublin, founded for the purpose of establishing a system of instruction preparatory to the university.

The Catholic University of Ireland, established in 1854, grants degrees in theology and philosophy, and since 1882 sends its students to the Royal University for examinations for degrees in arts, medicine, law, and engineering. Affiliated with the Catholic University, and now a part of it, are the following colleges: St. Patrick's, Maynooth; University College, Dublin; University College, Blackrock; St. Patrick's, Carlow; Holy Cross, Clonliffe; and School of Medicine, Dublin. There are additional, in different cities and towns, about 40 Roman Catholic colleges and seminaries for men, and a large number of academies or secondary schools for women. There are numerous non-sectarian schools, some of them of royal and private foundation and endowed, but the most prominent are those established since 1831 under the superintendence of the commissioners of national education. These schools are open to the children of parents of all denominations. The pupils are not required to attend any religious exercises or religious instruction of which their parents or guardians disapprove, and opportunity is given to pupils of each religious persuasion to receive separately at appointed times such religious instruction as their parents or guardians may approve of. Of these schools there were 8,670 in operation in 1899, with 785,139 pupils on the rolls. The average daily attendance was small, being only 513,852. In 1892 an act was passed by which a beginning was made of free education, and a modified system of compulsion. In 1878 an act was passed for the promotion of the intermediate secular education of boys and girls in Ireland. By this act about $5,000,000 from the Irish Church surplus fund was set apart, being invested in commissioners who are to apply the revenue arising from it to the purposes of the act, these being (1) the carrying on of a system of public examinations; (2) the awarding of exhibitions, prizes, and certificates to students; and (3) the payment of results fees to the managers of schools fulfilling certain prescribed conditions. The schools referred to in the act are of a grade superior to the national schools. The subjects of examination are Latin and Greek, modern languages, Celtic, natural science, mathematics, etc. The system of apportion according to results is no longer in use; instead the amounts awarded are based on average attendance.

Considerable attention is given to technical instruction. In all the convent schools the young girls have regular courses in domestic science, and in several trades are taught. The Department of Agriculture and Technical Instruction has an advisory board of technical instruction. In 1901–2 the course of experimental science had been adopted in 152 schools with 6,412 science pupils. The central institutions belonging to this department are the Royal College of Science, Dublin, and the Metropolitan School of Art. Throughout the provinces the work is being organized by the councils of county boroughs, urban districts, and counties. The annual grant for the technical instruction is $25,895,000. Provisions are made for the

IRELAND.

1. Blarney Castle. 2. Innisfallen, Lake Killarney.

special training of teachers for the difficult departments of work. See GREAT BRITAIN—EDUCATION.

Language and Literature.— The predominant in the Irish literature is the heroic, pathetic, love of nature, romance, virtue, and through all runs the traditional. Although the Ogham, a system of writing, was introduced into Ireland about 13 centuries before Christ, yet the literary productions were transmitted orally. Hyde says, "The love of literature of a traditional type, in song, in poem, in saga, was more nearly universal in Ireland than in any other country of western Europe."

The modern literature of Ireland, or the literature produced by Irish writers of the last centuries, has been included under English literature because the language used is English. See CELTIC LANGUAGES; GAELIC LITERATURE.

Music.— See IRISH MUSIC.

Art and Architecture.— Many of the ancient types of architecture extinct in other lands may still be found in Ireland. Their buildings and home life remained practically undisturbed for centuries; no ancient Roman architecture is found on the island. When Christianity was introduced, the change in form of the Druid temple was for several centuries in accordance with the natural development of the people, except the addition of the small cross, the windows facing the east, and the altar. When the building became too small a new one was erected beside it. Some of the existing ancient specimens are a group of stone buildings on Skellig Michael, a rock rising precipitously out of the sea to the height of 700 feet, and about eight miles due west of the nearest headland in the County Kerry. The approach is by a flight of stone steps. Dry rubble masonry forms the walls, and in this group, as in others, the absence of the arch shows its ancient origin. It is oval outside, bee-hive in form, but rectangular within. The door has a horizontal lintel, above which is a small cross worked into the stone wall. The six cells in the interior, the common room for prayer (choir), the chapel, all show it was occupied by monks. The doors, with inclined jambs and horizontal lintels, antedate the arch. A wider lintel above, or the double lintel, indicates progression in architecture, a method of relieving the pressure of the roofs. The roofs of the ancient buildings were of stone. There are many of these ancient ruins, some in a good state of preservation. Off the coast of Sligo, at Inishmurray, on the Isles of Aran, on islands off the coast of Kerry, and in many places are found buildings of dry rubble masonry. The change shows itself when cement is used and the walls become perpendicular, as at Gallarus, in Kerry, and a further advance is shown in St. Declan's oratory in Ardmore, with square perpendicular towers, or, more properly, supports at the corners. Some of these were erected in the 6th, 7th, and 8th centuries. St. Columb-Cille's monastery at Kells was built about 807 A.D. In the 'Annals of the Four Masters' mention is made of the church St. Kevin founded in about 1108, and which is still in existence, at Glendalough. The Romanesque style makes its appearance in the 11th century; the earliest example is in St. Flannan's, at Killaloe. Brian Boroimhe is said to have built churches at Killaloe, in County Clare. A church built about this time, at Freshford, the ancient Achadh-ur, eight miles northwest of Kilkenny, is still in use. At Clonfert Cathedral, in County Galway, there is a fine example of an Irish Romanesque doorway. This church is said to have been founded by St. Brendan, "the navigator." The interlaced patterns on the piers, the ornamented column, are all most beautiful. "There is not," says Mr. Brash, "a square inch of any portion of this beautiful doorway without the mark of the sculptor's tool, every bit of the work being finished with the greatest accuracy." The Cathedral at Ardmore, County Waterford, shows another advance in its decoration; here may be seen The Judgment of Solomon, Adam and Eve, The Magi bringing their gifts, the stable indicated by a cow, etc. Many of the modern cathedrals are most beautiful.

The "Round Towers" of Ireland have been for years subjects of study and discussion. There exist in Ireland in whole or part about 100 of those towers; 18 are in a perfect condition. Many claim that the Round Towers are of pre-Christian origin, and cite the similar towers, two in Scotland, seven on islands off the coast, one on the Isle of Man, and a few on the Continent, as examples of pagan architecture. Their average size is 100 feet in height, circumference at base, 50 feet, walls at door lintel, 3½ feet. The interior is divided into from four to eight stories. Petrie, who has studied the subject with care, claims that the towers are of Christian origin and were used both as bell towers and as safes or places in which to deposit the Church treasures. The Irish name for the towers, *Cloigtheach,* which means "house of a bell," supports the theory of Petrie and others. Petrie advances other and strong arguments in support of his theory. The 'Annals of the Four Masters' mentions the bells in some of the towers. One of the finest examples of a Romanesque doorway in a Round Tower is at Kildare. Some of the ancient pottery shows skill and artistic merit. In designing and coloring the ornamentation of the old Celtic manuscripts show great artistic power. The initial letters are most beautiful, especially in the 'Book of Kells,' a copy of the four Gospels in Latin, and in 'Annals of the Four Masters.' The symbolism used by other early nations is not found in the works of the ancient Irish. The designs are geometrical patterns, interlaced ribbon work, diagonal and spiral lines, strange animals, peculiar birds, and the key pattern. The ancient metal work shows unique and beautiful designs; the bell shrines, the brooch of Tara, and many pieces of old metal work may be seen in museums. The laces of Ireland, revived the last of the 19th century, show most intricate and charming patterns. Sculpture and oil painting are modern arts in Ireland, and in both many of Irish birth have excelled.

Religion.— The first authentic account of the introduction of Christianity into Ireland was in the 5th century, when Pope Celestine sent Germanus, bishop of Auxerre, and later, in 431, Palladius as bishop. Both Germanus and Palladius found on the island believers in Christianity, but no organized body of Christians. However, the chief work of conversion and organization was accomplished by St. Patrick, who, good authorities state, was sent to Ireland by the same pope. Killpatrick, a town of Scotland, is said to have been Patrick's birthplace, but some authorities claim that he was a native of France. He had been consecrated bishop before coming to Ireland as a missionary, and he selected Armagh as his see. A large number of converts were made, so many that even before Patrick died he had other bishops and a number of priests to assist him. The Roman Catholic Church in Ireland has four archdioceses and 25 dioceses. The archdioceses are Armagh, Dublin, Cashel, and Tuam. The Roman Catholic clergy and churches are all supported by voluntary contributions. The college at Maynooth, for the education of those studying to become priests, was founded in 1795. There are several other Roman Catholic ecclesiastical seminaries and colleges. See GREAT BRITAIN—CHURCH OF ENGLAND; etc.

The Reformation never made much progress in Ireland, and though a Protestant Episcopal church was established by law, it was only the church of a small minority. In 1869 it was disestablished. Previous to this time the clergy were supported by a tithe rent-charge, the proceeds of the Church lands, etc., the total annual income of the Church, including the value of houses and lands in occupation, being about $3,068,920. By the above act, taking effect from 1 Jan. 1871, the position of the Church and clergy was entirely changed, though those holding benefices at the time of its passing have not suffered loss. The property and tithes formerly belonging to the Church are now vested in commissioners, who pay to all deprived of income by the act, so long as they continue to discharge the duties of their offices, such an annual sum of money as they would otherwise have received, deduction being made of curates' salaries, and other outgoings to which the parties would have been liable, and regard being paid to the prospective increase of incomes by the falling in or cessation of such charges; or instead of an annual sum, an equivalent single payment has been paid to such as have commuted their claims in that manner. The Irish Church accordingly is no longer a state Church, and none of its bishops have now a seat in Parliament. It is still a vigorous and flourishing institution, however, and possesses funds amounting to over $40,640,000. Of this, upward of $20,000,000 have been voluntarily contributed by friends of the Church since it was disestablished. While disestablishing the Irish Church, the act at the same time declared the cessation of the Maynooth grant and the *Regium Donum.* The affairs of the Irish Church are now managed by the diocesan synods and by the general synod in conjunction with the representative body. The supreme legislative powers reside in the general synod, which meets in Dublin, and is composed of the archbishops of Armagh and Dublin and the 11 bishops, and of lay and clerical representatives from the different dioceses; the lay representatives being more than twice as numerous as the clerical. The representative body incorporated in 1870 consists of the archbishops and bishops *ex officio*, 39 lay and clerical elected members (three for each diocese), and 13 co-opted members elected by the other two classes conjointly. This body is empowered by its charter to hold Church property, subject to the regulations of the general synod. The Church uses the Book of Common Prayer, as revised in accordance with statutes passed by the general synod, and furnished with a preface containing an exposition of its formularies in the sense in which they are understood by the Church.

The Presbyterian Church of Ireland is chiefly confined to the province of Ulster, where it may be said, more especially in the counties of Down and Antrim, to be the leading religious denomination. Its ministers are supported by voluntary contributions, seat-rents, and church funds. They were formerly aided by an annual grant from government, called the *Regium Donum,* the amount of which, paid in 1869, was $202,735. This annual grant, however, was abolished, as already mentioned, by the Irish Church Act of 1869, and was commuted to a single sum of $3,506,860 paid to the Church. According to the census of 1901 there were in Ireland 3,310,028 Roman Catholics, 579,385 Protestant Episcopalians, 443,494 Presbyterians, 61,255 Methodists, and 56,703 members of other persuasions, besides 3,769 Jews.

History.—The beginning of the history of Ireland is, like that of all European nations, enveloped in fable. Among the ancients it was known at least as early as the time of Aristotle, who calls it *Ierne.* In Diodorus Siculus it is called *Iris;* in Strabo, *Ierne;* in Pomponius Mela, *Iverna;* in Pliny, *Hybernia.* Plutarch calls the island *Ogygian,* meaning very ancient, and says: "They drew their history from remote antiquity, so that of other nations is new compared with them." Yet the information to be found about Ireland in the works of the ancient geographers and historians is altogether very scanty. The bardic historians of the country speak of Greek and Phœnician colonies, and lists of kings, for which there is no authentic, but some probable, foundation. The vernacular language of the Irish proves that they are a part of the great Celtic race which was once spread all over Western Europe. The first probable records of the Irish people show that for the times they were advanced in civilization. The ancient bards were called *Fileas* or *Feardanos,* which means philosophers. Cæsar mentions in his 'Gallic Wars' their advancement. Pliny, Cæsar, and other authors say that the Druids who inhabited Ireland were learned; they knew philosophy and the sciences. In the Irish chronicles we find that in the reign of Eochy the First, more than a thousand years before the birth of Christ, "society was classified into seven grades, each marked by the number of colors in its dress, and that in this classification men of learning, that is, eminent scholars, were by law ranked next to royalty." Another proof of the existence of an ancient civilization, marvelous for its time, was the institution of Feis Tara or the Triennial Parliament of Tara. The monarch, Ollav Feola, who reigned as Ard-Ri, or monarch, of Erinn, about 1,000 years before Christ, established this parliament. The subordinate royal princes or chieftains, constituted one branch; the Ollavs or law-givers, and bards, judges, scholars, and historians, another branch; and the third consisted of the military commanders. Under the Ard-Ri, or monarch, were the kings of the provinces, and under each king were the clans who were governed locally by a chief, each clan selecting its own. Wars were frequent, as fighting and bloodshed were common pastimes throughout the then known world. The battle was the final court of appeal, and in most instances the first court of trial. A cause of dissension in Ireland, as in Great Britain and other countries, was the antagonism existing among people of different races. The Milesians, the Tuatha de Danaans, and the Firbolgs (q.v.) were distinct races centuries after the Milesians landed in Ireland. The differences among themselves seem not to have seriously affected their union when attacked by a common foe; as at the birth of Christ, when Rome was mistress of nearly all of Europe, she had never gained possession of Ireland. The introduction of Christianity into Ireland was not attended with bloodshed as in many other countries; indeed, afterward the nation seems to have enjoyed a season of repose from strife, although southern Europe was being overrun with the Germanic hordes. This repose favored the growth and expansion of Christianity and the progress of learning. The schools and monasteries founded by Saint Patrick and his bishops in the 5th century became the centres from which went forth many scholars; and even as early as the 6th century, Ireland became the seat of western learning; and its monasteries were the schools from whence missionaries who disseminated the Christian faith throughout continental Europe proceeded. In the 8th and 9th centuries the scholars of Ireland were among the most distinguished at the courts of the kings, especially at that of Charlemagne, but when the Northmen commenced their descents some of the schools were destroyed and the monks dispersed. The ravages of the Danes at this period had results different from the attacks of the Romans. The continued attacks for nearly two centuries fostered internal dissensions, when in the beginning of the 11th century Brian Boroimhe (Brian of the Tribute) united the greater part of the island under his sceptre, restored public tranquillity, and subdued the northern invaders. After a contest of about 20 years he conquered Malachy, the brave warrior who "wore the collar of gold" won from the Danish invader, and became Ard-Ri of all Erinn. After the death of Brian, the island became a place of dissension; frequent wars rendered them weak against a foreign foe. This condition was largely the result of the divisions, made by Brian, of the island among his three sons. At this time Henry II. of England, professing love for Ireland and a great desire to restore peace, sought to gain possession of the island. This was the beginning of the Anglo-Norman invasion of Ireland. Henry II. claimed to have received from Pope Adrian IV. a bull authorizing him to take possession of Ireland. (The authenticity of this bull is very doubtful.) After some delays occasioned by internal troubles in England, Henry attempted to gain possession of Ireland. For many years after, the history of Ireland was a record of persecution, confiscation of lands, and attempts to wrest from the people inalienable and hereditary rights. So great was the resistance that in the 14th century, at the time of Richard II., the authority of England extended practically over only a small portion of country on the eastern coast, called "The Pale" (q.v.). This was governed by various nobles subject to a viceroy. The subjection was, however, sometimes little more than nominal. The nobles quarreled among themselves, and were very often at open feud. The beginning of the reign of Edward III. (1327) was marked in Ireland by the outbreak of civil strife in every part of the English "Pale," advantage of which was taken by the Irish for a general rising, which threatened the safety of the English colonists, and which the government found itself unable to subdue, until it yielded to the demands of the barons in Ireland, by granting them complete civil and military jurisdiction in their own districts. During the wars with France some Irish troops served in the English armies, and the common sympathies induced by that circumstance seemed likely to promote a better state of feeling between the two races, when the breach was made wider than ever by the celebrated statute of Kilkenny (1367), framed under the viceroyalty of Lionel, duke of Clarence, son of Edward III., forbidding, under severe penalties, intermarriages between English and Irish, the assumption of Irish names by persons of English blood, the use of the Irish language, the native (Brehon) law, etc. In consequence of this the disturbances between the Irish and English inhabitants of Ireland increased so greatly that the English viceroy found it necessary to protect The Pale by payments of money to the Irish chiefs, and this state of matters continued during the reigns of Richard II., Henry IV., and Henry V., until, in that of Henry VI., when Richard, duke of York, was appointed governor of the island, who succeeded by his politic measures in restoring peace. In the reign of Henry VII. (1495) was passed Poyning's Act (so called from Sir Edward Poyning, lord-deputy of Ireland), which provided that all former laws passed in England should be in force in Ireland, and that no Irish Parliament should be held without previously stating the reasons on account of which it was to be summoned, and the laws which it was intended to enact. The power of the English government in Ireland was thus strengthened, but nothing was done to improve the condition of the Irish, whom the oppressive severity of the English yoke embittered without subduing. At the beginning of the 16th century the greater part of the island still remained unconquered by the English. The Irish still lived according to their old constitution under their own chiefs. In 1541 Henry VIII. received from the Irish Parliament the title of King of Ireland; but he did nothing to extend the English sway, or to improve the social circumstances of the people. The Reformation which took place in England during this reign took but a slight hold upon Ireland even in the English districts; but the monasteries were suppressed, and the tribute to the Papal see abolished. Elizabeth's reign was marked by a series of risings, which finally terminated in a general war against England, usually called the Rebellion. Hugh O'Neil, who had been raised by the queen to the dignity of Earl of Tyrone, was the leader in this war, which, though successfully begun, ended with the complete defeat of the insurgents, and the reduction of the whole island by the English (1603). More than 600,000 acres of land were taken from the Irish chiefs, and for the most part distributed among English colonists. The reign of James (1603–25) was somewhat favorable to Ireland; the arbitrary power of some of the chieftains was restrained, and the administration of justice improved, etc.; but the means which he took to effect some of these improvements were tyrannical. He demanded from every Irish chief the document upon which he rested his claim to his property, and if it were not to be found, or contained even any formal error, his lands were forfeited to the crown. Of 800,000 acres of land which in this way came into the hands of the king in the north of the island, a large share was entirely withdrawn from the Irish, and divided among Scotch or English settlers. In addition to this, the Catholics, on account of the oath of supremacy by which all public officers were required to acknowledge the king as head of the church, remained excluded from all official appointments. The Roman Catholic hierarchy established in the 5th century was still in existence. Various circumstances, led, in 1641, to an attempt to shake off the English yoke. Dr. Lingard says of this insurrection that it has been usual, for writers to paint the atrocities of the natives, and to omit those of their opponents, but that revolting barbarities are still recorded of both, and that if among the one there were monsters who thirsted for blood, there were among the other those who had long been accustomed to deem the life of a mere Irishman beneath their notice. After the death of Charles I., Cromwell was appointed (15 Aug. 1649) lieutenant of Ireland. With great cruelty, he reduced the whole country within nine months. All the possessions of the Catholics were confiscated, about 20,000 Irish were sold as slaves in America, and 40,000 entered into foreign service, to escape the severity of the conqueror. (See Drogheda.) Charles II. restored a portion of the lands, but fully two-thirds remained in possession of the English or of Irish who had become Protestants. Under James II. some changes were made; under his viceroy, Earl of Tyrconnell, Catholics were given a fair representation in Parliament. In the English Revolution of 1688, the Catholics of Ireland sided with James, and the Protestants with William III. For a time the army favoring James were fairly successful; but the landing of William in Ireland changed matters. The battle, 1 July 1690, at Boyne, won by William, proved a turning point, as it encouraged the English and in a great measure discouraged the Irish. Sarsfield's gallant defense of Limerick, the last place in Ireland that held out for James, saved that city from capture by William's troops; but on 3 Oct. 1690, the city capitulated, a treaty being concluded with Gen. Ginkell on behalf of the English, according to which the Irish were to be allowed the free exercise of their religion, as had been granted by Charles II. More than 12,000 Irish that had fought on the side of James went into voluntary exile. The Treaty of Limerick was not kept by the English, a fact which is commemorated by the name which the Irish still give to the place at which it was concluded, "The City of the Violated Treaty." By a decree of the English Parliament upward of 1,000,000 acres of land were now confiscated and divided among Protestants. In order to keep down every movement of the Catholic population, cruel penal laws were passed against those who adhered to that form of religion. By these laws the higher Roman Catholic ecclesiastical dignitaries were banished from the island: the priests were not allowed to leave their counties; no Roman Catholic could hold a public office, acquire landed property, enter into a marriage with a Protestant, etc. Such suppression and persecution naturally led to the formation of secret organizations whose object would be an overthrow of those in power, in order to secure freedom and justice. "Whiteboys," "Levellers," and a number of kindred organizations were formed, whose methods were not always fair; but who were brought into existence by force of circumstances. All this, however, did not ameliorate the general condition of the country, and it was not till the American War of Independence taught the English government the folly of attempting to govern a people by coercion, that the severity of the laws relating to Ireland was mitigated. In 1778 the penal laws against the Catholics, although not repealed, were made much more lenient. Catholics were henceforth permitted to acquire landed property, to erect schools, and to observe their own religion under fewer restrictions. In 1783, Poyning's Act was repealed.

The outbreak of the French Revolution had naturally a great effect on the minds of the Irish people. Out of a corps of volunteers which had been formed in 1779, but which had been dissolved a few years later, a society was formed calling itself the Society of United Irishmen, which included in it many Protestants, and which sought to make Ireland an independent nation. The Catholics at the same time took advantage of the embarrassment of the British government to demand equal rights with the Protestants, and the government gave in to this demand so far as to remove the hindrances which had been placed by the law in the way of Irish trade and industry, and to repeal nearly all that remained of the penal laws against the Catholics, who now received the right of acting as counsel before the court, and of entering into marriages with Protestants. When further demands were refused, the Society of United Irishmen allowed its revolutionary aims to become more apparent, and the government then determined to quell the movement by force. The Habeas Corpus Act, which had been introduced into the country in 1782, was repealed; the towns were strongly garrisoned, and the society dissolved and disarmed. But the conspirators, trusting to expected aid from France, were not discouraged. At the close of 1796 a considerable French fleet did actually appear off the Irish coast bearing 25,000 land troops, under the command of Gen. Hoche; but owing to adverse winds, and the incompetence of the commanders, it was obliged to return without having accomplished anything. The only effect of this expedition was to induce the government to take still stronger measures in Ireland, the whole of which was placed under military law. The United Irishmen were thus prevented from taking any open steps for renewing the society, but they continued to pursue their ends in secret, and devised for themselves a very skilful military organization. At its head was a directory of five men, whose names were known only to those at the head of the provincial committees. In January 1798 the society already numbered more than 500,000 members, when a treacherous member gave information regarding the society to the government, and several of the leaders were seized. In consequence of this the conspirators, not knowing the extent of the revelations that had been made, resolved to anticipate any further preventive measures on the part of the government, and rushed into premature action. In May 1798, simultaneous risings took place at different parts of the island; but the government was fully prepared, and the main body of the insurgents, who made a brave fight, suffered a decisive defeat at Vinegar Hill on 21 June. Flying columns traversed the island, and checked by the most violent measures any further outbreaks. In August a French squadron appeared in Killala Bay with 1,500 men on board, under Gen. Humbert; but the British troops prevented a junction with the insurgents, so that they were soon compelled to surrender. Another French expedition which approached the Irish coast in September was overtaken and attacked by Admiral Warren, and nearly all the ships composing it were captured. Several subsequent attempts of the French were similarly frustrated.

The events of this insurrection brought the British government to form the resolution of uniting the Irish and English Parliaments, since in the state of feeling which that movement too plainly manifested as prevailing among the people, it was seen that the independence of legislation enjoyed by the country fostered the desire of political independence, and it was feared that new revolutionary efforts might thence derive a legal sanction. The first proposal to this effect which was made in the Irish Parliament was rejected with indignation. The government then resorted to bribery to secure its purpose, and $8,000,000 was spent in buying up the rotten boroughs which had the majority of seats in the Irish House of Commons. The Irish landlords were from the first favorable to the project. By these means an act providing for the legislative union of the two countries passed the Irish Parliament on 26 May 1800, and the British Parliament on 2 July in the same year, in virtue of which the union was effected on 1 Jan. 1801. But although this measure bound the destinies of Ireland still more closely to those of England, yet it was far from putting an end to the religious and political troubles which had so long divided the two countries. In order to gain the masses the enlightened Pitt had promised a complete political emancipation of the Catholics; but the bigoted George III. could not be induced to make this concession. Enraged at this great breach of faith the Catholics in 1802 formed a Catholic Association, having for its object the accomplishment of this end; but it was not till the period of O'Connell's agitation, favored by a change of public opinion in England, that the government was induced to bring in an Emancipation Bill, which after passing both houses of Parliament, received the assent of George IV. on 13 April 1829. A new oath, which could be taken by Catholics as well as Protestants, was substituted for the one previously required from members of Parliament, and the Catholics were thus enabled to take a seat in the house. They were also allowed to fill all public offices except that of lord-chancellor.

This victory was greeted by the Irish Catholics with great joy; but they wanted more than emancipation which meant permission to hold certain offices, they wanted independence. The efforts of the national party were now directed to the repeal of the Union, for which purpose O'Connell founded the Repeal Association, which caused the Grey ministry in 1833 to bring before Parliament the Irish Coercion Bill (q.v.). When this bill became law the Lord-Lieutenant of Ireland was empowered to forbid all assemblies of the people, and to proclaim military law throughout the island; and in order to give force to the act an army of 36,000 men, besides 6,000 armed police, was sent over. The Coercion Act was indeed soon repealed, and from 1835, under the viceroyalty of Lord Mulgrave, a better feeling seemed to be growing up between the people and the government. But when the Tories came again into power in August 1841, O'Connell began anew the repeal agitation, and with such boldness that in 1843 the authorities caused him to be apprehended on a charge of conspiracy and sedition, on which he was convicted and condemned to pay a fine and suffer imprisonment for a year. These proceedings were, however, declared illegal by the House of Lords, and O'Connell was released. Soon after the terrible famine which visited Ireland in the autumn of 1845, and still more severely in the summer of 1846, cast all other interests into the background. The spirit of the people seemed broken, and many of them sadly left their native land and by hundreds of thousands emigrated to America. In the midst of this crisis O'Connell died, and the place of the party which he led was taken by one still more advanced, which received the name of Young Ireland. In these circumstances of political excitement the French revolution, which took place in February 1848, had a great effect upon Ireland. The leaders of the Young Ireland party, Smith O'Brien, Mitchel, Duffy, Meagher, and others, entered into relations with the provisional government at Paris, and the people generally began openly to provide themselves with arms, and to exercise themselves in the use of them. But the measures of the government fustrated the designs of the conspirators. The Habeas Corpus Act was suspended, the insurrectionary newspapers suppressed, and Smith O'Brien, who had been hailed by the people as King of Munster, and a number of his associates were arrested and condemned to death. This punishment was afterward commuted to transportation. In a short time peace was restored; but the material distress remained undiminished. Famine and disease decimated the population. The agricultural holdings were deserted, whole districts remained uncultivated, and a constant and overflowing stream of emigration directed itself toward the United States.

After a time agriculture revived, and the manufacturing industries of the island began to compete with those of England. In 1849 were chartered the Queen's Colleges, offering the same advantages to Catholics as to Protestants; but these institutions have been taken comparatively little advantage of by the former. The history of those institutions made the Catholics fear they were meant as a menace to their faith. In 1852 telegraphic communication was opened with Great Britain. In 1853 an industrial exhibition was held at Dublin, resembling that held two years before in London; another exhibition was held in 1865. The latter year witnessed the discovery of a new conspiracy designed to effect a separation between England and Ireland. This had its origin in America at the time of the Civil War in the United States, when the numerous Irish in that country saw an opportunity in England's attitude toward the seceding States. This conspiracy, originating among the members of a secret society calling themselves Fenians (see FENIANS), soon spread to Ireland; but before the Fenians could take any overt action in that island their design was stifled by the proceedings of the British government (1865–6). The attention of English statesmen was now strongly drawn to the necessity of doing all that could be done to render the Irish people loyal and contented; and with this view an act to disestablish the Irish Protestant Episcopal Church was passed in 1869, and another to improve the tenure of land, in 1870. Since 1871 an agitation for what is called Home Rule has made itself prominent. In 1880 Ireland became the scene of an agitation carried on mainly by a body calling themselves the Land League. Various severe laws were passed to "coerce," but further concessions were made, and to redress Irish grievances a land act was also passed in August 1881. Under this act substantial reductions on rents were made. The Land League was suppressed, but a new body called the National League was soon organized in its place. Another act for the relief of tenants in arrear with their rents was passed, 1885. In 1885, 86 Nationalist members, headed by C. S. Parnell, were returned to Parliament, and their pressure on the government led to the production of a scheme by Mr. Gladstone, in 1886, by which Ireland was to receive a parliament of her own and the Irish members to be withdrawn from the Imperial Parliament. This scheme and the accompanying land purchase scheme were rejected by Parliament and the constituencies; and a fresh act against crime in Ireland was passed in 1887, although statistics showed the island was in a most peaceable condition, and no remarkable acts of lawlessness were being committed. In 1898 a very important Local Government (Ireland) Act was passed. It established county councils, urban district councils, rural district councils, and boards of guardians in Ireland, and transferred to them the administrative functions formerly discharged by the grand juries and presentment sessions. The first elections under the act took place early in 1899. The results showed that the voters of Ireland realized they were gaining ground. They never lost an opportunity to proclaim their discontent with the existing land laws, and their desire for "Home Rule." The Irish members of the British Parliament kept the cause of Ireland before the people; and in 1903 a further concession was gained. On 1 Nov. 1903 a new "Land Act" went into effect whereby the tenants, sub-tenants, or the people, may purchase the land and hold it as their own. See GREAT BRITAIN—THE LAND LAWS; IRISH HISTORY.

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Ireland, Church of. See IRELAND.

Ireland, Language of. See CELTIC LANGUAGE; GAELIC LITERATURE.

Irenæus, ī-rē-nē'ŭs, **Saint**, one of the Greek Church Fathers: b. Asia Minor: d. Lyons, France, about 202. He was a learned and zealous man, a pupil of Polycarp and Papias. He actively opposed the Gnostics, and especially the Valentinians. His works are lost, except his 'Libri V. adversus Hæreses,' of which there are fragments in the original Greek, and a Latin version, made, it is supposed, toward the end of the 4th century. He suffered martyrdom at Lyons, of which he was bishop, in the persecution under Septimius Severus.

Irene, ī-rē'nē, empress of Constantinople: b. Athens about 752 A.D.; d. Lesbos 15 Aug. 803. In 769 she married Leo IV., after whose death, caused, as is generally believed, by poison administered by her, she raised herself (780) and her son Constantine VI., then but nine years old, to the imperial throne. When Constantine came of age he refused to permit her to participate in the government, and seven years later was arrested at the order of his mother, blinded and at last murdered. Irene was the first woman who reigned over the Eastern Empire. Her triumphal entrance into Constantinople, her liberality, the freedom bestowed on all prisoners, and other artifices employed by her, were not sufficient to secure her from the consequences of her criminal accession. She had ordered many nobles into banishment, when Nicephorus, her treasurer, who had secretly been made emperor, exiled her in 802 to the Isle of Lesbos. Her zeal for image-worship has caused her to be regarded as a saint by the Greek Church.

Ireton, īr'tôn, **Henry**, English general and statesman: b. Attenton, Nottinghamshire, 1611; d. Limerick, Ireland, 26 Nov. 1651. He was graduated at Trinity College, Oxford, and brought up to the law; but when the civil contests commenced joined the parliamentary arm·

and by the interest of Cromwell, whose daughter Bridget he married in 1646, became commissary-general. At the battle of Naseby he commanded the left wing, which was defeated by the furious onset of Prince Rupert, and was himself wounded and made prisoner. He soon recovered his liberty, and took a prominent part in all the transactions which threw the Parliament into the power of the army. He had also a principal hand in framing the ordinance for the king's trial, and was one of the judges. Ireton accompanied Cromwell to Ireland in 1649, and was left by him in that island as lord-deputy. He reduced the natives to obedience with great vigor, but not without cruelty. He was buried in Westminster Abbey, and after the Restoration his body was taken up, suspended from the gallows with that of Cromwell, and buried in the same pit.

Irid'ium, a metallic element resembling platinum in its general properties, and occurring in nature in the metallic form, alloyed, usually, with platinum and osmium. The commercial supply comes chiefly from the Ural district, from Brazil, and from Borneo. Small amounts have also been obtained from California. The existence of iridium was first recognized, in 1802, by Tennant, who observed that an insoluble residue remained behind after dissolving platinum ore in aqua regia. In 1804 he showed that this residue contains two new metals, to which he gave the respective names «iridium» and «osmium.» The separation of iridium from the other metals of the platinum group is a matter of some difficulty; and for details of the processes employed the more extended treatises on metallurgy and the chemistry of the metals must be consulted. Iridium is frequently obtained in the form of a spongy gray mass, or a gray powder; but by heating either of these to whiteness, and subjecting them to compression, the metal may be brought into the form of a compact, lustrous mass resembling steel. In this form it is harder than iron, and somewhat malleable when hot, though brittle when cold. At ordinary temperatures it has a specific gravity of about 22.4, being, with the exception of osmium, the heaviest substance known. Its specific heat is about 0.0323 at ordinary temperatures, and its coefficient of linear expansion (Fahrenheit) is about 0.0000039. Its melting point is very high, the estimates given by various authorities ranging from 3,600° F. to 4,500° F. Compact iridium, after being strongly heated, is insoluble in all acids, and is not affected by air or moisture. The metal has the symbol Ir, and an atomic weight of 193 if $O = 16$, or 191.5 if $H = 1$. It forms numerous salts, but these are of no practical importance. The name «iridium» (from Greek, «rainbow,») refers to the varied colors exhibited by the salts of this element, as they pass from one state of oxidation to another. Metallic iridium, either alone or alloyed with other metals of the platinum group, is used in the arts to a limited extent, where a hard, noncorrosible metal is needed. In particular, it is used for the tips of gold and stylographic pens, for the construction of standards of length, and for standard electrical resistance coils.

Iridosmine, ĭr-ĭ-dŏs'mĭn, or **Osmiridium,** a natural alloy of iridium and osmium in varying proportions, is a hard slightly malleable mineral, crystallizing in hexagonal prisms. It occurs as irregularly flattened grains, and contains some platinum, rhodium and other metals of the platinum group. It is found associated with platinum in the Ural Mountains, in South America, and elsewhere. It is also found in the black sands on the ocean beaches of northern California, and a small amount is recovered yearly by placer miners in the Sierra Nevada. Iridosmine is used to a small extent for pointing gold pens.

Iriga, ē-rē'gä, Philippines, pueblo of the province of Ambos Camarines (Sur), Luzón, on the Buhi River, 23 miles southeast of Nueva Cáceres. It is on the main road, is a military and telegraph station, and one of the most important towns in the province. Pop. 17,100.

Iris, ī'rĭs, in Greek mythology, daughter of Thaumas and Electra, sister of the Harpies, the fleet golden-winged messenger and servant of the Olympian gods, especially of Zeus and Hera. Iris was originally the personification of the rainbow, though she does not appear in the Homeric poems as the goddess of the rainbow. She is sometimes represented as a beautiful virgin with wings and a variegated dress, with a rainbow above her, or a cloud on her head exhibiting all the colors of the rainbow.

Iris Family, a natural order of monocotyledonous herbs, mostly perennials with tubers, corms or rhizomes, and usually with an acrid flavor. About 800 species belonging to more than 50 genera have been described from temperate and tropical climates, mostly from South Africa and tropical America. They are characterized by two rows of leaves, the outer of which fit over and protect the inner (equitant); regular or irregular perfect flowers which are frequently handsome; perianth six parted, the other floral organs in threes; and many-seeded, three-celled fruits (capsules). Some species have been used as food in countries where they are native; others furnish rootstocks which are used for making perfumes, especially orris; some few have been employed to a limited extent in medicine; but the species most widely popular are cultivated for ornamental purposes. Of these last the most important genera are *Iris* (fleurs-de-lis), *Gladiolus, Freesia, Crocus, Tigridia, Tritonia, Sisyrinchium, Ixia* and *Belemcanda*, elsewhere described.

The plants of the genus *Iris* constitute one of the chief ornaments of the northern regions of the globe, and usually grow in wet places, bearing flowers of various colors, but the prevailing tint is blue. The common wild iris or flag (*I. pseudacorus*), common in Europe and also found in the eastern United States, has yellow flowers of large size and long sword-like leaves. The gladdon or stinking iris (*I. fœtidissima*) is a British species, with bluish flowers. Among favorite garden species are the English iris (*I. xiphioides*), the Persian iris (*I. persica*), the common iris (*I. germanica*), the snake's-head iris (*I. tuberosa*), and the Chalcedonian iris (*I. susiana*). Orris root consists of the rootstocks of the white-flowered *I. florentina* and some other species. Among other species found in the United States are the larger blue flag (*I. versi-color*), common from the Atlantic coast to the Mississippi, the slender blue flag (*I. virginica*), and several dwarf species.

Irish Academy, Royal, a literary and archæological association founded in Dublin, Ireland, in 1786. Its object is to promote the study of literature, antiquities, and science. The library founded and owned by the association contains a large number of Irish manuscripts and documents of public interest. It has a fine collection of antiquities which have been loaned to the National Museum, Dublin. The association is governed by a council consisting of 21 members. This council meets regularly several times a year. The work is divided among the members, who are subdivided into committees. The committees are three in number; committee of literature, committee of science, committee of antiquities. Students making historical research in Ireland have found this association of great assistance.

Irish Catholic Benevolent Union, a fraternal organization founded in the United States in 1869. It has 149 subordinate societies and 14,000 members. The benefits disbursed since organization have amounted to over $2,500,000, and during the year 1902 amounted to $45,371. The membership in the union is confined to persons of Irish extraction who are communicants in the Roman Catholic Church.

Irish Deer, or **Elk.** See Elk.

Irish Language, Society for the Preservation of, an organization established in 1873, in Boston, Mass. The object is to foster the study of the Gaelic language so that it may again be one of the spoken languages of the Irish people. At first the society was called the Philo-Celtic Society. The headquarters are now in Dublin, where the organization was established in 1877. It has a number of branches in different parts of the United States.

Irish Land Laws. Under the Brehon laws, when the people of Ireland were divided into tribes, the land was usually the property of one of the four or five tribes which were the strongest in Erin. A large portion was given to the king or chief of the tribe, then divided among the clans that made up the tribe. Here again a large portion was given to the chief of the clan and then divided among the septs. The chief of the septs received the largest portion of the amount set apart for the sept. The free tribesmen, after the chief, received the greater part of the sept lands.

Some of the tribesmen, the Ceil, owned cattle, some, the Daer and Saer, were loaned cattle by the chief. The Fuidhir were the tenants who performed the manual labor.

When a chief died, the tribesmen distributed his land among his descendants, and when a tribesman died, the chief distributed his property. After England took possession of Ireland, the land tenure in a large part of the island continued to be administered under the Brehon laws; but within «The Pale» the English feudal system prevailed; there the king alone owned the land and the tenants derived ownership from him. Gradually England forced her land laws upon Ireland. This was done by driving the «rebellious Irish» out of certain counties, Kings and Queens, then all Ulster, when the Ulster plantation was established, in 1607. Other confiscations and dispossessions took place until all Ireland came under the English law. Cromwell took forcibly the best lands of Munster and Leinster and a large part of Ulster, and divided the whole among his soldiers. Although some of the lands were restored later, it was retaken, by act of Parliamen, under William III. Naturally the chiefs and leaders among the people of Ireland were deprived of their lands and the friends of the king of England or the English government, were given Irish possessions as a reward. The penal laws later made it a crime for a Catholic to acquire or hold land. Thus the Irish land question virtually began with the entrance of Henry II. into Ireland. With the Irish owners deprived of their lands there was instituted the system of «landlordism» which has been a hindrance to Ireland's progress. The majority of those who owned the land did not live upon it, and usually the money received for rent was spent in a foreign country. The landlord owned only the land, the houses had to be built and all improvements had to be made by the tenant and at his own expense. The more a holding was improved, the more rent was demanded. The «middle men» who held lands under the owner, and sublet to tenants were the means of increasing the burdens of the peasantry. The commission under Lord Devon, in 1843, to investigate conditions in Ireland, revealed an alarming state of affairs and the famine of 1846–8 brought the Irish Land question to the notice of the whole civilized world, even many of the English statesmen who had censured Irish shiftlessness were astonished when they learned the nature of the land laws which gave power of eviction without any remuneration for improvements; and the wonder was that so much thrift and industry existed. In 1847 Lord Russel endeavored to have Parliament pass an act to protect the tenant against loss by eviction. This measure failed, and others accepted by Parliament later proved ineffectual. Two years after the terrible devastation by famine, the Tenant Right League was organized in Dublin, and its members began a systematic campaign to elect to Parliament members pledged to support measures for the relief of the tenants. The Land Acts of 1860, under the Palmerston ministry, may be said to have resulted from the agitation kept up by the Tenant Right League. Various other organizations for the betterment of the people of Ireland were established, and among them were «physical force» societies. In 1870, under the Gladstone ministry, three new laws were enacted; that a tenant could not be evicted if his rent were paid; that this non-payment must be for at least three years; and that if the tenant choose, he might sell his improvements. This purchase of improvement clause was a great advance in favor of tenants' rights. The Land League in various parts of the world, especially the United States, continued the agitation and brought the question of the wrongs of the Irish tenants before the whole world. The Ashbourne Act of 1885 provided for the purchase of the lands by the tenants and nearly $25,000,000 was set aside for that purpose. Later a like amount was added. In 1891 the Balfour Law Purchase bill was passed and nearly $150,000,000 was provided for its enactment. In 1896 this law was improved; but for various reasons all the laws enacted by Parliament proved ineffective only in so far as the bringing of the matter to the notice of fair-minded statesmen. (See Land League.) The most radical and satisfactory «Land Purchase Bill» was enacted 14 Aug. 1903, whereby the tenant may purchase and own land and the government will, under certain and fair conditions, be responsible for the payment. To George Wyndham, who as chief secretary for Ireland, prepared the bill, the credit is largely due for the passage of the act. (See WYNDHAM, GEORGE.) Consult: Reports on the «Land Purchase» acts for relief of Ireland; Hansard's 'Parliamentary Debates'; Guinell, 'The Brehon Laws'; Maine, 'Lectures on the Early History of Institutions'; Fisher, 'History of Landholding in Ireland'; Richey, 'The Irish Land Law'; Godkin, 'The Land War in Ireland'; Richey, 'The Irish Landlord.' See GREAT BRITAIN—THE LAND LAWS.

Irish Literary Society, an organization established in 1892, in London. Its object is to promote the study of Irish literature, music, art, and history. Some of the leading Irish literary men and women of England and Ireland are active or honorary members, and strive in many ways to promote the work of the society. The society provides lecture courses on topics pertaining to literary Ireland, and it has a large library which may be used by any of its members. Some of the members are Justin McCarthy, W. B. Yeats, Rev. Stopford Brooke, Barry O'Brien, and several of the well known writers among the Irish women. There were (in 1903) about 625 members.

Irish (Gaelic) Literature. See CELTIC LITERATURE; GAELIC LITERATURE.

Irish Moss, an edible dulse or seaweed. See CARRAGEEN.

Irish Music has been celebrated from almost prehistoric times, Irish teachers of the art as early as the 7th century holding high rank as specialists in the faculties of continental and English colleges. While the bagpipe was the popular instrument of the common people, the harp was in great favor among the noble and educated classes, and their professional harpists were noted for their skill. The Irish scale originally consisting of five notes, gradually developed with the addition of a sixth and a seventh, until the Irish harp had a finely graduated scale of tones and semitones either in the key of C or G, extending through a compass of four octaves. A harp in the museum of Trinity College, Dublin, said to be that of Brian Boru, has 30 strings, and the Dallway harp, made in 1621, has 52 strings. The national temperament was so musically imbued that there were special songs and airs for different crafts and for almost every conceivable occasion. War marches were played by the pipers at the head of the clansmen marching to battle; spinning, weaving, smithy, plowing, boating, and sporting songs were in daily use, and there were even milking songs, slow and plaintive airs which had the effect of soothing the cows and induced them to submit gently to the milking operation. In Irish literature, native music is frequently classed under three different styles, known as mirth, sorrow, and sleep music, comprising (1) lively, spirited pieces, as jigs, reels, hornpipes and other dance music; (2) solemn and slow pieces, as laments or dirges, commonly called *caiones* or *keens*, and sung on the occasion of a death; (3) plaintive and soothing airs, such as nurse tunes, cradle songs, lullabies, etc. In the numerous collections of these airs, about 2,000 different melodies are preserved, some of the most popular being 'Savourneen Dheelish,' 'Eileen Aroon' (popularly known by the Scotch appropriation 'Robin Adair'), 'The Coolin,' 'Garryowen,' 'Langolee,' 'Molly Asthore' and 'Patrick's Day.' With the universal spread of music after the 17th century, Irish music as a national feature became merged in the general history of the art. Turlogh Carolan, Carroll O'Daly, Reilly and the Conallons were among the chief of Ireland's ancient harpists and musicians. In modern times Ireland's musical productivity is represented by Michael William Balfe, William Vincent Wallace, Sir Charles Villiers Stanford, and others. Consult: Graves and Stanford, 'Songs of Old Ireland and Irish Songs and Ballads' (1882–92); id., 'Songs of Erin'; Graves and Wood, 'Irish Folk Song'; Graves, 'Songs of Irish Wit and Humor'; and collections of Bunting, Joyce, Moore and Petrie.

Irish Presbyterian Church, formerly called the Synod of Ulster. Its members are mostly descended from the Scotch Presbyterians, who migrated to Ireland by invitation of James I., between 1609 and 1612, to colonize Ulster.

Irish Sea, the body of water between England and Ireland. It is connected with the Atlantic Ocean on the north by the North Channel, and on the south by Saint George's Channel. The north shore of Wales and the southwest shore of Scotland are washed by this sea. It is almost circular in form, about 140 miles north and south, and the same east and west. The largest arms of the sea are on the west shore. The Morecambe Bay on the coast of England, and several large fiords. Dublin and Dundalk bays are the most important on the west coast. The only large islands are the Isle of Man in the north, about midway between England and Ireland, and Anglesey off the northwest coast and a part of Wales.

Irish Terrier, a rough-coated, strongly built terrier, resembling the Welsh and Scotch terriers. See DOG.

Irish Texts Society, an organization established in London. Its object is to promote the study of Irish literature,— that is, of literature in the Irish text. They foster societies and issue publications to aid the work. In 1900 they published their third volume, which contained the poems of Egan O'Rahilly. In 1901 their annual volume contained Keating's 'History of Ireland,' edited by David Comyn. The volume of 1903 contains an 'Irish-English Dictionary.'

Iritis, ī-rī'tĭs, inflammation of the iris, the colored curtain that shows the pupil in its centre. This disease follows several types, depending on the kind and virulence of the causative agent. In the serous form there is an exudation of blood-serum into the space in front of the iris, and more or less fibrinous matter that tends to glue the parts together. Pain shoots through the whole eyeball, and vision is dimmed by the turbid fluid. Persistent adhesions to the lens are formed, causing a permanent distortion of the shape of the pupil. Another form is the plastic, in which the pupil is actually occluded by the fibrinous deposits. Rheumatism and syphilis are the two most frequent causes of the malady, but many constitutional diseases — as gout, diabetes, anæmias, and menstrual disorders — may be factors in causing the disturbance, and it may also be secondary to diseases in other parts of the eye, or even in the other eye, as in sympathetic ophthalmia. The treatment consists of dilating the pupil by dropping solutions of some drug, as atropine, into the conjunctival sac, treating the constitutional disease at the seat of the malady, and in relieving the pain by hot fomentations, blood letting, and the administration of drugs that are sedative. Syphilitic iritis is a lesion of the third stage of syphilis (q.v.), where tiny spots called gummata grow in the substance of the iris.

Irkutsk, ir'kootsk, a provincial government of Russia, in eastern Siberia, separated from China by the Sayan Mountains. It has an area of 287,061 square miles. The country is generally mountainous, but produces rye, barley, oats and vegetables. The most important rivers are the Angara, Lena and its tributary the Vitim. Gold, iron, and salt figure foremost among the mineral products. Agriculture, cattle-breeding, and the transport of goods to and from China are the chief occupations of the people. Pop. 501,237 (one third exiles and forced colonists). The capital city, Irkutsk, on the Angara, is the residence of the governor-general of eastern Siberia and the seat of a bishop.

Iron, a common and exceedingly useful metallic element, which has been known and used in the arts for many centuries. It occurs in nature in the metallic form, both in meteorites and in certain lavas and volcanic rocks; but the commercial supply is obtained by the reduction of the oxids (or other ores) of the metal, by strongly heating them in a blast furnace with carbon. Iron is grayish in color, with a marked lustre. It crystallizes in the isometric system, usually in the form of cubes or octahedra. The melting point of iron varies to a considerable extent, according to the impurities with which the metal is associated, and also, apparently, according to the physical condition of the iron itself. Pictet gives it as about 2900° F. for iron that is sensibly pure. The specific gravity of the metal also varies to a considerable extent, the determinations ranging from 6.95 to 8.2. The specific gravity of pure iron, at 60° F., may be taken to be 7.85. The specific heat of the metal is about 0.112 at ordinary temperatures, and its coefficient of expansion (on the Fahrenheit scale) is about 0.0000068. Taking the electrical conductivity of mercury (at 32° F.) as unity, the conductivity of iron is about 9.68 at 32° F., and 6.19 at 212° F. Iron is the most magnetic substance known. Soft, pure iron is capable of being magnetized very highly when surrounded by a solenoid of wire that is conveying an electrical current; but its magnetization persists only while the electric current is flowing, falling off, upon the cessation of the current, to a value that is practically negligeable. It is upon this property of temporary magnetization that the action of the telephone, the telegraph, and many other useful electrical inventions depends. (See MAGNETISM; and for a full discussion of the phenomena of magnetization, consult Ewing, 'Magnetic Induction in Iron and Other Metals.') Hardened steel, when magnetized by the action of the electric current (or otherwise), retains a large proportion of its magnetism permanently. Iron becomes nonmagnetic at a red heat, but regains its magnetic properties upon cooling again. Wrought iron, when pure, is malleable to a certain extent at all temperatures; but it yields to the hammer with special readiness when heated to whiteness, and it may then be forged and welded without difficulty. The presence of any considerable proportion of sulphur or phosphorus makes the metal "short," or brittle. When phosphorus is present in too great a proportion, the iron is brittle in the cold (that is, "cold-short"); while if sulphur is present in excess it is brittle when hot (that is, it is "hot-short").

Chemically, iron is a dyad. It has the symbol Fe (from "ferrum," the Latin name for the metal), and an atomic weight of 56 if $O = 16$, or 55.6 if $H = 1$. It forms two basic oxids, (1) ferrous oxid, FeO, which gives rise to a series of salts known as "ferrous" salts, and (2) ferric oxid (or ferric sesquioxid), Fe_2O_3, which gives rise to a corresponding series of "ferric" salts. A third oxid, having the formula Fe_3O_4, is also known, which is magnetic, and occurs in nature, either amorphous or crystallized in octahedra, as the mineral "lodestone." This oxid is black in color, and is known as the black oxid, magnetic oxid, or ferroso-ferric oxid. It may be prepared, artificially, by oxidizing iron at a high temperature, either in air or in steam, or by heating carbonate of iron to 650° F., in a current of carbon dioxid. It is not readily attacked by acids or other chemical agents, and for this reason a coating of it is often formed on articles of iron to protect them from further oxidation. The Russian iron that is used for stove-pipes is coated in this way, by a secret process. When in mass, iron does not readily decompose water at ordinary temperatures, though it does so at high temperatures. Finely divided iron decomposes water at 212° F., and at lower temperatures according to some authorities. When in a sufficiently fine state of subdivision, iron will burn in the air or in oxygen, with the formation of a mixture of Fe_2O_3 and Fe_3O_4. Iron forms alloys with many metals, and combines directly with chlorine, bromine, iodine, fluorine, sulphur, carbon, boron, silicon, phosphorus, and arsenic. Melted iron dissolves carbon to some extent, and when the molten mass is cooled the carbon is largely deposited in the graphitic form, although a part of it remains in the iron, combined with it in the form of a carbide; and it is believed that the presence of varying quantities of such carbides has much to do with the physical qualities of iron and steel. When melted iron that is saturated with carbon is allowed to cool under great pressure, the carbon is partly deposited in the form of minute crystals of diamond (q.v.); but the manufacture of the diamond by this method has not yet been made commercially practicable.

Ferrous Compounds.— Ferrous oxid, FeO, has not yet been prepared in a state of absolute purity, but it may be obtained approximately pure by reducing ferric oxid, Fe_2O_3, by heating it to 600° F. in a stream of pure hydrogen. It is black in color, and absorbs oxygen with great readiness, passing into the higher oxids. Ferrous sulphate, otherwise known as protosulphate of iron, green vitriol, or copperas, is prepared by dissolving metallic iron in sulphuric acid, and crystallizing by evaporation. It has the formula $FeSO_4 + 7H_2O$, and is greenish in color. It is soluble in water, but the solution oxidizes readily, the salt becoming converted into ferric sulphate, $Fe_2(SO_4)_3$. Ferrous sulphate is largely used in the manufacture of certain black dyes, in the preparation of writing ink, and, to a certain extent, in photography. The ferrous oxalate developer, made by mixing a solution of ferrous sulphate with one of oxalate of potassium, was formerly in great favor, but has now fallen into comparative disuse, owing to the discovery of other developers that are more active and more convenient to handle. Ferrous chloride, $FeCl_2$, may be prepared by heating excess of iron wire or iron filings in chlorine, or by passing dry hydrochloric acid gas over hot metallic iron. It crystallizes in white, lustrous, six-sided forms, and is volatile at a yellow heat. In air it oxidizes readily to a mixture of ferric oxide and ferric chloride. Ferrous carbonate, $FeCO_3$, is an insoluble compound, occurring in nature as "spathose iron ore," and constituting a valuable ore of iron. Ferrous sulphide, FeS, is a black or grayish-black body, which may be prepared by melting sulphur and iron together in the proportion of 56 parts (by weight) of iron to 32 of sulphur. It is insoluble in water, but dissolves readily in dilute acids, with copious liberation of sulphuretted hydrogen gas. See CHEMICAL ANALYSIS.

Ferric Compounds.—Ferric oxid, Fe_2O_3, occurs native as hematite (q.v.), and it may be prepared artificially by heating ferrous sulphate to redness. Ferric hydrate, $Fe(OH)_3$ is precipitated as a brownish-red powder when ammonia or caustic potash is added to the solution of a ferric salt. Ferric sulphate and ferric chloride are prepared by dissolving this hydrate in sulphuric and hydrochloric acids, respectively. In general, a ferrous salt, when in solution, is converted into the corresponding ferric salt by the action of oxidizing agents; and the ferric salts, conversely, are reduced to ferrous salts by the action of certain reducing agents. Ferrous salts give a white precipitate with caustic alkalies, and, with potassium ferrocyanide, a light-blue precipitate which quickly turns black. Ferric salts give a reddish-brown precipitate with caustic alkalies, and a deep blue precipitate with potassium ferrocyanide.

Iron Age, (1) in mythology, the last of the four great ages of the world, supposed to be characterized by abounding oppression, vice, and misery. (2) In archæology, an age, the third in succession, in which weapons and many other implements began to be made of iron, stone having been used for these purposes in the first, and bronze in the second.

Iron Founding, Chemistry of. Chemistry is the science which deals with the composition of material things; the chemistry of iron founding or iron casting is the science which deals with the composition of cast iron. Cast iron implies a quality of iron which can be melted and poured into moulds and which will take the shape of the moulds. The three properties which make cast iron valuable as a cast product are fluidity, low shrinkage, and mutability of hardness. Pure iron does not have these essential characteristics, consequently the casting properties of cast iron must be due to impurities present with the iron. The chemistry of iron founding must therefore deal with these impurities and their reactions in making iron a cast product. The substances which occur with iron are carbon, silicon, phosphorus, sulphur, and manganese, and each of these has a decided effect upon cast iron.

Carbon.—Carbon is the controlling element; in fact, cast iron could not be cast iron without carbon. Iron as it comes from the blast furnace, known as pig iron, contains from two to four and one half per cent. carbon. Cast iron as it comes from the cupola generally retains from three to four per cent. carbon; special grades sometimes contain as low as two and one-quarter per cent., and as high as four and one-quarter per cent.

Condition of Carbon in Cast Iron.—Chemically, all the carbon which does not dissolve in a certain strength of nitric acid is classed as Free Carbon, while the carbon which dissolves in this acid is designated as Combined Carbon.

Free Carbon.—Free Carbon occurs as pure carbon interspersed in appreciable-sized particles between the crystals of iron. Free Carbon is subdivided according to its structure and mode of formation into Graphitic Carbon and Annealing Carbon.

Graphitic Carbon.—Graphitic Carbon is the crystalline or platy form of carbon existing in all soft pig and cast iron which has been allowed to cool slowly from a molten condition.

Annealing Carbon.—Annealing Carbon is an amorphous modification of carbon which is developed in white iron by continued annealing at a high temperature.

The difference between Graphitic and Annealing Carbon is a physical one and is due to the mode of formation.

Combined Carbon.—Combined Carbon exists in cast iron in two forms, Hardening Carbon and Carbide Carbon. Neither is visible to the naked eye, but each gives to iron a definite physical structure which is discernible under the microscope. Chemically, they may be separated by treating the iron for a long period with a weak non-oxidizing acid in a non-oxidizing atmosphere.

Hardening Carbon.—Carbon is held in the hardening condition by rapidly cooling iron from a high temperature. The exact condition of the carbon has not been definitely determined. The writer considers that in this rapid cooling the carbon is caught and held in an atomic condition by the surrounding iron.

Carbide Carbon.—Carbide Carbon is the carbon which exists in the carbide of iron Fe_3C.

Factors Controlling the Condition of the Carbon.—There are three factors which control the condition of carbon in cast iron. First, the percentage of carbon in the iron; second, the rate at which the iron cools; third, the percentage of other elements present with the carbon in the iron.

(1) *Condition of Carbon Determined by Amount Present.*—The more carbon there is present in molten cast iron when it begins to cool, the greater will be the percentage of carbon which will separate out in the free condition during cooling. For example—a four per cent. carbon iron would contain a greater percentage of free carbon than a three per cent. carbon iron, provided both were cooled under similar conditions and carried the same amount of other elements.

(2) *Condition of Carbon Determined by Rate of Cooling.*—The slower cast iron cools the greater will be the percentage of carbon present in the free condition, and conversely, the faster

an iron is cooled, the greater will be the proportion of the carbon present in the combined condition. If a portion of molten cast iron of a correct composition is poured into water the carbon will be retained in the combined condition; if another portion of the same iron is cooled very slowly, all the carbon will separate out into the free condition.

(3) *Condition of Carbon Determined by Other Elements Present.*—The condition of the carbon in cast iron is controlled by the percentage of carbon present and the rate of cooling, consequently any elements which affect these two reactions will affect the relation of the free to the combined carbon. Silicon, sulphur, phosphorus, and manganese take a prominent part in one or both of these reactions and consequently exert an important influence upon the condition of the carbon. (This is discussed later under the individual elements.)

Effect of Carbon on the Physical Properties of Cast Iron.—Free carbon makes iron soft and is instrumental in prolonging the fluidity, decreasing shrinkage, and regulating strength. Hardening carbon and carbide carbon increase the hardness and strength of cast iron; they prevent the decrease in shrinkage which would occur if their carbon was present in the free condition; they lower the melting point of cast iron.

Action of Carbon in Affecting the Physical Properties of Cast Iron.—As cast iron cools from a molten condition the carbon separates out as free carbon, unites with the iron as carbide carbon, and is retained in the form of hardening carbon. Cast iron in the molten state is a solution of carbon in iron; as the temperature decreases the ability of the iron to hold the carbon in solution decreases, and the carbon begins to separate out as graphitic carbon. Heat is rendered latent in the solution of the carbon in the iron and this heat will be given up when the carbon separates out from the iron. This evolved heat will prolong fluidity and consequently will give a longer time for the separation of free carbon, thus increasing the softness and decreasing the shrinkage of the iron.

When cast iron cools, the carbon which did not separate out as free carbon tends to unite with the iron as carbide carbon in the compound Fe_3C. This occurs while the iron is passing through the zone of temperature in the neighborhood of 700° C. The remainder of the carbon, which neither separates as free carbon nor unites with the iron as carbide carbon, remains present as hardening carbon.

Silicon.—Silicon is of value to cast iron on account of its influence upon the carbon. Silicon of itself would add no beneficial quality as its effects are indirect and through the carbon. Pig iron generally contains from two-tenths of one per cent. to twelve per cent. silicon. The lower silicon grades are hard charcoal, basic, or off bessemer irons, while the extremely high silicon irons are special softeners made to mix with other irons to increase the percentage of silicon. Cast iron carries from four-tenths of a per cent. to one per cent. silicon for chilled work and from one to three per cent. for different grades of grey iron work.

Condition of Silicon in Cast Iron.—The condition of silicon in cast iron has not been fully determined. Certain silicides of iron have been separated from cast iron, but their composition is so indefinite and they are so easily broken up that their condition exerts no important influence upon cast iron.

Effect of Silicon on the Physical Properties of Cast Iron.—Silicon through its action on the carbon softens cast iron, reduces its shrinkage, increases its fluidity, and regulates its strength.

The effect of silicon as a softener is limited, and when too much silicon is present its softening action ceases and it begins to harden iron. The same is true with regard to its effect on fluidity and strength. Cast iron with three and one-half per cent. silicon will hold almost no carbon in combination, consequently any silicon in excess of this amount exerts a direct effect upon the iron and renders it unfit for use as a cast product.

Action of Silicon on Carbon.—The importance of the action of silicon on carbon is due to the fact that silicon reduces the solubility of iron for carbon. An iron containing silicon will dissolve less carbon than an iron containing none. At a given temperature, then, the more silicon an iron contains the less carbon will the iron retain in the dissolved condition, consequently when an iron cools from a high temperature the amount of carbon that will separate out from solution is regulated by the amount of silicon present. The higher the silicon the less carbon will the iron hold in solution, and the more will separate out as free carbon.

Phosphorus.—Phosphorus confers both beneficial and harmful properties on cast iron. Cast iron generally contains from two-tenths to one and five-tenths per cent. phosphorus, but on account of its injurious effect it should be kept below one per cent. for light thin castings, and below five-tenths per cent. in heavy castings.

Condition of Phosphorus in Cast Iron.—Phosphides of iron have been separated from cast iron, and phosphorus probably exists in some such form in cold cast iron. In the liquid state it presumably acts as a dissolved gas, giving greater activity to the particles of the iron and prolonging the period of cooling.

Effect of Phosphorus on the Properties of Cast Iron.—Phosphorus makes iron fluid, or at least prolongs the fluidity, and thus aids the iron in taking the exact form of the mold. It makes iron weak, brittle, and liable to break under shocks. It is advantageous in light, thin castings where fluidity and exactness of outline are important and where strength can be neglected. It is very detrimental in large irregular-shape castings, especially where strength is required.

Action of Phosphorus on Cast Iron.—Phosphorus by prolonging the fluidity of the iron gives the graphite a further opportunity to separate and thus tends to reduce shrinkage. By prolonging the iron in a plastic condition just after it sets, phosphorus allows the separating graphite to force the iron into the minutest corners of the mold. The phosphorus prolongs the cooling of the iron as it crystallizes out and thus allows it to separate into larger crystals, which weakens the iron and causes it to be brittle. When phosphorus is present in large quantities it forms a eutectic with the iron which fills up the crevices between the particles which have previously solidified. When the eutectic solidifies later it causes strains in the iron which makes it short and liable to break under shock.

Sulphur.—Sulphur acts in two ways in cast iron. First through the carbon and second by uniting directly with the iron. On account of its injurious action sulphur is generally kept below fifteen hundredths of one per cent., and for light work below eight hundredths of one per cent.

Condition of Sulphur in Cast Iron.—Sulphur exists in cold cast iron as a sulphide of iron or as a sulphide of manganese. In molten cast iron it is probably dissolved as gaseous sulphur.

Effect of Sulphur on the Properties of Cast Iron.—Sulphur makes iron hard, red short, weak, and liable to contain blow holes. Its only beneficial effect is to give a hard wearing quality to iron subjected to frictional wear.

Action of Sulphur on Cast Iron.—Sulphur, by shortening the time of cooling of cast iron, prevents the separation of graphitic carbon. The carbon which has not been able to separate as free carbon remains in the combined condition, and consequently sulphur tends to harden the iron.

When cast iron solidifies sulphur is still in a gaseous condition and surrounds each particle of iron with a covering of gaseous sulphur. When the iron is sufficiently cold, the sulphur solidifies, or unites with the iron as a sulphide of iron. In this condition it occupies less space than in the gaseous condition and thus leaves the crystals surrounded by minute spaces which makes the iron very brittle and weak.

Manganese.—Manganese acts in two opposite ways on cast iron. It increases the power of the iron to hold carbon in solution and consequently tends to increase the combined carbon and hardness. It unites with the sulphur and forms a sulphide of iron which separates out before the iron sets and thus prevents the sulphur from exerting a hardening effect. Pig iron contains from two-tenths of one per cent. to three and one-half per cent. manganese, while cast iron ordinarily runs from one-tenth of one per cent. to one per cent. in manganese.

Condition of Manganese in Cast Iron.—Manganese exists in three conditions in cast iron. In the molten condition it tends to unite with the sulphur as manganese sulphide. As the iron cools through the critical temperature the manganese unites with the carbon to form a carbide Mn_3C. Any manganese not so united alloys with the iron.

Effect of Manganese on the Properties of Cast Iron.—Manganese by its action on the carbon tends to harden cast iron, while its effect on sulphur tends to soften cast iron. Whether the hardening effect with the carbon or the softening effect on the sulphur predominates depends upon the amount of manganese and sulphur present.

Action of Manganese on Cast Iron.—Manganese unites with the sulphur and forms a manganese sulphide at a temperature above the solidifying temperature of cast iron. Consequently this manganese sulphide has no more detrimental effect on the iron than so many small particles of any neutral impurity. Manganese therefore prevents the bad effect of the sulphur, and hence in the case of high sulphur irons it acts as a softener. The manganese in excess of that which unites with the sulphur unites with the carbon to form a carbide Mn_3C. This carbide hardens the iron, for it of itself is an intensely hard substance.

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Iron, Manufacture of. The metallic products extracted from iron ores for use in the arts are generally divided into three classes: (1) pig or cast iron, (2) wrought iron, and (3) steel. See IRON AND STEEL; IRON AND STEEL INDUSTRY; STEEL INDUSTRY; STEEL.

Although the minerals in which iron occurs are very numerous, the only ones from which the metal can be extracted under economical conditions—that is, the only ores of iron—are those in which the iron is present as an oxide, as in magnetites, hematites, and limonites, or as a carbonate as in siderites. (See IRON ORES.) When carbonate of iron, moreover, is heated to a sufficiently high temperature either at an early stage of the process of manufacture or in a preliminary operation (the calcining of the ore), the carbonic acid which it contains is expelled as a gas and the iron is reduced to the condition of an oxide, hence the operation of extracting metallic iron from its ores always consists in the deoxidation or reduction of iron oxide.

In order to reduce oxide of iron two conditions are essential: (1) contact with a reducing or deoxidizing substance, and (2) a high temperature. By heating iron oxide in contact with some carbonaceous fuel these two necessary conditions are realized, the carbon acting both as the needed fuel and as the needed reducing body, for at a sufficiently high temperature it has a stronger affinity for oxygen than iron and therefore deprives the latter of that element.

Iron ore, however, never consists of pure oxide of iron: in the richest varieties the iron oxide is associated with at least a small amount of other minerals, generally of an earthy character, such as quartz, clay, or limestone, and which are called the *gangue* or *vein stuff*. In the majority of cases the gangue is silicious, that is, made up chiefly of silica or quartz. Silica is *per se* a very infusible compound, but when brought in contact with iron oxide at a high temperature it combines readily with it to form a silicate of iron, a readily fusible substance or slag.

Besides the earthy matters which constitute the gangue, iron ores generally contain other minerals in which are present such elements as phosphorus, sulphur, manganese, etc. See IRON FOUNDING, CHEMISTRY OF.

Finally, if metallic iron be kept in contact with incandescent carbon for a sufficient length of time, a considerable amount of that element will be absorbed by the metal. The conditions are then said to be carburizing. This affinity of iron for carbon plays a most important part in its metallurgy, chiefly because of the marked influence of carbon upon the melting point of the metal. Pure or rather carbonless iron requires a very high temperature to be melted (about 2,000° F.), necessitating the use of special furnaces and implements capable of producing intense heat. By the introduction of some carbon in the iron, however, its melting point is greatly lowered, from which the important conclusion is to be drawn that if the metallic product of the metallurgical operation be highly carburized it will be produced and maintained in a liquid state much more readily than if it were freer from carbon. If the iron contains but a small amount of carbon and if we lack the means of producing an intense heat, the product of the operation will be pasty and not molten.

The Primitive or Direct Methods.— The simple operation outlined in the preceding paragraphs which consists in heating iron ore in contact with carbonaceous fuel, was the one conducted in the direct or primitive methods which for ages were the only ones used for the production of iron and steel. Charcoal was the fuel employed and the simple furnace required, called a forge or bloomery, resembled a smith's forge.

So simple is the operation required for extracting a small mass of malleable iron from some rich ore that it seems highly probable that man became acquainted with the use of iron at a very early period of his existence. A fire accidentally lighted by a primeval man upon the ground where iron ore occurred near the surface would have resulted, under suitable conditions, in the production of some metallic iron. Indeed, the first iron furnaces of which we have any record consisted in a single excavation dug preferably on the side of a hill, facing the prevailing wind, and with suitable openings at the bottom for the necessary draft. Artificial blast was later introduced and the construction of the furnace improved. It will suffice to mention here two representative types of this class of furnaces: (1) the old catalan furnace or forge, and (2) the American bloomery, a modern adaptation of this primitive forge.

The catalan forge takes its name from the province of Catalonia, in Spain, where at one time it supplied a large proportion of the world's production of iron, and where, indeed, it is still in operation, as well as in other localities adjacent to the Pyrenees. In its more modern form it consists of a shallow hearth made up of thick iron plates, with the exception of the back, which generally consists of masonry lined with fire clay, while the bottom is frequently made of a movable block of granite. The blast was undoubtedly at first supplied by crude bellows, but was later produced by a water blower or "trompe." The furnace is kept filled with charcoal and small lumps of rich iron ore until a pasty mass of metallic iron is obtained weighing some 350 pounds, called a "bloom," and which contains much slag. It is then removed from the furnace and much of the slag expelled by hammering or squeezing.

For many years a direct process known as the American bloomery process was extensively used in those localities of the United States where suitable ore and an abundant supply of charcoal were available. This process does not differ in any essential feature from the catalan method, which has just been described, but in details of furnace construction and in manipulations there are many points of difference between the two methods.

The hearth of the bloomery is kept full with burning charcoal and coarsely pulverized ores until a bloom of iron weighing some 300 or 400 pounds has been produced and which generally requires three hours. The loss of iron in the operation is said to be about 20 per cent and the fuel consumption some 2½ tons of charcoal per ton of iron produced.

These methods are called direct because they yield iron by the direct treatment of the ore in a single operation, in contradistinction to the modern methods in which at least two distinct treatments are required for the production of iron and steel, the first operation yielding, as will be seen presently, an impure product called cast iron, which must be refined or purified in order to convert it into iron or steel.

While these methods are now obsolete, having been replaced by the more modern indirect processes, they are still in use in some countries, although only to a very limited extent.

According to James M. Swank, in 1902 and 1903 there were no forges in operation in the United States for the manufacture of blooms and billets from the ore. In 1901 the blooms and billets so made amounted to 2,310 gross tons, against 4,292 tons in 1900, 3,142 tons in 1899, 1,767 tons in 1898, 1,455 tons in 1897, 1,346 tons in 1896, 40 tons in 1895, 40 tons in 1894, 864 tons in 1893, and 2,182 tons in 1892. All the ore blooms produced since 1897 were made by the Chateaugay Ore and Iron Company, of Plattsburgh, N. Y., at its Standish Works, which, however, have been idle since 1892.

The Blast Furnace.— In order to prevent the great waste of iron previously alluded to and resulting from the combination of the gangue of the ore with some of the metallic iron, it is necessary to provide a substance with which the silica of the gangue will readily unite, forming with it a fusible slag, and as silica is an acid it is necessary to provide a base to that effect.

Limestone (a carbonate of lime) is the most readily obtainable and cheapest substance for such purpose. It is either burned or calcined in a preliminary operation by which it is converted into lime, the carbonic acid escaping as a gas, or if used raw, it is likewise changed to lime at an early stage of the metallurgical operation by the heat to which it is exposed.

The substances which are thus added for the purpose of forming a fusible compound with the gangue of the ore or with other impurities are called fluxes.

The use of fluxes constitutes one of the most important improvements ever introduced in the manufacture of iron, for it made it possible to extract the metal, under economical conditions, from the enormous amount of relatively lean ores which occur in nature, and to do so at a relatively very low cost. Previously to the use of fluxes it was unprofitable to treat ore containing less than some 60 or 70 per cent of metallic iron, while with their assistance iron ores with as little as some 25 per cent of iron may be profitably smelted.

With the addition of lime, however, it is no longer possible to carry on the operation in the very simple furnace or forge previously used, because the resulting slag or silicate of lime is a much more infusible substance than the silicate of iron produced without the addition of lime and a sufficiently high temperature to fuse this lime slag could not be produced in the forge furnace.

The very high temperature required to fuse the lime slag necessitates the use of a very different type of apparatus (a high, chimney-like furnace), together with the necessary appliances for the production of the needed heat; in other words, the reduction of the ore must be carried on in the modern blast furnace. The blast furnace was gradually evolved from the primitive forge or bloomery by a mere increase in height, such furnaces as the "Osmund," the "Stückofen," and the "Blauofen" forming as many steps in this evolution. The exact date of the origin of the blast furnace, that is, of an apparatus in which cast iron alone could be produced — and it might be added with addition of flux — is not positively known but it is generally believed that it originated in the Rhine provinces about the beginning of the 14th century.

The operation conducted in early blast furnaces consisted chiefly in smelting iron ore with the necessary amount of charcoal for fuel and of limestone to flux the gangue of the ore. The waste gases which contained a large amount of carbon monoxide were allowed to escape and to burn freely at the top of the furnace. The molten cast iron was allowed to collect at the bottom of the furnace until a sufficient quantity had accumulated, when it was withdrawn by opening a tap hole at the bottom and in the front part of the furnace. The slag was permitted to escape as soon as formed by flowing through an opening and over a stone on one side of the furnace known as the dam-stone. The blast was at first created by rude bellows, later by blowing cylinders, and finally by steam-blowing engines, while no attempt was made at preheating it.

The following improvements introduced in blast furnace practice, outside of mere improvements in construction, marked the most important steps which have led to the modern blast furnace operations. They are mentioned in a chronological order: (1) Use of coke instead of charcoal introduced by Abraham Darby in 1735; (2) the heating of the blast first proposed by James Beaumont Neilson in 1828; (3) the closing of the top of the furnace and utilization of the waste gases by P. Taylor in 1840; (4) the heating of the hot blast stoves by the waste gases of the furnace successfully accomplished between 1833 and 1845 by Faber du Faur and James Palmer Budd; (5) the cup and cone arrangement for closing the top of the furnace invented by G. Parry in 1850; (6) the waste gases used for generating steam by James Palmer Budd in about 1855; (7) regenerative stoves for heating the blast introduced by E. H. Cowper in 1860.

The important and numerous improvements in construction cover every part of the furnace as well as every appliance connected with iron making. To attempt even to mention them would occupy an amount of space which is not here available.

Modern American blast furnaces generally measure from 90 to 100 feet in height and from 20 to 30 feet in diameter at the widest part, while the hearth diameter frequently measures 13 or 14 feet, giving a capacity of from 20,000 to 30,000 cubic feet. The bosh walls which extend from the hearth to the widest part of the furnace are cooled by hollow rings of cast iron or bronze built in sections and inserted into the brick work, and through which water is constantly flowing. The water required for cooling purposes often exceeds 3,000,000 United States gallons in 24 hours. Two down-comers conduct the blast from the top of the furnace to the dust-catchers, from which it is led to the stoves and the boilers by means of a gas main. Another main leads the blast from the stoves to the furnace. Before connecting with the bustle pipe surrounding the furnace the hot blast main frequently divides in order to better equalize the pressure around the complete circle. Explosion doors are provided at the furnace top, and whenever possible in all pipes and chambers carrying gas.

Blast at the rate of 40,000 to 60,000 cubic feet per minute is forced into the furnace through pipes or "tuyeres," varying between 12 and 20 in number, under a pressure of 10 to 15 pounds per square inch and preheated by its passage through the stoves to a temperature of 1,000 to 1,500° F. The output of these furnaces frequently averages 600 tons of pig iron in 24 hours and is occasionally considerably greater, the furnace being tapped six times a day and some 100 tons of iron being obtained at each cast. The tapping hole is frequently opened by means of compressed air drills and closed by means of a tapping hole gun which forces clay into the hole. The fuel consumption varies between 1,500 and 2,000 pounds of coke per ton of pig iron, according to conditions.

The raw materials are conveyed to the top of the furnace by an inclined plane and skip cars, which discharge the raw materials automatically into a receiving hopper provided with a bell and placed over the main hopper. The use of an upper bell acting as a seal while the material is introduced into the furnace, prevents the escape and waste of the gases during this operation, resulting in further economy.

Modern blowing engines supplying the blast to the furnace are constructed both horizontal and vertical and are generally compound and condensing. They frequently have a capacity of some 30,000 cubic feet of air per minute which they can deliver under a pressure of 25 pounds or more per square inch if needed. Two such engines are generally employed for each furnace. A recent improvement in blowing engine construction consists in the use of gas or internal combustion engines for creating the blast. The first successful engine of this type was built at the Cockerill Steel Works at Seraing in Belgium and the results were so encouraging that many other similar engines have since been constructed, especially in Germany, Belgium, and France. It has been found by careful tests that gas blowing engines consume only from one sixth to one fourth of the gas which would be required to raise the steam for use in an ordinary engine of the same capacity. In spite of its evident superiority over steam engines, however, its introduction into American plants is proceeding very slowly.

The modern stoves employed for heating the blast before it enters the blast furnace consist, roughly stated, in high cylindrical chambers filled with bricks placed some distance apart. The waste gases from the furnace are admitted at one end of these chambers together with sufficient air to burn them, and the hot products of the combustion on their way to the chimney heat the brick work to a very high temperature. After the stove has thus been properly heated, the supply of gas and air is shut off and the cold blast from the engine is admitted. The heat which has been stored up in the brick work is now imparted to the blast, which in this way is highly preheated. After the stove has cooled down to a certain temperature the blast is shut off and the stove is again heated by the waste gases. Modern furnaces are generally provided with four of these stoves, the blast passing in succession through each stove for one hour, while the three others are being heated. With such regenerative system of heating the temperature can readily be maintained at 1,450° F., which results in a considerable economy of fuel in the furnace.

Until quite recently it was the universal practice, after opening the tap hole, to allow the iron to run into sand molds, prepared for that purpose on the floor in front of the furnace, and this method is still widely used. The metallic mass filling each mold is called a pig, while the metal filling the channels connecting a number of molds is called a sow. The pigs are, of course, fastened to the sow, and, after solidification, must be broken loose, generally with sledgehammers. When the cast iron is to be used for conversion into steel by the Bessemer process the metal as it flows from the furnace is frequently received in large tanks or «ladles» mounted on wheels, which are afterward taken to the steel mill, where the metal is converted into steel without being allowed to solidify, thus saving the cost of remelting the pig iron. In later years casting machines have been introduced to save the heavy labor connected with the handling of the pigs, and to otherwise expedite the casting operation. Nearly all these devices consist in an endless chain, the links of which are made of small iron molds, which are filled in succession by passing under the stream of molten metal. The chain then carries the partially solidified pigs or «chills» under water to promote their cooling and discharge them automatically on cars, the empty molds returning to the ladle again to be filled, and so on.

In the modern furnace the slag tap hole or «cinder notch» is kept closed as well as the iron tap hole, being opened only at stated intervals, generally a short time before the casting of the iron. In the latest American practice the slag is generally received in ladles which carry it away to the dumping place, or it is handled by means of a device known as «slag conveyor,» and which is not unlike the casting machines just described, consisting in an endless chain of shallow pans which are successively filled as they pass under the stream of molten slag. After being immersed under water the pans are automatically emptied on cars.

The Products of the Blast Furnace.—Owing to the extremely high temperature at which the operation must be conducted and to prolonged contact between the reduced iron and the incandescent carbonaceous fuel, the conditions in a blast furnace are strongly carburizing, the metal absorbing a large amount of carbon, (generally between 3 and 4 per cent). Moreover, owing to the fact that highly carburized iron is much more fusible (melting generally between 2,100° and 2,400° F.) than iron containing little carbon, and to the intense heat of the furnace, the extracted metal, instead of being obtained in a semi-fused, pasty condition, will be perfectly liquid, and on account of its high specific gravity will settle at the bottom of the furnace. The slag also will be melted, and being lighter than the iron, will float as a separate layer above the metallic bath. The molten slag and the molten iron are withdrawn separately from the furnace, thus effecting their complete separation.

This highly carburized iron produced in the blast furnace is called pig iron, or cast iron. Owing principally to the large amount of carbon which it contains, the properties of cast iron are very different from those of wrought iron and steel.

Owing to the intensely reducing conditions prevailing in a blast furnace, to the high temperature and to the presence of metallic iron, many impurities, such as phosphorus, sulphur, manganese, and silicon, which are always present in greater or less amount in the ore, flux, and fuel, are partially or wholly reduced to the metallic state, and in this condition are retained, in part at least, by the molten cast iron. Cast iron, therefore, is not simply an association of iron and carbon, but contains also varying amounts of the impurities just mentioned.

The following table illustrates the rapid increase in the world's production of cast iron since the beginning of the last century.

YEARS	Production tons.	YEARS	Production tons.
1800	825,000	1880	17,950,000
1830	1,825,000	1890	27,157,000
1850	4,750,000	1900	40,400,000
1870	11,900,000	1903	46,420,000

The following table shows the wonderful growth of the manufacture of cast iron in the United States:

YEARS	Production tons.	YEARS	Production tons.
1810	53,908	1901	15,878,354
1850	563,755	1902	17,821,307
1875	2,023,733	1903	18,009,252
1900	13,789,242	1904	16,497,033

The Refining of Cast Iron or the Indirect Methods for the Production of Wrought Iron and Steel.— Cast iron is not malleable — it cannot be forged; that is, it cannot be shaped into finished implements by mechanical pressure such as that exerted by hammering, rolling, etc. Cast iron, therefore, can only be used as such for casting purposes, which means that cast iron implements can only be obtained by pouring the molten metal into molds having exactly or very nearly the external shape of the objects we desire to manufacture. Cast iron, moreover, is brittle and lacks both strength and toughness, which further greatly limits its useful application. To produce a metal which is forgeable, which possesses more strength and toughness and other valuable properties absent in cast iron, and, therefore, a much more useful metal, it is necessary to subject cast iron to a refining operation by which it is converted either into steel or into wrought iron.

This indirect method of producing iron and steel is the prevailing modern method, for, in spite of strenuous efforts made to improve the older or direct method, it remains by far the cheaper of the two.

The refining of cast iron or its conversion into wrought iron or steel consists essentially in eliminating a large proportion of the impurities which it contains, especially carbon and silicon. In order to expel these impurities we must bring the cast iron in contact with a substance, either solid or gaseous, possessing more affinity for them than the iron itself, and here again heat is required for such reaction to take place. Oxygen has a very great affinity both for carbon and silicon, and in general for the other impurities present in cast iron, and it is upon this element that we shall depend for the elimination of the impurities. We may for that purpose use either atmospheric oxygen or the oxygen of some oxidizing substances. The oxidizing agents generally used besides atmospheric oxygen are rich iron ore or rich slag from some previous operation, or the slag produced in the refining operation itself. These substances are composed essentially of oxide of iron, which is an oxidizing compound, for it readily parts with some of its oxygen which is taken up by the carbon of the cast iron.

When cast iron in order to be purified is exposed at a sufficiently high temperature to the action of atmospheric oxygen or of some other oxidizing substance, the silicon which it contains combines with some oxygen, being converted to silica. Some of the iron itself will be oxidized and the resulting oxide of iron will in turn enter into combination with the silica to form a fusible silicate of iron or slag.

The carbon present in the cast iron also combines with some atmospheric oxygen, or more frequently with some of the oxygen held by the slag or by some iron ore purposely added, and is converted into carbonic oxide or carbonic acid gas, in which condition it escapes from the furnace. By being deprived of its oxygen the iron ore added in some of these refining operations is reduced to the metallic state and incorporated into the refined metal.

The Products of the Refining of Cast Iron.— As was the case in the treatment of the ore, the nature of the metal resulting from the refining of cast iron will likewise greatly depend upon the temperature at which the operation is conducted. If the temperature be low the refined metal will be obtained in a semi-fused or pasty condition, and will on that account include a relatively large amount of slag, while it will generally be quite free from carbon. In other words, the product of the refining operation conducted under these conditions will be wrought iron, or, if the conditions be made slightly more carburizing, steely iron. These are the conditions prevailing in the old forge refining of cast iron or "finery method," as well as in the more modern puddling process for the manufacture of wrought iron, which methods will be outlined briefly.

The Finery Methods for the Production of Wrought Iron.— When the ironmaster of the 13th or 14th century, through the gradual development in height of its catalan or other forge so increased the carburizing conditions that he finally obtained a small amount of molten cast iron, he was confronted with the necessity of refining this brittle, unforgeable metal in order to convert it into malleable iron, and he quite naturally endeavored to conduct this refining operation in furnaces similar to the low hearths or forges which for so many centuries had been the only apparatus used for the direct extraction of iron from its ores. In these forges, known as "fineries," the pig iron was melted in contact with charcoal and under the oxidizing influence of a blast issuing from a single tuyere. While the details of the finery operation and of the furnace differed much in various countries, and even in different sections of the same country, their essential features were identical. Four of these processes attained especial prominence and have not been entirely driven out of existence by the puddling process nor later by the Bessemer process; they are the Walloon process as still conducted in Sweden, the Franche Comté process, the Lancashire process still used in England, the United States, and some other countries, and the South Wales process which was for many years extensively used in South Wales for the production of iron plates for tinning. In recent years, however, soft Bessemer and open hearth steel have taken the place of wrought iron for such purpose and this once flourishing industry is now quite, if not altogether, extinct.

These charcoal hearths or fineries are frequently used for the remelting of iron and steel scrap resulting in the production of wrought iron of high quality. The operation consists in filling the hearth with charcoal, upon which the scrap is placed and covered with additional charcoal and the charge melted. The slag produced in this operation is very basic and therefore promotes the removal of the phosphorus and sulphur which are eliminated to a notable extent.

The iron manufactured or remelted in these hearths is mainly used for the manufacture of plates, sheets, skelp rods, etc., which are used in the manufacture of boiler tubes, boilers, screws, rivets, wire, etc.

According to J. M. Swank, the iron blooms produced in forges from pig iron and scrap in 1903, in the United States, and which were for sale and not for the consumption of the makers, amounted to 9,940 tons, against 12,002 tons in 1902, 8,237 tons in 1901, 8,655 tons in 1900, 9,932 tons in 1899, 6,345 tons in 1898, 7,159 tons in 1897, and 6,494 tons in 1896. All the pig and scrap blooms made in forges from 1895 to 1903, and for sale, were made in New York, Pennsylvania, and Maryland.

The Puddling Process.— The finery methods described in the preceding paragraphs were the only ones available for the conversion of cast iron into wrought iron until an Englishman by the name of Henry Cort invented the puddling process in the year 1784, a date which marks a very important epoch in the metallurgy of iron. It has been seen that in the finery processes the pig iron is heated in contact with solid fuel, and this necessitates the use of charcoal, because this fuel alone is sufficiently pure to yield wrought iron of good quality. If the attempt were made to use inferior fuels, such as coal or coke, it would be found that the iron absorbed so much impurity from the coal, notably sulphur, as to be of inferior quality. The necessity of using such an expensive fuel as charcoal, and a large amount of it, is a serious limitation of the finery processes, greatly increasing the price of the iron. To make the use of more impure but cheaper fuel possible, Cort proposed to conduct the refining of the pig iron in the hearth of a reverberatory furnace, that is, out of contact with the fuel itself, thereby preventing the contamination of the iron by the impurities of the fuel. In a reverberatory furnace the fuel is burnt in a separate fireplace, the substance to be treated coming ir contact only with the flames and gases resulting from the combustion of the fuel. In the puddling furnace, moreover, the labor required per ton of iron was greatly reduced and it was possible to treat in one operation a considerably greater amount of pig iron.

The puddling operation as originally conducted by Cort and others is now known as the "dry puddling process," while the more modern method of conducting the operation which involves some important alteration of the original method, is known as the "wet" or "pig boiling" puddling process. Only the latter will here be described.

The Wet or Pig Boiling Puddling Process.— In the original or dry puddling process, while the oxidation of the carbon, silicon, and other impurities was brought about to a certain extent by the oxide of iron formed during the operation, we depended mostly for their elimination upon the oxygen of the air, and this necessitates for reasons which cannot here be explained the use of white or refined pig iron. The modification about to be described was introduced into the puddling process for the purpose of making it possible to treat grey cast iron at once in the reverberatory furnace doing away with the preliminary refining operation and otherwise hastening the process. It is said to have been first used by Joseph Hall, of the firm of Barrows and Hall, of Tipton, England, about the year 1830.

The modern puddling furnace employed for the conduct of the pig boiling process resembles in its general lines the earlier puddling furnaces, the essential difference being in the nature of the lining of the hearth. The bottom of the hearth and the sides are made of iron plates which are protected by a thick layer of oxide of iron, called the "fettling" of the furnace. The substances used for fettling purposes consist of pure hematites (ferric oxide) crushed or ground to the desired size and of slags or scales obtained in the production or working of iron, and which are very rich in oxide of iron, such as roasted tap cinder or "bull-dog." This oxide lining, as previously stated, plays an important part in the operation by giving up a part of its oxygen to the carbon and other impurities present in the pig iron, thus greatly hastening their removal. From 300 to 500 pounds of grey pig iron are generally treated in these furnaces, frequently with the addition of some hammer scale, which consists of magnetic oxide of iron and which therefore help in oxidizing the impurities. The pig iron is now melted and becomes liquid without assuming the pasty condition characteristic of white pig iron. During the melting down period a large proportion of the silicon is oxidized and some of the carbon chiefly by the oxygen of the air. Some iron also is oxidized and slag formed, while owing to the removal of silicon the remaining carbon passes to the combined condition.

The bath is constantly stirred or "rabbled" so as to promote contact of all portions with the oxidizing lining and with the iron oxide of the slag, thus hastening the oxidation of the silicon and carbon. As the carbon is expelled the mass becomes pasty, the metal having now "come to nature." The spongy mass of wrought iron is then divided into balls weighing some 60 pounds, which are withdrawn from the furnace and worked in the usual way.

The whole operation lasts usually about 1½ hour, but may be longer or shorter, according to the purity of the metal treated. The loss varies from 7 to 20 per cent, being chiefly dependent upon the amount of impurity in the pig iron. According to Turner, the consumption of coal in the puddling furnace per ton of puddled bars amounts generally to about 2,600 pounds. The following interesting comments are from Prof. H. M. Howe:

"While the yearly production of wrought iron in the United States more than doubled between 1870 and 1890, yet since the latter year it has shrunk very much, probably nearly to that of 1870; and between 1870 and 1900 the proportion which the production of wrought iron bears to that of steel diminished very greatly. Of the combined annual production of wrought iron and steel in the United States that of wrought iron formed 95 per cent in 1870, 63 per cent in 1880, 37 per cent in 1890, and probably not far from 15 per cent in 1899. The corresponding numbers for Great Britain are 34 per cent for 1890 and 19 per cent for 1899, and 16 per cent for 1901. In the year 1899 the average number of British puddling furnaces in operation is reported as 1,149 out of a total of 1,320 in existence. Thus in 19 years the position of wrought iron changed from that of the chief product to one of secondary importance."

Albert Sauveur,
Assistant Professor of Metallurgy, Harvard University, and Editor of 'The Iron and Steel Magazine.'

Iron and Steel Industry in America. The iron of commerce is classified under three groups. These are "wrought iron," "steel," and "cast" or "pig iron."

In the colonial period the British government systematically discouraged all efforts of the colonists to produce iron, in order to avoid competition with home industries. There were forges or bloomeries in nearly all the colonies from the times of earliest settlement, and as unlimited supplies of fuel were always at hand in the vast forests it was only necessary to find ore and obtain persons who could construct forges. The iron required for structural purposes, such as bars, straps, nails, sheets, etc., was obtained in the early days either by hammering the bloom from the forge or by shaping with rolls propelled by water-power. In fact, before the invention of the puddling process in England by Cort, in 1784, a large proportion of all forms of wrought iron were derived in this manner. The old so-called "Walloon" process of refining pig iron into the malleable or wrought form or into a crude mild steel was introduced into the colonies at an early date in their history. By the puddling process malleable iron is not directly produced from the ore, as in the older methods of manufacture, but indirectly from pig iron. The introduction of the puddling process was second in importance to no other invention in the history of the iron industry of this country.

After the Revolution the iron industry developed steadily but slowly, probably owing to the fact that, as in colonial days, much, if not most, of the iron used along the seaboard was imported. No statistics of the production of iron were collected before the year 1810. The production of pig and cast iron in that year was 53,908 tons; wrought and malleable iron of all kinds, 27,105 tons; having a total value of $6,081,374, of which amount Pennsylvania produced $2,473,748. The product of the steel furnaces of Massachusetts, Rhode Island, New Jersey, Pennsylvania, Virginia and South Carolina in 1810 was 917 tons, valued at $144,736; of the whole number of steel furnaces Pennsylvania contained five, producing 531 tons, valued at $81,147. An analysis of these figures gives us some idea of the state of the industry at the beginning of the century. The product of the blast-furnaces — pig, or, as it was at that time termed, cast iron — was run directly into small castings then in demand for commercial purposes; the malleable iron was probably all derived directly from the ore in forges or bloomeries, whence it was taken to the rolling or slitting mills to be made into rods, bars, plates, nails, etc. The steel made at this period in the United States was probably all produced by the cementation or blister process, and was all of the grade now known as high-carbon or tool steel. Although Huntsman's improvement of this process, by which the steel bars thus made were fused in crucibles and subsequently cast into ingots, had been in operation in Sheffield, England, a number of years prior to 1810, it is doubtful if his invention had been adopted in the United States at this early date. In the census of 1820 the quantities of iron made are not given; their value, however, is stated as follows: Pig or cast iron, $2,230,275; wrought iron, $4,640,669; total, $6,870,944. The 1830 census gave: Pig iron and castings, $4,757,403; wrought iron, $16,737,251; total, $21,494,654. The production of iron steadily increased upon much the same lines as before and in 1840, 804 blast-furnaces produced only 286,903 tons of iron, and 795 bloomeries, forges, and rolling-mills only 197,233 tons of malleable or bar iron. For the first time in the history of the industry the production of cast or pig iron exceeded that from the bloomeries and forges. No figures are published for the value of the product in 1840, but if we assume the ton of pig iron to have cost $30, and the ton of hammered bar iron $90, we obtain $8,607,090, or nearly double the value of pig and cast iron produced in 1830. The total value of the bar iron at this estimate would be $17,750,970.

The high cost of manufacturing charcoal, and its enormous consumption in the furnace per ton of iron produced, were serious obstacles to the growth of the industry, even where a good supply of ore was well assured. As early as 1835 the adaptation of anthracite to the manufacture of iron began to attract attention, and Franklin Institute offered a gold medal "to the person who shall manufacture in the United States the greatest quantity of iron from ore during the year, using no other fuel than anthracite coal, the quantity to be not less than 20 tons." The medal was never awarded, but there is abundant evidence that from 1830 to 1840 a number of attempts to use mineral fuel in smelting iron ores were made. The first practically successful attempt to produce pig iron by the use of anthracite was made by David Thomas at Catasauqua, Pa. The furnace which he erected there for this purpose was blown in on 3 July 1840. It was equipped with a "hot blast" operated by water-power, and thus inaugurated in the United States, two of the greatest innovations in blast-furnace practice. This furnace, producing from the start 50 tons of iron per week, continued in profitable operation until the year 1879, when it was dismantled. The early forms of hot-blast apparatus consisted of nests of iron pipes heated externally by separate fires, the object being to pass the air from the blowing- or blast-engine through these pipes, thereby greatly augmenting its temperature, and to decrease the consumption of fuel per ton of ore smelted. The hot blast was patented in 1828 by James B. Neilson of Glasgow, and its use is perhaps the most important improvement ever made in blast-furnace practice, for without it the present large and cheap production of pig-iron would have been impossible. Notwithstanding that the success in smelting iron in blast-furnaces with anthracite had been practically demonstrated in 1840, the general use of this fuel appears to have grown slowly; it was 10 or more years before the use of coal (either anthracite, coke, or a mixture of the two) became general. In 1846 the first furnace constructed with the intention of using raw bituminous coal as fuel was successfully placed in operation at Lowell, Mahoning County, Ohio. Although coke had been in general use in England for a number of years, it was not until 1837 that it was successfully used in the United States in the blast-furnace at Lonaconing, Alleghany County, Md. The manufacture of Connellsville coke was commenced in 1841, but, according to Weeks, it was not until a number of years later, when railroad transportation had become more fully developed, that its value as a furnace fuel became thoroughly demonstrated. The period between the years 1840 and 1850 was a most eventful one in the history of the American iron industry. The introduction of the improvements in smelting already indicated, together with the use of steam-power for propelling the blast and in performing other varieties of work about the furnaces, its replacement of water-power in operating rolling-mills and hammers, in mining coal and ore, and the rapid growth of the railroads, produced a stimulating effect probably never before experienced in a similar degree by any American industry. The railroads contributed largely to the development of the iron industry in two ways: directly, by rendering transportation comparatively cheap, thereby enlarging the iron market and increasing the demand; and indirectly, by creating in their construction a new and unprecedentedly large consumption of iron. As the production of iron increased in later years, the older iron-ore deposits became exhausted, or were proved inferior to the newly discovered ore-beds of the Lake Superior region. The problem of suitably locating a modern blast-furnace producing from 9,000 to 10,000 tons of pig iron per month became a serious one, and its solution has had the effect of moving the geographical centre of the iron industry west of the Alleghany Mountains, nearer a new and larger ore supply, yet handy to the coke of Connellsville. In 1850 there were produced in the United States 563,755 tons of pig iron by 377 establishments, and wrought iron to the value of $22,629,271 in 552 establishments.

The evolution of iron and steel plate making, particularly boiler-plates, forms an interesting chapter in the growth of our great industry.

About 1815, when steam began to be used, Dr. Charles Lukens remodeled his mill to produce thicker plate. The bloom was reheated at the forge and hammered thin, usually about one and a half inches. It then went to the rolling-mill, where it was laid on a bed of coal in what was called a grate-furnace. After heating, it was rolled into plates one quarter and three sixteenths of an inch thick and sent to the boiler maker. But soon the mill began shearing into regular commercial sizes: 48 and 49 by 26 by one quarter or three sixteenths; or, if large enough, it was sheared into plates 68 and 69 by 26, and the scrap was cut into nails. But when the reverberatory furnace was introduced, the scrap was arranged into piles of such size as was necessary to produce the required plate, heated to a welding heat, and rolled in the mill. This state of things continued until the introduction of the puddling furnace. The most important advances made in the years between 1850 and 1860 were the invention of the "three-high" roll-train; the introduction of mills for rolling beams, by Cooper & Hewitt, at Trenton, N. J.; and the invention in 1848 of the "universal mill," by Daelin, a German engineer, which found its way to America 12 years later. In the manufacture of the finer qualities of steel, no progress was made up to 1860. According to the census of 1860, 97 establishments in the United States produced 51,290 tons of blooms, valued at $2,623,178; 286 establishments produced 987,559 tons of pig iron, worth $20,870,120; 256 establishments produced 513,213 tons of rolled iron, worth $31,888,705; 13 establishments produced 11,838 tons of steel (probably of cheap grades), worth $1,778,240.

During the Civil War the resources of the iron industry in the Northern States were taxed to their utmost. The industry in the South, strained at an early day beyond its feeble capacity, soon broke down, and most of the requirements of the Confederate armies were supplied from abroad. In the train of dire disaster wrought by the Civil War some good to the iron industry may be found; for not only did iron ships make their appearance in the navy, but the use of iron plates had its inception. As early as 1859 the French had built the frigate Gloire, armored with iron plates five inches in thickness, and in 1861 the British constructed the frigate Warrior, which was protected by solid iron plates four and a half inches thick. As regards armor, either of these vessels was much better protected than any of our monitors constructed during the Civil War, for the first monitor was protected by six to eight thicknesses of one-inch iron plates bolted one on the other with overlapping joints, and later vessels were probably protected in much the same way by armor made up of a greater number of similar one-inch plates.

In 1855 and 1856, Henry Bessemer, of London, had obtained patents for a process of converting molten pig iron into steel by forcing small jets of cold air through the molten iron; but his invention was not successful until modified by Robert F. Mushet, who added to the molten steel, after the blast had been stopped, a sufficient quantity of spiegeleisen (an alloy of iron and manganese) to neutralize the oxide of iron caused by blowing and to give the steel the proper degree of hardness and fluidity. Neither Bessemer nor his American rival, William Kelly, of Pittsburg, who secured a patent but did not utilize it, accomplished anything in America until 1866, when their interests were combined with Mushet's and the first plant to produce the steel as a commercial article was put in successful operation by the Pennsylvania Steel Company at Steelton, near Harrisburg, Pa., June 1867. The first steel rails rolled in the United States in the way of regular business were rolled by the Cambria Iron Company, Johnstown, Pa., August 1867, from ingots made by the Pennsylvania Steel Company. The production of Bessemer steel in the year 1867 was 3,000 tons, the industry continuing to grow with rapid strides. In 1890, 4,131,535 tons were produced, in 1900 7,532,028 tons, and in 1902 9,138,363 tons. Of these amounts 2,550 tons were made into rails in 1867, 1,853,862 in 1890, 2,250,457 in 1900, and 2,935,392 tons in 1902. The importance of the invention of the Bessemer process to the world in general and the United States in particular cannot be overestimated, since it has reached a development with us greater than in any other country in the world. In 1901 the total amount of all varieties of steel made in the United States was 44 per cent of the entire world's product. The rapid and enormous development of the Bessemer-steel industry in the United States is attributable chiefly to the great extension of our railroads. Bessemer steel is also used for steel bars, merchant steel and for tin plates. The basic Bessemer or Thomas process though used in Germany to produce 4,888,054 tons in 1902, has not gained a foothold in this country.

The open-hearth steel process was first used in 1856, when the Siemens Brothers of London perfected what is now generally known as the Siemens regenerative gas-furace, without which no open-hearth steel can be made. In 1864, Messrs. Emile and Pierre Martin, of the Sireuil works in France, erected, with the assistance of Dr. Siemens, one of the regenerative gas-furnaces to convert steel in an open-hearth or reverberatory furnace of their own construction. This scheme was a success from the start, and by a subsequent consolidation of the Siemens and Martin inventions a steel-making apparatus was devised, known as the Siemens-Martin or open-hearth process. This process was introduced into America in 1868 by F. J. Slade for Cooper, Hewitt & Company, at the works of the New Jersey Steel and Iron Company, at Trenton, N. J. In 1870 the production of open-hearth steel in the United States was 1,500 tons, and in 1890 574,820 tons, the industry showing a rapid development during the intervening 20 years. Great Britain was long the largest producer of open-hearth steel in the world, and in this branch of the iron industry the United States was somewhat behind its great rival, until 1900. In 1890 Great Britain produced 1,564,200 tons, as against 574,820 tons in the United States; in 1899 Great Britain produced 3,030,251 tons and the United States a little more than 2,900,000 tons; but in 1900 the figures are 3,398,135 tons for the United States (following James M. Swank, 'Iron and Steel at the Close of the 19th Century,' 1901; the census figures, always incomplete, are 3,044,356) and 3,156,050 for Great Britain. This growth is all the more striking when it is known that in 1895 the writer of this article hopefully prophesied that the production might reach in that year 1,000,000 tons. Five years later it had passed the 3,000,000-ton mark. The so-called "basic" open-hearth process, although in successful operation in Europe for a number of years, was not introduced into the United States until 1888, when a number of such furnaces were constructed at the works of Carnegie, Phipps & Company, at Homestead, near Pittsburg, Pa. Without going into technicalities, the basic open-hearth process may be briefly defined as an ordinary open-hearth plant whose furnace lining is made of a basic material, such as dolomitic limestone or the mineral magnesite. When pig iron containing a sufficiently great quantity of phosphorus to render it unfit for conversion into steel by any other method is melted in such a furnace, the basic lining, together with a basic flux which is added, removes the objectionable phosphorus and renders (other conditions being normal), the resulting steel equal to that prepared in the open-hearth furnace in the old and usual manner. The purposes for which open-hearth steel is ordinarily adapted are quite different from those for which the Bessemer steel is most suitable; but the converse of this fact, however, is not true, since open-hearth steel may be and frequently is used to an equal, if not greater, advantage wherever Bessemer steel is employed. In this country, at least, all high-grade structural material, such as boiler and ship plate, bridge and building members, high-grade castings, etc., is almost invariably of open-hearth steel, which is generally considered, and doubtless is, more uniform in quality than soft steel made by the Bessemer method.

One of the most curious phases in the history of the American iron industry is the fact that although the United States at one time consumed nearly 60 per cent of the world's entire production of tinned plates, with the exception of a few sporadic attempts in 1873 and 1875, no tin or terne plates were made in the United States until 1891. Great Britain furnished virtually all the tin-plate used in the United States during the 20 years ending 1890. No better evidence of the success of our domestic tin-plate industry could be afforded than the fact that our imports have steadily decreased since 1889, those for 1890 being 29,435 tons, for 1894 215,068 tons, and for 1900 only 60,386 tons. The American production amounted to 999 tons in six months of 1891; to 6,092 tons in 1892; 44,563 tons in 1893; over 100,000 tons in 1895, and in 1900 to 302,665 tons. The census of 1900 reports 57 establishments manufacturing tin and terneplate; gives their capital as $6,650,047, its wage-earners as averaging 3,671, and their wages as $1,889,917; and estimates the cost of materials at $26,728,150, and the value of the product as $31,892,011. In 1890 the industry was practically non-existent and was not reported in the census of that year.

If the history of the development of the American blast-furnace practice were written it would form a large book of itself. In 1870 most of the blast-furnaces in operation were still very primitive, and although no statistics for that year are given, it is probable that the best of them did not produce as an average over 50 tons of pig iron per day, whereas in 1902 the production of 300 tons per day was a common occurrence, and some furnaces regularly produced over 500 tons daily. The table at the bottom of the page taken from the United States census reports, exhibits the production of pig iron from 1870 to 1900.

These figures show the rapid fall in the number of establishments, resulting from the movement of concentration nowhere so strikingly shown as in the steel and iron industry. The capital invested has increased 150 per cent approximately in 30 years, the production nearly 700 per cent and the value of the product almost 200 per cent. During the 20 years between 1870 and 1890 production in the Middle States had nearly quadrupled, in the Western States increased nearly 5 times, and in the Southern States nearly 10 times. In 1890 the American product passed the record figures of the British furnaces, made in 1882. Between 1890 and 1895 the American trade suffered considerably and fell below the British in its total product; then it again advanced and is now 100 per cent greater than that of Great Britain.

The wonderful growth of the world's iron industry within 50 years is shown by the following tables, in metric tons (2,204 pounds).

Country	1854	Per cent	1902	Per cent
United States	750,000	12.5	18,003,448	40.7
Great Britain	3,000,000	50.0	8,653,976	19.5
Germany	400,000	6.6	8,402,660	19.0
France	750,000	12.5	2,427,427	5.5
Russia	200,000	3.3	2,566,000	5.8
Austria-Hungary ..	250,000	4.3	1,335,000	3.0
Other countries ..	650,000	10.8	2,869,480	6.5
Totals...........	6,000,000	100.0	44,257,991	100.0

Even more striking is the increase in steel output in the last 35 years, as shown below:

Country	1867	Per cent	1902	Per cent
United States	19,963	4.1	15,186,406	44.0
Great Britain	235,000	47.8	5,102,420	14.8
Germany	122,591	26.0	7,780,682	22.5
France	47,597	9.7	1,035,304	4.8
Russia	6,271	1.3	1,730,250	5.0
Austria-Hungary...	15,000	3.1	1,143,000	3.3
Other countries ...	35,000	7.1	1,900,82[illegible]	5.6
Totals..........	491,422	100.0	34,479,783	100.0

PRODUCTION OF PIG IRON.

	1870	1880	1890	1900
Number of establishments..........	386	341	304	224
Capital	$56,145,326	$89,531,362	$134,608,543	$148,226,113
Wage earners....................	27,554	41,695	33,415	39,358
Total wages.....................	$12,475,250	$12,665,428	$14,614,458	$18,500,462
Tons produced...................	1,832,876	3,375,912	8,845,185	14,452,234
Cost of materials................	$45,498,017	$58,619,742	$110,098,615	$131,536,424
Value of product.................	$69,640,498	$89,315,569	$145,643,153	$206,823,202

The total iron and steel exports and imports of the United States for the years 1890, 1900, and 1902 are shown below, the totals being long tons (2240 pounds).

Year	Exports	Imports	Excess
1890	45,687	603,749	Imp. 558,062
1900	1,154,284	209,955	Exp. 944,329
1902	370,805	1,212,839	Imp. 842,034

A sketch of the American iron industry would be incomplete without some reference to the introduction of the manufacture of armor-plate into the United States. This class of material not only has a peculiar and limited demand, but its manufacture requires the highest degree of metallurgical and mechanical skill, together with an exceptionally expensive plant. When the reconstruction of the United States navy was begun, some 20 years ago, we had absolutely no facilities for making the simplest kind of armor-plate, although we had some of the largest steel-works in the world. One of the first of the new armored vessels completed (the monitor Miantonomoh) was protected by "compound" plates imported from England. All the large forgings for the guns and shafts of the earlier ships were likewise imported. Owing to the policy of Congress, the Bethlehem Iron Company, and Carnegie, Phipps & Company, of Pittsburg, were induced to erect expensive plants necessary for making not only the heavy gun-forgings required, but also for all the different grades and thicknesses of armor-plate. In 1891 these firms began to supply armor for the ships in course of construction, although at first their output of finished armor was extremely slow. The delays have now been slowly overcome, and at the present time there is little doubt that these great steel-works will be able to supply the armor as fast as new ships are constructed. How successful these works have been in furnishing our government with the best grades of armor-plate could have no better illustration than the fact that the Bethlehem Iron Company soon began supplying foreign governments with armor for their ships. The only two important iron and steel commodities which the iron industry of the United States did not supply in 1890 (tin-plate and armor-plate) are at present being made in large quantities, and the census for 1900 reports during the year 1900 15,302 tons of armor plate all produced in Pennsylvania, and valued at $7,526,479. Vast improvement has been made in the machinery necessary to manipulate iron and steel. The Bethlehem Iron Company has a hammer of 125 tons' capacity, built by John Fritz and put into successful operation in 1891. But armor-plate is no longer rolled nor forged by hammers, but manufactured with huge hydraulic presses, some with an energy of 15,000 tons. George Fritz is the inventor of what is known as the "automatic tables," which with John Fritz's roll train enables the manufacturer to successfully handle almost any weight of ingot. I well remember when a 500-pound mass of iron was thought to be so heavy that the whole neighborhood gathered in to see it rolled. The necessity of handling such very heavy weights as could be made from ingots cast in large masses brought into play the invention of hydraulic machinery, so that we now have pumps to produce any required pressure in a series of pipes which deliver the water to the hydraulic engines in any part of the works. By simply turning a valve now a boy will pick up a heavy ingot (say of 10,000-pound weight) with his hydraulic crane and deliver it anywhere within reach of the crane. If on a car, it may then be taken by a small locomotive to the rolling-mill, where another crane picks it up and puts it into the furnace, and, after heating to the required degree, takes it out and delivers it to the machinery at the rolls; then the automatic tables push it back and forth through the rolls until it is reduced to the required dimensions. The same tables now take it to the shears, which are also operated by hydraulic power, and the plate, sometimes two inches thick, is sheared ready for shipment. All this is done with more ease than was possible a few years ago. Within the last few years electricity has been brought into play to do some of the heavy work.

Revised by S. Sanford,
'Engineering and Mining Journal,' *New York.*

Iron and Steel, Metallography of. The study of the structure of metals has been actively pursued for the last 10 or 15 years in all metallurgical countries, and has called into existence a new department of metallurgy, for it has been shown that all alloys and all industrial metals (which always contain a certain amount of impurities), are made up of constituents which may be regarded as minerals, and as the study of rocks created the science of petrography, from the study of the constitution of metals was developed the new science of "metallography."

In order to examine the structure of metals through the microscope, it is necessary to prepare surfaces almost absolutely free from the minutest scratches. To accomplish this, it is quite evident that the sample must be rubbed successively over various abrasive substances of increasing fineness. Supposing the surface to be examined has been filed with a smooth file, the tool marks would not be removed and a perfectly specular condition could not be imparted to the surface in a single operation. The transformation must be gradual. The file marks must be effaced by rubbing the sample over a properly selected polishing substance, and replaced by finer markings. These, in turn, must be removed by a second rubbing with a finer abrasive agent, being replaced by still finer marks and so on, until finally, the last operation removes the very minute marks from the previous treatment and leaves the surface absolutely free from scratches or nearly so. Emery powder of various degrees of fineness is the abrasive substance which naturally suggests itself, at least for the first treatments. The powders may be used in the shape of emery wheels, emery cloths, or papers, or even spread loose over a suitable support, in which case they are kept wet during the rubbing. Emery may, of course, be replaced by carborundum for these operations. The polishing powder known as "jeweler's" or "gold" rouge suggests itself for the final polishing. It is generally spread over a piece of wash leather or other soft and smooth texture, which in turn is fastened to a block of wood. The powder is generally kept wet during the rubbing. The details of the manipulation vary greatly with different operators, but it may be said that they all use emery (or carborundum) in some form for the rough polishing and jeweler's rouge for the final treatment. The markings left even by the finest emery powders, however, cannot always be removed readily by the rouge, and the operation is frequently a long and tedious one. The need of a suitable polishing powder to be used after the last emery treatment and before the final rouge polishing was soon made evident and many substances, such as water-of-Ayr stone, crocus, tripoli, diamontine, "Brilliant Belge," etc., have been tried. It is in this particular that the polishing methods of the various experimenters engaged in metallographic work vary the most. Somewhat roughly stated, the method at present in use for the preparation of metallic samples, is in most cases as follows:

One or more treatments with emery (or carborundum) of increasing fineness.

One treatment with one of the powders mentioned above.

One treatment with jeweler's rouge.

The polishing may be done entirely by hand, or it may be hastened by the use of some simple power-driven machine consisting of revolving emery wheels and discs upon which the various powders are spread.

Many treatments have been tried to develop the structure of polished samples of iron and steel, *i. e.*, to make their structure apparent when examined under the microscope. To do this, it is necessary to impart unlike appearances to the various constituents. The most successful methods and those most widely used consists in etching the polished surfaces with highly diluted aqueous solutions of acids, especially nitric acid or with absolute alcohol containing a small proportion of acid, a solution made up of 10 parts of nitric acid in 90 parts of absolute alcohol being especially effective.

Microstructure of Pure Metals.—When a properly prepared sample of a pure metal is examined under the microscope it is generally found to be made up of irregular polyhedric grains as shown in figure 1, which represents a drawing of the structure of pure gold under a magnification of 50 diameters.

It will be noticed that many of the grains are hexagonal, which strongly suggests that gold crystallizes in the regular cubic system, these hexagonal grains being probably due to interfering cubes and octahedra.

Many pure metals, including iron, crystallize in the cubic system, and exhibit, therefore, a structure similar to that of gold.

The dark net work shown in Fig. 1 mark the junction lines between adjacent grains. It is made apparent by suitable treatment of the polished surface, generally by immersing it in some acid, the acid corroding the metal more deeply between the grains than over their surface.

These grains of which pure metals are composed are not single-crystals. If the polished sample be etched more deeply and examined under higher power, it will be found that each grain is made up of a great number of small crystals, frequently cubic. It will be found, moreover, that all these small cubes which make up a single grain are oriented in the same direction in the same grain, but that their direction changes as we pass from one grain to another.

The size of the grains varies with the nature of the metal, some metals being made up of much larger grains than others, even when cast and solidified under exactly the same conditions.

The presence of impurities, sometimes of an extremely small amount, frequently exert a powerful influence on the size of the crystalline grains, some impurities increasing it, others reducing it.

The size of the grain in the same metal is also greatly affected by the temperature to which the metal is heated and from which it is allowed to cool, and by the rate of cooling. Generally speaking, it may be said that the higher the temperature, the larger the grain, and also that the slower the cooling the larger the grain. These results might have been anticipated, if it be considered that slow cooling from a high temperature are conditions favorable to the formation and growth of crystals.

Undisturbed cooling is a necessary condition to the free development of crystals. If

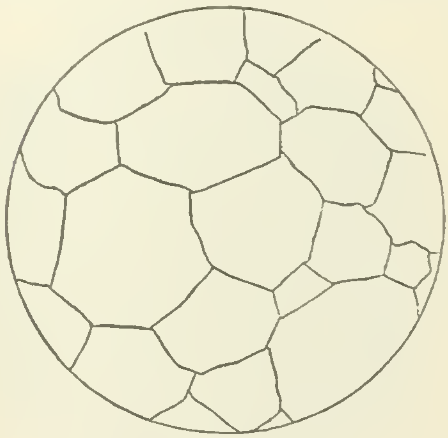

Fig. 1.—Structure of Pure Gold (Andrews) Magnified 50 Diameters.

the metal be agitated while solidifying, and worked—that is subjected to powerful mechanical pressure—while cooling from a high temperature, the formation of the crystalline grains will be greatly hindered, if not altogether prevented, the metal assuming an amorphous-like structure, hence the important influence of work upon the structure of metals.

The Microstructure of Pure Iron.—Pure iron is not a commercial product. It can only be obtained in small quantities by carefully conducted laboratory manipulations, and even with the most refined care it is quite impossible to produce it absolutely pure. The purest commercial iron is of Swedish origin and may contain as much as 99.8 per cent. of iron.

When a sample of this iron is properly prepared and examined under the microscope, some regions may be found which are absolutely free from slag and from carbon, and which exhibit, therefore, the crystalline structure of pure iron, or, at least, of carbonless iron. (See Fig. 2.) It will be noted that this structure is very similar to that of gold shown in Fig. 1. Like gold, it is made up of polyhedric grains, generally hexagonal. Iron, like gold and like many other metals crystallizes in the cubic system.

Ferrite.— Pure iron, or rather carbonless iron, considered as a microscopical constituent, has been called ferrite, a name which suggests its nature and which was proposed by Prof. Henry M. Howe. This constituent necessarily makes up the whole mass of carbonless iron, while in low carbon steel and in gray cast iron, ferrite occurs in decreasing amounts as the percentage of combined carbon increases.

The physical properties of ferrite are evidently those of carbonless iron. It is, therefore, soft, being easily scratched by a needle, a test which will occasionally be found useful by the metallographist. It is moderately strong, having a tensile strength of some 50,000 pounds per square inch. It is very ductile, its elongation amounting to 20 or more per cent. in eight inches. Ferrite does not possess any hardening power since carbonless iron cannot be hardened by sudden cooling from a high temperature.

The Microstructure of Commercial Wrought Iron. Longitudinal Section.—The microstruc-

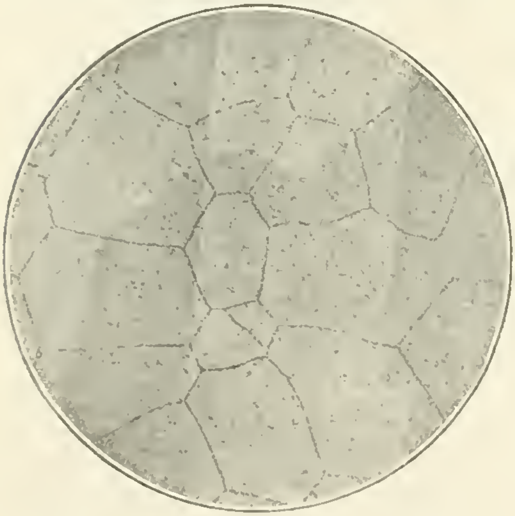

Fig. 2.—Structure of Carbonless Iron. Magnified 150 Diameters (Longmuir) Ferrite.

ture of the longitudinal section of a wrought iron bar is shown in the accompanying illustration (Fig. 3). The ground mass or matrix of the metal will be found to be made up of polyhedric crystalline grains similar in every respect to the crystalline grains of pure iron and of pure metals in general. Many irregular black lines, varying much in thickness and length, but all running in the same direction, will also be noted in Fig. 3. These lines indicate the location of the slag which is always present in commercial wrought iron, and which assume the shape of streaks or fibres running in the direction of the rolling or forging, thus imparting a fibrous appearance to the metal. Wrought iron then is made up of a mass of ferrite, as might have been anticipated, assuming its characteristic crystalline structure, and of numerous elongated particles of slag.

It was thought for many years that wrought iron actually had a fibrous structure, and, indeed, the number of persons who still hold this view is surprisingly large. Many valuable properties were attributed to puddled iron on account of its "fibrous structure" which were denied to steel because of the "crystalline structure" of that metal. The microscope has summarily disposed of this erroneous belief in showing that the ferrite which constitutes the bulk of wrought iron is in no way different from the ferrite forming the bulk of low carbon steel. Both are equally crystalline.

When wrought iron contains an appreciable amount of carbon it results in the appearance of another constitutent, soon to be described.

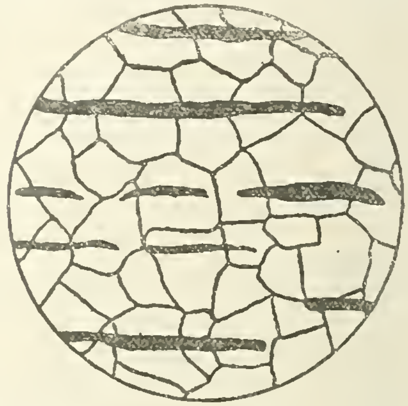

Fig. 3.—Structure of a Longitudinal Section of Wrought Iron (Longmuir) Ferrite and Slag.

Transverse Section.—The microstructure of the transverse section of a wrought iron bar is shown in Fig. 4. Like the structure of a longitudinal section (Fig. 3), it consists in a

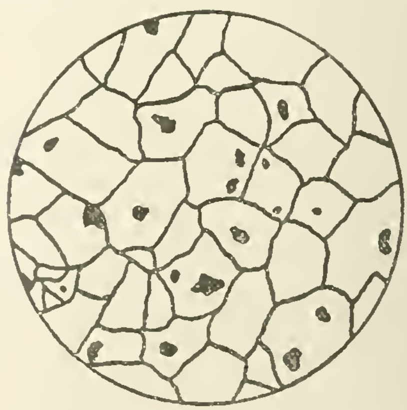

Fig. 4.—Structure of a Transverse Section of Wrought Iron (Longmuir) Ferrite and Slag.

mass of crystalline grains of ferrite. The slag, however, which in the latter section occurred as fibres running in a direction parallel to the rolling, here assumes the shape of irregular, dark areas, which correspond to the cross-sections of the slag fibres.

The Microstructure of Low Carbon Steel.—If a small amount of carbon be introduced into molten iron and the resulting product cast, the metal is converted into what is known as low carbon steel. From the fact that it was obtained in a molten condition it will follow that, unlike wrought iron, it is quite, if not altogether, free from slag. The absence or presence of slag constitutes the most distinct difference between wrought iron and low carbon steel, for these two metals may otherwise have identical chemical composition and very similar, if not identical, physical properties.

The microstructure of a very low carbon steel is illustrated in Fig. 5. It will be noted that it consists in a mass of ferrite; that is, of carbonless iron, made up of polyhedric crys-

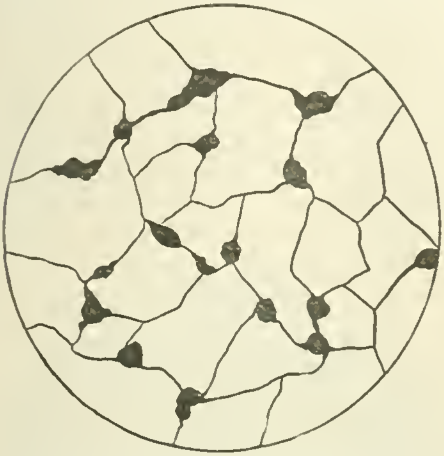

FIG. 5.—Structure of Low Carbon Steel. Carbon 0.08 per cent (Arnold) Ferrite and Pearlite.

talline grains and very similar to the ferrite constituting the bulk of wrought iron. At the junction lines of many ferrite grains, however, some dark areas will be seen, which indicate the presence in the metal of another constituent. Since ferrite does not contain any carbon, it is evident that all the carbon present in the steel has segregated into these small dark masses, and thus we arrive at the interesting

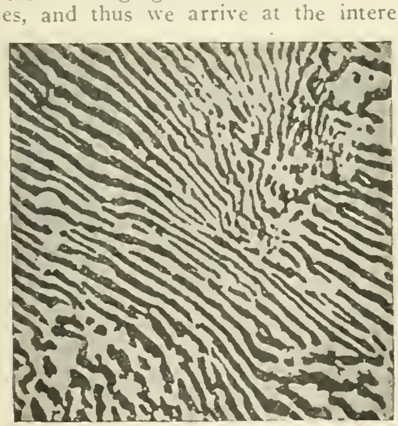

FIG. 6.—Structure of Pearlite Highly Magnified (Osmond).

conclusion that in low carbon steel the carbon is not disseminated all through the mass, as might reasonably have been expected, but that it gathers in small particles embedded in a mass of iron.

Pearlite.—Speculating as to the nature of this new constituent, we know that it cannot consist of pure carbon; for it is known that the carbon present in steel does not exist in the free state, but is combined with some iron, forming the carbide or iron Fe_3C. This iron carbide must necessarily be located in the dark areas, but are these made up exclusive of this carbide? To assist us in determining the character of this constituent, let us examine it under a high magnification. We then find that each dark particle breaks up into two components (Fig. 6), which occur as small parallel plates alternately bright and dark. As to the nature of these components, it is evident that one of them is the carbide Fe_3C and the other must necessarily be iron or ferrite; for these are the only two constitutents which, to the best of our knowledge, are present in unhardened steel.

Dr. Sorby, who was the first observer to describe the appearance of this interesting constituent, proposed for it the name of "pearly constituent," because it frequently exhibits a display of color very suggestive of mother of pearl, especially when viewed by oblique illumination. Later Prof. Howe suggested the name of pearlite, which has been universally adopted.

FIG. 7.—Structure of Medium High Carbon Steel. Carbon 0.38 per cent (Arnold) Ferrite and Pearlite.

Cementite.—The carbide Fe_3C has been called cementite, also by Prof. Howe, because it occurs abundantly in cemented steel, merely owing to the fact that this steel is generally a high carbon steel. Pearlite then is a mechanical mixture of ferrite and cementite after the fashion described in the preceding paragraphs.

It should be stated here that pearlite does not always assume such a distinctly laminated structure. In many instances its structure remains ill-defined or assumes a granular rather than a lamellar appearance, this being due chiefly to the treatment to which the steel has been subjected.

A high magnification is required for the resolution of pearlite, generally not less than 200 diameters. The samples should also be very carefully etched.

The Microstructure of Medium High Carbon Steel.—The microstructure of a steel containing 0.38 per cent. of carbon is illustrated in Fig. 7 under a magnification of 100 diameters. It will be noted in comparing this structure to that of low carbon steels (Fig. 5), that the introduction of more carbon in the iron has resulted, as should be expected, in the presence of a greater amount of pearlite and of a correspondingly smaller proportion of ferrite. The pearlite occupies now roughly about one-third of the total area. Under sufficiently high power the pearlite areas exhibit the characteristic lamellar structure illustrated in Fig. 6.

On further addition of carbon, the amount of pearlite, which is evidently proportional to the percentage of carbon, increases correspondingly, as shown in Fig. 8, which illustrates the microstructure of steel containing about 0.59

Fig. 8.—Structure of Medium High Carbon Steel. Carbon 0.59 per cent (Arnold) Ferrite and Pearlite.

per cent. of carbon. The pearlite occupies here over one-half of the total area. It will be noted that the ferrite areas are not resolved into polyhedric grains, apparently because the ferrite now occurs in particles often too small to be made up of several crystalline grains. The

Fig. 9.—Structure of High Carbon Steel. Carbon 0.89 per cent (Arnold) Pearlite.

internal structure of these small masses of ferrite, however, is still made up of small cubic crystals as previously described. A high-power photomicrograph of this steel would reveal the laminations of the pearlite shown in Fig. 6.

The Microstructure of High Carbon Steel.—It has been shown that the introduction of an increasing amount of carbon in steel results in the formation of a correspondingly increasing proportion of pearlite and decreasing amount of ferrite. A degree of carburization, therefore, must necessarily be reached, when the whole mass will be made up of pearlite, the ferrite having finally disappeared. This critical point in the structure of steel is attained when the metal contains about 0.80 per cent. carbon. In exceptionally pure steel a little more carbon may be required to cause the complete disappearance of ferrite, while in the presence of much impurity a smaller percentage may be sufficient.

Steel made up exclusively of pearlite is sometimes said to be saturated, it is also called "eutectic," or "eutectoid," steel, the latter term having recently been suggested by Prof. Howe. If it contains less than 0.80 per cent. carbon, and, therefore, an excess of ferrite, it is called under-saturated or "hypo-eutectoid" steel, while if it contains more than this amount of carbon

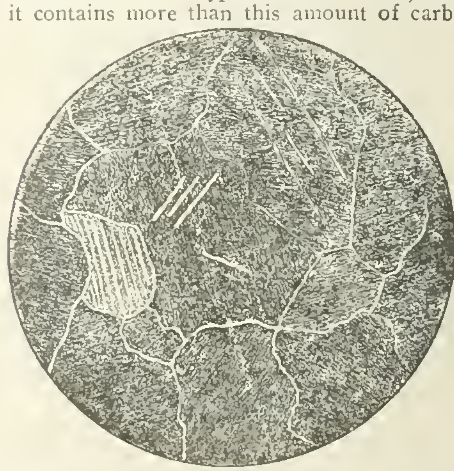

Fig. 10.—Structure of High Carbon Steel. Carbon 1.20 per cent (Arnold) Pearlite and Cementite.

(and therefore, as will be seen, an excess of cementite) it is called over-saturated or "hyper-eutectoid" steel. The use of the terms eutectic and eutectoid implies that steel is considered as an alloy of two constituents, ferrite and cementite, which, upon cooling, gives rise to the formation of a third constituent, pearlite, made up of small particles of both components. Many alloys contain a constituent possessing the same characteristics and which is called "eutectic alloy."

The structure of steel made up exclusively of pearlite is shown in Fig. 9. The magnification is not sufficiently high to show clearly the laminations of pearlite.

Let us now consider what effect a further addition of carbon will have upon the structure of the metal. Fig. 10 is the reproduction of a drawing showing the structure of a steel containing 1.20 per cent. carbon, or much more carbon than the amount required to convert the whole mass into pearlite. It will be noted that while the bulk of the metal is still made up of pearlite, it now contains also another constituent, which in Fig. 10 occurs chiefly as a light net-work surrounding the meshes of pearlite. This structure recalls that of medium hard steel and an inexperienced eye might be led to infer that this light constituent is ferrite. This net work, however, consists of cementite which is now present in excess over the amount required to form pearlite, just as in the case of low carbon steel, ferrite was in excess.

Cementite has a more metallic lustre than ferrite and remains bright and structureless even after prolonged etching, while ferrite is colored and resolved into grains after such treatment. Cementite is extremely hard and stands in relief in the structure, while ferrite is soft and is depressed by the polishing. Ferrite is readily scratched by a needle, while cementite cannot be marked. The excess of cementite, however, does not always assume the shape of a fine net work, its mode of occurrence depending upon the treatment to which the steel is subjected.

With further increase of carbon, the amount of cementite will necessarily increase and the proportion of pearlite decrease correspondingly.

The structure of unhardened carbon steel just described may, for our purpose, be accounted for as follows: The carbon present in the steel unites with a portion of the iron to form the carbide Fe_3C or cementite (which con-

FIG. 11.—A Graphical Representation of the Relation Between the Carbon Content and the Microstructure of Iron Carbon Alloys.

tains 6.67 per cent. carbon). The remaining iron, or ferrite, and this cementite then unite structurally in definite proportion to form pearlite, leaving as the case may be, an excess either of ferrite or of cementite, the former in low carbon steel, the latter in highly carburized steel.

The changes in the structural composition of steel, due to changes in the percentage of carbon may be represented graphically as shown in Fig. 11.

This diagram clearly illustrates the fact that if no carbon be present the whole of the metal is made up of ferrite, and that by introducing increasing amounts of carbon, pearlite is formed in increasing quantity, while ferrite decreases correspondingly. With 0.80 per cent. of carbon the whole mass consists of pearlite. Further addition of carbon results in the introduction of cementite in the structure, which then increases in amount with the carbon, while the proportion of pearlite decreases.

In our description of the structural composition of steel we have purposely ignored the effect of impurities, because while their influence is not to be overlooked, quantitive information on this point is lacking.

The Microstructure of Cast Iron.—Cast iron may be sharply divided into two classes: (1) White cast iron and (2) Gray Cast Iron. That is, into cast iron free from graphitic carbon and cast iron containing graphic carbon. The microstructure of these two varieties of cast iron will be considered separately.

The Microstructure of White Cast Iron.—Like steel, white cast iron is free from graphitic carbon; it contains the whole of its carbon in the combined condition, that is, as the carbide Fe_3C or cementite. We should, therefore, ex-

FIG. 12.—Structure of White Cast Iron Magnified 150 Diameters (Longmuir). Pearlite and Cementite.

pect to find the microstructure of white cast iron very similar to that of high carbon steel that is made up of pearlite and a large excess of free cementite. In Fig. 12 is shown under a magnification of 56 diameters, the structure of a sample of a white cast iron, and it will be seen that as just anticipated, it is composed of pearlite and cementite, roughly in equal proportions. This iron contained about 3.50 per cent. of combined carbon, which theoretically would call for about 45 per cent. of free cementite. A higher power would as usual be re-

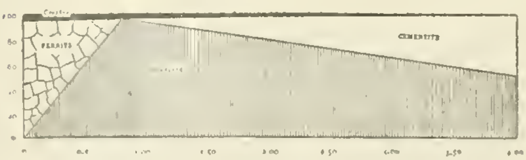

FIG. 13.—A Graphical Representation of the Relation Between Percentage of Combined Carbon and the Microstructure of Cast Iron.

quired to resolve the structure of the pearlite areas.

The close analogy which exists between the structure of steel and that of white cast iron, is, therefore, evident. Indeed it is not possible to distinguish high carbon steel from white cast iron by the examination of the structure of these metals; nor is this possible by any other test. To distinguish between high carbon steel and white cast iron, we must necessarily adopt an arbitrary rule, consisting, for instance, in calling steel, all carburized iron containing less than 2 per cent. carbon and cast iron, those products which are more highly carburized. Starting with carbonless iron and gradually increasing the carbon content, we produce in succession, low carbon steel, medium high carbon steel, high carbon steel, and finally white cast iron, without any suggestion as to when the metal ceases to be steel and becomes cast iron. The changes of structure and of properties caused by this gradual increase of carbon are continuous and do not indicate any abrupt transformation. As the carbon increases the strength of the metal increases until the carbon content reaches about 1 per cent. and then it decreases; the hardness increases and the ductility and weldability decrease continuously; the malleability decreases and finally disappears, but these changes occur gradually as the carbon increases and not abruptly upon reaching the composition of white cast iron.

To sum up, white cast iron may be considered as forming the most highly carburized member of the steel series.

The Microstructure of Gray Cast Iron — Gray Cast Iron free from Combined Carbon.— Perfectly gray cast iron does not contain any combined carbon. It should, therefore, be made up of a mass of carbonless iron (ferrite) and of a certain amount of graphitic carbon. The graphite occurs as numerous plates irregular in shape and size, disseminated through the iron, and breaking up its continuity. It is because of this breaking up of the continuity of the metallic mass that the original ductility and malleability of the iron is so completely destroyed by the presence of a sufficient amount of graphite.

Gray cast iron is seldom free from combined carbon. It generally contains from 0.10 to 1 per cent. and even more of carbon in the combined condition, and it is well known that this percentage of combined carbon depends chiefly upon the amount of silicon present and upon the rate of cooling of the casting. Various proportions of combined carbon, and, therefore, of graphitic carbon impart different appearances to the fracture of cast iron, which was, and still is to a considerable extent, classified accordingly into the various grades "No. 1, 2 and 3 Foundry," "mottled," "forge," etc.

The presence of some combined carbon in the iron must necessarily imply the presence of some pearlite in its structure. The metallic matrix which in perfectly gray iron consists of ferrite now possesses the structural characteristics (and therefore the properties also) of a low carbon steel. Gray cast iron containing a small amount of combined carbon may be considered as a low carbon steel whose continuity is destroyed by the presence of numerous plates of graphite. Such an iron would correspond to a No. 1 Foundry.

The presence of a larger proportion of combined carbon must necessarily result in a correspondingly greater amount of pearlite in the structure.

By increasing the percentage of combined carbon in cast iron, we convert its metallic matrix into steel of a correspondingly higher carbon content. We must necessarily reach a point, therefore, when the matrix will become a mass of pearlite, or, in other words, when it will assume the character of a saturated or eutectoid steel. This will occur when the metal contains about 0.70 per cent. of combined carbon. It will be remembered that in the case of steel some 0.80 per cent. of carbon was required to convert it into a mass of pearlite. In the case of cast iron, however, the amount of iron to be saturated is less (because of the space occupied by the graphite) and requires a correspondingly smaller amount of carbon, namely some 0.70 per cent.

Classified by its fracture, a cast iron of this character would correspond to a number 3 or 4 Foundry.

A further increase of combined carbon would result in the presence of some free cementite in the structure. Such cast iron is known, from the appearance of its fracture, as "mottled" iron.

Relation Between the Structure of Cast Iron and the Percentage of Combined Carbon.— The relation between the structure of cast iron and the proportion of combined carbon may be clearly illustrated by the diagram of Fig. 13, in which the percentage of total carbon (graphitic carbon plus combined carbon) has been assumed to be 4 per cent. and to remain constant. The plan followed is the same as that used to illustrate the changes of structure in steel and will therefore be readily understood. By comparing this diagram with that of Fig. 11, the close analogy between the constitution of steel and that of cast iron is strikingly brought out. That the properties of steel and cast iron, in spite of this similarity, differ so much, is due to the presence of graphitic carbon which by breaking up the continuity of the steel mass greatly decreases its strength and ductility, and deprives it of its malleability.

The structure of iron and steel which has been briefly described in the preceding paragraphs is greatly affected by the treatment or treatments, both thermal and mechanical, to which the metals are subjected during the processes of manufactures and further conversion into finished implements. Metallographic methods, therefore, afford a means of detecting defective treatments and of suggesting improvements in manufacturing methods through a careful study of the close relations existing on the one hand between the structure of iron and steel and their physical properties, and on the other hand between their structure and the treatment they have received.

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Iron in Medicine. In its native form, iron is devoid of action, but when reduced to a salt, or oxide, capable of dissociation, it becomes active. Iron differs from many of the other heavy metals in that it is an active ingredient of the tissues. In the human blood it is an absolutely essential constituent, and its importance is great for all of the tissues of the body. It is well known that the presence of iron is necessary for the active processes of photosynthesis in plants, and that in its absence the higher plants are unable to develop chlorophyll. Nencki, a Russian biologist, has shown that reduction compounds of hæmoglobin and of chlorophyll are very closely allied, and he propounds the interesting speculation that probably the same iron compound was present in the living matter before a differentiation of animal and plant was made, and that as plants and animals developed along divergent lines of structure the iron compounds became somewhat separated in their chemical character.

Iron combinations in medicine are usually divided into two classes, inorganic and organic. In the former the iron is dissociated in solution, and is usually acted upon by the hydrochloric acid of the gastric juice and converted into soluble chlorides, in which form it probably enters into the tissues. In the organic iron it is probable that the same conversion takes place, although there is much controversy regarding the method of its absorption; but this is true of all iron. The iron is usually taken up in the stomach and intestines, the larger part of it being rejected, and it enters into the blood in the form of an albuminate which passes into the duodenum, some being absorbed by the epithelium, and more or less of it carried directly to the spleen and probably to the liver. In the spleen it seems to undergo some changes, and is taken up by the blood and thereafter deposited more particularly in the liver and in the bone-marrow. When there is deficiency of iron in the blood or other organs, the liver gives up its store and it is absorbed by the tissue that is most in need of it. While in the blood, iron is the great organ of oxidation. By means of the hæmoglobin the oxygen of the air is taken up and distributed to the different parts of the body. This permits of the active chemical oxidative changes that take place throughout the entire body, which changes are of such vital importance in general metabolism, and without which the body suffers, degenerates and dies.

Iron is used particularly for diseases in which the blood is poor in that metal. This is particularly the case in anæmias of primary and secondary character. In primary anæmia or chlorosis (q.v.), iron is a distinct help, often curing the condition. In primary pernicious anæmia, which is a grave blood-disease, it is of secondary value. In all of the secondary anæmias, those that follow hemorrhage, the acute infectious diseases, such as scarlet fever, malaria, whooping-cough, measles, typhoid, pneumonia, etc., iron is of great service. It is particularly valuable following childbirth or any condition in which there has been a great loss of blood. It is also useful in conditions of scanty menstruation, in tuberculosis, and is one of the best general tonics in the realm of medicine. The effects of inorganic and iron solutions on the teeth should be borne in mind, although they are much exaggerated. Iron is apt to cause a certain amount of constipation, but this, by proper laxatives regularly taken, should be overcome.

Iron Mask, The Man with the, a famous personage who was kept a prisoner in two or three French prisons in the time of Louis XIV., and who excited a curiosity corresponding to the care with which his identity was concealed. His first prison was the castle of Pignerol, of which Saint-Mars was governor. In 1686 he was carried by Saint-Mars to the isles of St. Marguerite; and the same precautions were observed as upon his first journey. Saint-Mars having been appointed governor of the Bastile in 1698, carried the prisoner with him there, but still masked. An apartment had been prepared for him more convenient, and furnished with more care than those of the other unfortunate beings who inhabited this sad abode. He was not permitted to take off his mask even before his physician. In other respects the greatest attention was shown him, and nothing which he requested was refused him. His education appeared to have been carefully attended to; and he amused his leisure by reading, and playing upon the guitar. This unknown person died 19 Nov. 1703, at 10 o'clock in the evening, without having undergone any severe sickness. He was buried the next day in the afternoon in the cemetery of the church of St. Paul. He was, it was said, about 60 years of age, although the register of burials for the church of St. Paul, in which he is mentioned under the name of Marchiali, makes him only about 45. It is said that orders were given to burn everything which had been employed in his service; that the walls of the chamber which he had occupied were rubbed down and whitewashed; and that the precautions were carried so far, that the tiles of his room were removed, in the fear that he might have displaced some of them to conceal a letter behind them. Conjecture exhausted itself to discover who this mysterious personage might be.

At the time of the destruction of the Bastile, in July 1789, there were not wanting curious persons, who sought, in the archives of this fortress, to discover some notices which might throw light upon this historical problem. But to no purpose. A widely-accepted conjecture was first thrown out in a letter written in 1770 by Baron D'Heiss to the 'Journal Encyclopédique.' According to this view the Man with the Iron Mask was Count Girolamo Magni, or Mattioli, first minister of the Duke of Mantua, who had betrayed the interests of Louis XIV. by failing to secure for him, as he had pledged himself to do, in consideration of a large bribe, possession from his master of the fortress of Casale. For this offense he was lured to the French frontier, secretly arrested, and imprisoned in the fortress of Pignerol in 1679. The secret was preserved so carefully, on the supposition that Mattioli was the prisoner, because his seizure and detention were flagrant violations of international law. In a more recent investigation by M. Jung, 'La Vérité sur le Masque de Fer' (1873), an attempt is made to identify the Mask with a gentleman of Lorraine, who was connected with an association for the assassination of Louis. Funck-Brentano in 1894 revived the view that Mattioli was the mysterious prisoner, and many now consider the controversy settled and this view established. Consult: Hopkins, 'The Man in the Iron Mask.'

Iron Mountain, Mich., city, county-seat of Dickinson County; on the Chicago, M. & St. P. and the Chicago N. W. R.R.'s; about 47 miles southwest of Marquette and 57 miles west by north of Escanaba. It was settled in 1879 and chartered in 1888. It is the commercial centre for a large mining section in Michigan and for a farming section in Wisconsin. The city government consists of a mayor and council, elected annually. Its trade is principally in iron-ore and farm products. Pop. (1900) 9,242.

Iron Mountain, the southern spur of the St. Francois Mountains, a low range in the eastern part of Missouri. This mountain, which is really a hill or knob, is in St. Francois County, about 60 miles southwest from St. Genevieve, the nearest point on the Mississippi River. It is about 300 feet above the surrounding land and about 2,000 feet above the sea. It covers an area of 500 acres. It is famous for its remarkable mineral deposits, specular or hematite iron-ore, the purest iron ore in the United States. The average elevation above the land around is 550 feet, and the area it covers is about 500 acres. Large oak trees flourish on its slope, their roots embedded in soil composed largely of fragments of peroxide of iron. Excavations were begun in 1845. An artesian well has been sunk to the depth of 152 feet, with the result that the beds passed through from the surface were as follows: Iron ore mixed with clay, 16 feet; sandstone, 34 feet; magnesian limestone, 7½ inches; gray sandstone, 7½ inches; hard blue rock, 37 feet; pure iron ore 5 feet; porphyritic rock, 7 feet; iron ore 50 feet to the bottom. It would seem that nearly the whole mountain was a mass of magnetic iron ore. The adjacent valleys are underlaid with magnesian limestone in horizontal strata. Pilot Knob (q.v.), about six miles south of Iron Mountain, also contains an extensive deposit of iron ore; Shepherd Mountain, a short distance southwest of Pilot Knob, is the largest of the iron mountains in that immediate vicinity.

Iron Ores. Although iron is the most abundant of the useful metals, forming 5 per cent of the earth's crust, it is rarely found native — one famous native occurrence of it, however, being at Ovifak on the west coast of Greenland. The iron ores of chief commercial importance are hematite, magnetite, limonite, siderite and pyrite. Pure hematite contains 70 per cent iron; magnetite 72.4 per cent; limonite 59.89 per cent; siderite 48.27 per cent; pyrite 46.6 per cent. Iron ores, however, are practically never mined pure, but are mined in quantity averaging 10 per cent and over less iron than above stated, the principal impurities being silica, alumina, and lime.

Hematite, ferric oxide (Fe_2O_3), by far the most important iron ore, varies greatly in physical characteristics. Specular hematite is black, with a brilliant metallic lustre. Martite is a variety of hematite. Magnetite, a ferro-ferric oxide ($FeO.Fe_2O_3$), is black magnetic, and crystallizes in octahedra, but as mined it is usually massive or granular. Ilmenite, an oxide of iron and titanium, is not yet an ore of commercial importance. Franklinite, an oxide of iron, manganese, and zinc, found at Franklin, N. J., is used in making spiegeleisen, an alloy of iron and manganese after the zinc has been removed by roasting. Limonite or brown hematite, hydrated ferric oxide ($2Fe_2O_3.3H_2O$), is brown or yellow in color and occurs in massive, earthy, or in botryoidal forms. Bog-ore is a variety of limonite. Goethite, differing from limonite in crystalline form and containing less water, is found in large quantities in Minnesota. Siderite, or spathic iron, ferrous carbonate ($FeCO_3$), is white to gray when pure, and crystallizes in rhombohedra. As mined, it varies much in appearance, owing to oxidation. Clay iron stone is siderite mingled with clay. Blackband ore is siderite mixed with more or less bituminous matter. Pyrites, ferric disulphide (FeS_2), often called "fool's gold," is used in great quantities to make sulphuric acid. The residue, known as "blue-billy," or pyrites clinker, is in some countries smelted in the blast-furnace as an iron ore.

In smelting an ore the silica, lime, and alumina are removed as slag. Ores high in silica require more limestone in the furnace-charge for fluxing, that is, for combining with the silica. Some ores contain silica and lime in such proportions as to be self-fluxing. The higher the iron content of an ore, generally speaking, the greater the yield per ton of material put through the furnace, and the lower the cost per ton of the iron made.

A very hard ore must be broken into small lumps to give best results in the furnace. Hematites often smelt easier than magnetites. A fine granular ore makes trouble in smelting, and a certain proportion may be lost as dust, which clogs furnace-flues. The really injurious impurities most often found in iron ores are sulphur, phosphorus, and titanium. Sulphur can be largely removed by roasting the ore before smelting; phosphorus cannot, and all the phosphorus in the ore goes into the iron. For making steel by the Bessemer process an ore should contain less than 1–1,000 of its amount of iron; thus, to be classified as Bessemer, an ore containing 61 per cent iron should contain less than .061 per cent phosphorus. For making steel by the basic process, high phosphorus ores are used.

The present development of the world's iron mines is the outcome of many factors. Generally speaking, it is cheaper to bring the ore to the fuel than the fuel to the ore, hence, countries or districts that have great supplies of iron ore may be insignificant producers of pig-iron. Low-priced fuel has been the chief factor in determining the location of iron and steel industries, while the chief factors in the development of iron mines are the quality of the ore and the cost at which it can be put down at the furnace.

Iron-Ore Supplies of the World.— The iron industry in Asia is several thousand years old, but the annual output of iron ore is small. China has vast but little-developed deposits of limonite and hematite. Japan is very poor in iron ores. The iron industry of Australia is not of importance. The only ores exported from Africa are mined in Algeria, where the annual production has fallen to about 150,000 tons. Europe has famous ore fields. The ores of Elba and those of Styria were worked by the Romans. Certain Swedish mines have been worked almost continuously since 1300. The German output now comes chiefly from so-called minette beds of Lorraine and Luxemburg. The ore, a low-grade limonite high in phosphorus, is used in making steel by the basic process, and the present annual output is over 7,000,000 tons annually. The total ore supply left in the field is estimated at nearly 2,000,000,000 tons. The iron fields of Great Britain have passed their greatest productiveness. The principal districts are Cleveland in North Yorkshire, yielding clay ironstone containing about 30 per cent iron; Cumberland and Lancashire, yielding red hematite containing 50 to 60 per cent iron; and Lincolnshire, Leicestershire, and Northampton, yielding cheaply-mined low-grade hematite. The blackband ores of Scotland are of much less importance than formerly. The principal Spanish mines are in the Bilbao district in the province of Biscay, the productive field being 15 miles long and 2½ wide. The ores are red and purple hematite, limonite, and carbonate, the iron content in the crude ores running from 45 to 56 per cent. The district has produced to date about 95,000,000 tons. The greater part of the

Russian ore supply comes from the Ural Mountains, the ores on the east side of the range being magnetite, and on the west side limonite and carbonate. Near Krivoi Rog, in the Caucasus, are mines of hematite and magnetite. Fully 80 per cent of the iron ore of France is obtained from the minette beds of the Moselle that extend into Lorraine and Luxemburg. Most of the French ores are limonites. The principal Austrian iron mines are in Styria, the Styrian Erzberg having one of the largest deposits of siderite in Europe, yielding yearly about 1,000,000 tons of carbonate ore, containing 40 per cent of iron. In Bohemia are mines of magnetite, limonite, and siderite. Sweden has immense deposits of iron ore, chiefly magnetite with some specular hematite. The most important deposits are at Grangsberg in Central Sweden, where are specular hematite and magnetite ores containing 62 to 64 per cent iron and 0.9 to 1.5 per cent phosphorus, and at Gellivare, 100 miles from the Gulf of Bothnia, where are huge bodies of magnetite that run from 68.69 iron and 0.05 phosphorus to 60 per cent iron and 1.5 per cent phosphorus. The ores from this field and the neighboring districts of Kurunavara and Luossavara will be of great importance to British iron-masters, and shipments to the Atlantic seaboard of the United States are quite possible.

WORLD'S PRODUCTION OF IRON ORE — METRIC TONS.

United States	29,350,325	37.7
Germany	16,570,182	21.4
Great Britain	12,475,700	16.1
Russia	6,700,000	8.6
France	4,260,747	5.5
Austria-Hungary	3,623,115	4.7
Sweden	2,793,566	3.6
Other countries	1,800,000	2.4
Total	77,573,635	100.0

The total production was undoubtedly larger, since among the "other countries" are those that collect no returns of mineral output. The figures are for 1901 or 1902.

The iron ore supplies of South America have been little developed, and those of Mexico are just coming into prominence. In the province of Santiago, Cuba, are deposits of high-grade hematite. From there over 690,000 tons were exported to the United States in 1902. At Belle Isle, N. F., beds of hematite are now worked on a large scale. In Ontario, Quebec, and British Columbia are deposits of good hematite and magnetite, and the Dominion will soon be a large producer. There is a possibility of iron ores being mined in Labrador.

The United States leads the world in the production of iron ore. The ores mined range from low grade limonite to the highest grade hematites and magnetites. The purest ore ever mined in the United States in quantity was probably the magnetite from the Lovers Pit at Mineville, N. Y., which ran 72 per cent iron in carload lots, though the Lake Angeline mine at Ishpeming, Mich., has shipped hard hematite running 68 per cent iron and 0.008 phosphorus in thousand-ton lots. Minnesota now leads the States in production, with Michigan second, Alabama third, and Pennsylvania fourth. The chief centre of iron-ore production is about Lake Superior, where the ores occur along five mineral belts or "ranges," in Pre-Cambrian rocks. The Marquette range, in Michigan, was opened in 1856; the Menominee, mostly in Michigan, but partly in Wisconsin, in 1887; the Gogebic, in Michigan and Wisconsin, in 1884; the Vermilion, in Minnesota, in 1884; and the Mesabi, in Minnesota, in 1892. The ores shipped are nearly all red hematite. The Marquette produces some magnetite. As much of the ore is hauled long distances to a furnace, 60 per cent iron was once about as low grade ore as could be shipped profitably, but now some mines ship Bessemer ores containing but 45 per cent iron. The ore-bodies are sometimes of great size. The Chapin mine, on the Menominee range, is working lenses 100 feet wide and 600 feet thick in the middle, and 2,500 feet long. The Fayal mine, on the Mesabi range, in 1902 shipped 1,681,000 tons, and the Chapin in the same year 927,747 tons. The Mesabi deposits are flat-lying, covered by a varying depth of clay, sand, and boulders. By stripping off the surface and working the granular ore with steam-shovels, an enormous output is possible. The output of the various ranges in 1902 was: Mesabi, 13,342,840 long tons; Menominee, 4,627,524; Marquette, 3,853,010; Gogebic, 3,663,484; Vermilion, 2,084,263; making a total of 27,571,121 long tons.

In the South there are three important iron-mining centres — one near Birmingham, Ala., another in southeastern Tennessee, and the third in southwestern Virginia. The ores are red hematites and low-grade limonites. The growth of the Alabama industry is due to cheap ore, limestone and coking-coal being found in close proximity. Pennsylvania leads the Union in the production of magnetite, chiefly from the great ore-body at Cornwall, and also produces much limonite. New York and New Jersey also produce magnetite, and the former State some red hematite. Carbonate ores now come chiefly from Ohio. Of the western States, Colorado produces limonite, and in Utah and Wyoming are great deposits of magnetite and hematite, destined to be of importance in the near future. The famous specular hematite mines at Pilot Knob and Iron Mountain, Mo., are exhausted. Texas has large deposits of ore, and several other States are or will be important producers.

Mining and Handling Iron Ores.— Some extraordinary records of cheap mining and transportation have been made in the Lake Superior iron-ore trade. Large ore-bodies, effi-

UNITED STATES IRON ORE PRODUCTION — IN LONG TONS.

	1880	1890	1900	1902
Lake Superior	1,985,334	7,558,076	19,095,393	27,571,121
Southern States	627,517	2,904,322	5,100,000	4,850,000
Other States	4,884,658	4,056,469	1,758,000	2,215,000
Total	7,497,509	14,518,867	25,953,393	34,636,121

cient labor, and excellent management have been the factors in reducing mining costs, while the long lake-water haul, nearly 900 miles, in specially designed vessels, has made it possible to put down Lake Superior ores at Pittsburg, over 1,100 miles from the mine, at a total transportation cost of under $2 per ton. On the Mesabi range, in some large mines steam-shovels load the ore directly upon the cars, one shovel having loaded 170,000 tons in 26 days, or at the rate of over 6,500 tons per day. The shovels are each operated by five men, and the labor cost for mining and loading averages but about 16c per ton, and at one mine which dug and loaded 293,651 tons in 174 days, the labor cost was only 4c per ton. The loaded ore-trains go 50 to 115 miles to a shipping port. There they are run on to long, high docks having large pockets or bins into which the ore runs through openings in the bottoms of the cars. From these pockets the ore passes by gravity down along chutes into the hold of the vessel, so that no hand-labor is required. The ore-pockets hold about 160 tons each, and number from 90 to 384, according to the length of the dock.

In unloading the ore from the vessels, the use of labor-saving machinery is even more notable. A series of steel bridges, easily moved along the docks, is supplied with hinged arms which can be lowered into the hatch of the vessel. Along each arm and across the bridge runs a trolley-train to which are attached automatic grabs similar to a double scoop. The grab or scoop holds about five tons of ore, and when it begins to draw together it digs into the ore. The grabs can remove over half of the cargo without any assistance, and the remaining half is brought directly under the hatch by use of a scraper, operated by similar machinery. The grabs are so controlled by the engineer that he can drop them at any point over the hold he may wish, and after a grab seizes its load of ore it is raised at full speed, carried rapidly along the trolley to any given point, and dumped into railroad cars or on stock piles. This 5-ton grab has a hoisting speed of 100 ft. a minute, and can run along the bridge at the rate of 1,000 ft. a minute. The bridges to which the arms with their grabs are attached are worked by electricity. By such a device 26 men can do the work of 300 under the old system. Another unloading device, the Hulett unloader, requires even fewer men, and takes out a larger proportion of the cargo without aid.

Bibliography.— Owing to the enormous growth of the iron industry, there is no recent single work covering the production and use of iron ores. Statistics of production can be found in 'The Mineral Industry,' the 'Mineral Resources of the United States,' and the 'Engineering and Mining Journal.' Descriptions of geological occurrence and mining methods can be found in the monographs and bulletins of the United States Geological Survey; and the 'Transactions' of the American Institute of Mining Engineers. See GOETHITE; HEMATITE; ILMENITE; LIMONITE; MAGNETITE; MINING; ORE DEPOSITS. SAMUEL SANFORD,

Assoc. Editor 'Engineering and Mining Journal.'

Iron Skeleton Construction, a modern system of constructing high buildings, by which architects and builders are enabled to plan and erect buildings as high as 15 or 20 stories on plots of ground 20 to 30 feet wide. By the use of this system the thickness of walls is considerably reduced, thus giving a larger floor space, a very desirable consideration, especially in office buildings. Iron and steel columns are carried up from foundation to roof, and then covered in with bricks or stone. Thus a carrying capacity equal to that of walls of much greater thickness is produced. A 12-story building in New York city thus constructed upon a lot 25 by 100 feet means a saving in floor space of thousands of feet.

I'ronclad. See ARMOR-PLATE.

Ironclad Oath, The, an act passed by the United States Congress in 1866, excluding voters, in the States lately in rebellion, from the franchise. The act practically disfranchised all Southerners over 25 years of age. It was repealed shortly after its passage.

Irondale, ī'ėrn-dāl, Wash., a place in the northeastern part of Jefferson County, a few miles south of Port Townsend. The first blast-furnace on the Pacific coast was erected at this place in about 1880. The furnace was in operation about 12 years, and was then abandoned because of the great expenses incurred in production. The ore was obtained from Texada, an island belonging to British Columbia, and 130 miles distant. The last of the 19th century the Pacific Steel Company, a corporation in which practical iron-makers of Pennsylvania are the chief owners, began investigations as to the nature of the ore, and the possibility with improved machinery, to manufacture iron at Irondale or vicinity at paying rates. As a result the Pacific Steel Company have taken up the work abandoned by the Puget Sound Iron Company. The works have been so improved as to be practically new, and 20 brick charcoal kilns have been erected for the use of the company. Coke is obtained in Washington.

Ironton, ī'ėrn-tôn, Ohio, city, county-seat of Lawrence County; on the Ohio River, and on the Detroit S., the Norfolk & W., and the Cincinnati, H. & D. R.R.'s; about 100 miles directly southeast of Columbus. The Chesapeake & Ohio railroad, in Kentucky, has here a ferry for passengers and freight, which practically gives the city the benefit of four important railroads. Ironton was settled in 1832, and for some years was known as a river-trading town. It was incorporated in 1849. It is situated in a section of country noted for its clay (suitable for pottery), iron ore, and bituminous coal. Its chief industrial establishments are foundries, rolling-mills, blast-furnaces, machine-shops, nail-works, furniture factories, and planing-mills. It has also among its manufactures doors and mantels, stoves, boilers, cement, and fire-bricks. The clay in the vicinity is much used for pottery. The parks, River View, Lincoln, and Beechwood, are attractive. Some of the principal buildings are the Briggs Public Library, the Kingsbury school, Odd Fellows' Hall, Masonic Temple, City hospital, and several churches. Ironton was the home for some time of the artist Sarah Cotter-King. Pop. (1900) 11,868.

I'ronweed, a tall, coarse, composite plant of the genus *Vernonia*, three species of which grow abundantly in woods and along roadsides throughout the southern half of the Union, bearing heads of magenta-colored flowers somewhat like miniature thistles. The most conspicuous species (*V. gigantea*) is often 10 feet high, and blooms in August and September. A similar species (*V. noveboracensis*) grows in low grounds throughout the Northern States.

I'ronwood, Mich., city in Gogebic County, on the Wisconsin C. and the Chicago & N. W. R.R.'s; about 12 miles south of Lake Superior and 33 miles southeast of Ashland. It was settled in 1884 and incorporated in 1887. It is situated in a region rich in iron ore and timber; the section is known as the "Gogebic iron region." The famous Norrie mine is in this vicinity. Ironwood is the trade centre for the greater part of the mining and lumbering business of the county. Some of the principal buildings are the Carnegie library, the city-hall, the high school, and several churches. Trolley lines connect the city with Gile and Hurley, Wis. The government is vested in a mayor, who is elected annually, and a council. The mayor appoints, subject to the approval of the council, all the subordinate officials except the members of the board of education. Pop. (1900) 9,705.

Ironwood, a popular name for many trees whose timber is very hard and heavy. Probably the best known species in America is also known as leverwood, *Ostrya Virginica*, of the natural order *Cupuliferæ*, indigenous from Nova Scotia to Florida and westward to Minnesota and Texas. It is a medium sized tree with furrowed bark, birch-like foliage, pistillate flowers in catkins resembling the female flowers of hop, hence its popular name hop-hornbeam. The name ironwood is also sometimes applied to *Carpinus Americana* or *Caroliniano*, of the same natural order. (See HORNBEAM.) Among foreign "ironwoods," perhaps the most widely known is *Mesus ferea*, an East Indian tree planted around Buddhist temples for its fragrant flowers, which are used to decorate the images of Buddha. Another Asiatic species is *Metrosideros vera*, from which the Chinese and Japanese make rubbers. In Australia and South Africa various species of *Olea, Melaleuca, Sideroxylon, Notelaea*, and *Myrtus* are valued for their timber, locally called ironwood, employed where great toughness is desirable and weight no obstacle.

Iroquoian Stock, a linguistic stock of North American Indians deriving their name from the form Iroquois (q.v.), the name given to the "Five Nations." The Saint Lawrence River was probably their first habitat, and from there they gradually spread to the Great Lakes, primarily because of the hostility of the Algonquins. Cartier found, in 1535, a people living between Montreal and Quebec whose language showed them to be Wyandots, but 100 years later these had entirely disappeared and the Algonquins occupied their territory. The Iroquoian stock is divided into four groups: the northern — Wyandot, Tionontati, Wenrorono, Tohotænrat, Neuter, Hochelaga; the central — Mohawk, Oneida, Cayuga, Onondaga, Erie, Conestoga, Seneca; the southern — Tuscarora, Meherrin, Nottaway, Chowanoc, Coree; the Cherokee — Elati or Lower Cherokee, Middle Cherokee, and Atali or Upper Cherokee. The tribes of the Iroquoian stock were all agricultural, and were noted for their houses and fortifications. They have also made considerable advance in education. The whole population is about 43,000, of whom 10,000 are in Canada. The major portion of the population are Cherokee. See IROQUOIS.

Iroquois, ĭr-ō-kwoi', the name given by the French to the confederacy of North American Indians, called by the English the "Five," and afterward the "Six Nations." The Mohawks, Oneidas, Onondagas, Cayugas, Senecas, and Tuscaroras, after they were driven from their hunting-grounds in North Carolina in 1712, were the members of this confederacy. They formerly resided on the Mohawk River in New York State and on the lakes which still bear their names, and extended their conquests to the Mississippi and beyond the St. Lawrence. Their valor and successes had procured them the name of the Romans of America. Their territory abounded with lakes well stored with fish; their forests were filled with game, and they had the advantage of a fertile soil. The sachems owed their authority to public opinion: the general affairs of the confederacy were managed by a great council, composed of the chiefs, which assembled annually at Onondaga. The history of the Iroquois probably dates back to 1535, when Cartier found the peoples who had settled along the shores of the Saint Lawrence River, from Quebec to Montreal, and who, judging from the similarity in languages were undoubtedly the ancestors of the later Iroquois. The Algonquins, who at this time were more powerful, drove those people from their habitations and scattered them throughout the country, some, like the Hurons, traveling west, and the majority, among whom were the Iroquois, going south, settling mainly in North Carolina. Hiawatha, their leader, then persuaded them to form a league or confederacy for their own protection, and the league thus formed became known as the "Five Nations," and was based upon such sound and well-ordered plans that it is in existence at the present time. In 1712 they were driven from their territory in North Carolina and coming north again settled in Central and Western New York. Here they gathered other tribes and merged them into the confederacy: and in 1715 took in the Tuscaroras, after which the league was known as the "Six Nations"; they bought firearms and supplies from the Dutch and gradually strengthened themselves so that in 1630, they took the offensive in a long and bloody war against the Algonquins, first attacking the French missions among the Hurons in Canada and either slaying, capturing, or sending into exile all this tribe: they then rapidly subdued the Neutral Nation, the Erie, the Ottawa, and all the remaining tribes of the Algonquin race: and conquered in quick succession the Conestogas in the south, those east of the Hudson, among whom were the Mohicans, and the Miami and Illinois tribes of the Middle West, the only tribes who successfully opposed them being the Ojibwas of the Northwest and the Cherokees of the South. In the long wars between the British and the French, which continued with some interruption for nearly a century, until 1763, they were with a few exceptions in the British interest. These exceptions were notably the

Cayugas and the Mohawks, over whom the French Jesuit missionaries exercised a great influence, and who later withdrew from the league and settled in the villages of Caughnawaga and Saint Regis. In the Revolution the Iroquois as a league were neutral, but the separate tribes took up the warfare generally in favor of the British, the Oneidas and some of the Tuscaroras being the only ones who sided with the Americans. Brant led the Mohawks and Cayugas into Canada, where, at the end of the war, the Canadian government gave them several reservations, and where a majority of them are at the present time. The reservations for the Iroquois in the United States are mostly in New York, where all now live except the Oneidas, who in 1820 migrated to Wisconsin, and a small band of Senecas, who have a small reservation in the Indian Territory. According to the United States census, and a Canadian report, the total number of the Iroquois in 1902 was about 17,000, of whom about 8,000 were in the United States. See SIX NATIONS, THE.

Irradiation, an apparent enlargement of a bright body when seen against a background darker than itself. A simple method of observing this phenomenon is to view a bright sky through the spaces between a grating. If the breadth of the opening can be made equal to the breadth of the bars of the grating it will be seen that, when viewed from a little distance the bars look narrower than the spaces between them. This is obviously owing to the encroachment of the light upon the dark spaces around it. The first question to arise and one which was long discussed was whether the encroachment was due to an excitation of the nerves of the retina outside the limits on which the light fell upon the nerves, or whether it was necessary that the light should actually fall outside of its geometrical limits. The latter view is found to be the correct one, unless in cases of extreme brilliancy of the light. Irradiation is almost entirely in the nature of an optical defect or aberration of light. It begins with the atmosphere, which, when light passes through long stretches of it, slightly deflects the rays, so that a point is no longer seen as such, but as a small ill-defined waving surface. No lens ever brings the rays from a point to exactly the same focus. The lenses of the eye itself have defects which everyone who consults an oculist is acquainted with. The result of all these imperfections is to produce the enlargement we have described.

Irradiation is a notable subject in the history of astronomical observations. It was necessarily larger with the imperfect telescopes of former times than with the improved ones of our own period. Total eclipses of the sun, the transits of Venus and Mercury were especially productive of the phenomenon. The enlargement of the moon resulted in a star appearing as if within the bright disc of the moon when its light was really only grazing the surface. The sharp points or horns of light formed by the limb of the sun during the transits of Venus and Mercury were rounded off, so as to present quite an illusory view of their form. Just at the beginning and end of total eclipses of the sun the phenomenon known as Bailey's beads, really enlargements of the last points of light from the sun's limb, which could be seen before the sun was quite covered, looked like a string of beads. Many learned memoirs have been written on the subject, but the consensus of opinion to-day is toward the very simple and comprehensive theory above mentioned.

Irrawad'dy. See IRAWADI.

Irredentists, an Italian political party formed in 1878, having for its object the redemption and incorporation into the kingdom of Italy of all those regions near Italy having an Italian-speaking population and which they called "*Italia Irredenta*" (unredeemed Italy). This immense territory included some of the lands now belonging to France, Austria, Switzerland, and England. The immensity of the undertaking was probably the cause of the downfall of the movement, though the formation of the Triple Alliance also gave it a setback, as Austria was the enemy against whom the main efforts of the party were directed.

Irrigation, the watering of land by artificial means to make it productive. Historically, irrigation seems coeval with the earliest attempts to construct complicated machinery, and the systems of irrigation used in the earliest times in the Far East, in Babylonia, and in Egypt, dating in the last-named country 20 centuries before Christ, furnish as important a chapter in the history of invention as in the story of agricultural development. In our times the systems of India (q.v.) and Egypt (see ASSOUAN; NILE) are probably the best organized, being largely under governmental control. In Europe, irrigation is widely used in northern Italy, southern France, and throughout Spain. The British colonial possessions of the southern hemisphere, notably Australia and South Africa, benefit more and more by artificial water-supply.

Early Irrigation in America.— Irrigation was practised in prehistoric times by the town-building Pueblo Indian tribes inhabiting portions of New Mexico and Arizona. The descendants of these Indians still utilize some of the lands which were tilled by irrigation at the time when the Spaniards first came from the south, and practise many of the primitive customs of their ancestors. The Mexicans of mixed Spanish and Indian origin, gradually extending their settlements from the south, through necessity practised irrigation. The early missions of the Pacific coast also used it, and in southern California particularly are to be found the ruins of substantial dams and headworks built of masonry and constructed by Indian labor. But the first systematic application of irrigation in the arid West by English-speaking people was made by the Mormons on the shores of the Great Salt Lake. The soil was so barren that crops could not be raised by ordinary means, and they turned the waters of the little cañon streams upon the ground where Salt Lake City now stands. After many years they succeeded in mastering the art of irrigation, and under the wise rules of Brigham Young, limiting the size of irrigated farms, the Mormons have become a prosperous people. At about the time the Mormons were settling Utah, the gold-miners in California were building ditches for placer-washing, and were using water from these ditches for irrigation. The results obtained attracted public attention, and irrigation slowly

1. Scene in Southern California, showing the furrow method of irrigation.
2. Desert land reclaimed by irrigation, showing recently planted orchards.

developed as an adjunct to mining. With the stoppage of hydraulic mining, the ditches built for mining were either abandoned or used exclusively for irrigation. Many of them have been enlarged, and have now even greater value than in the old days of mining excitement.

Development in the United States.— The successful irrigation attained by the Greeley colony in Colorado, and the wonderful results shown by the Mormon communities in Utah, Idaho, and Arizona greatly stimulated the colony idea; many organizations brought people in large bodies from the Eastern States, and even from Europe, and placed them on small farms located near each other and supplied with water from a common ditch. Individual settlers also sought opportunities for bringing land under cultivation by artificial watering; and thus, at many widely scattered points, irrigation has been introduced. There are no statistics concerning the area irrigated in 1870, but it is probable that in that year there were not over 20,000 acres under irrigation in the whole United States; but 1870–80 saw a rapid development of small ditches, constructed by individuals and associations of farmers. At the end of that period there were probably 1,000,000 acres under irrigation. In the decade 1880–90 occurred the "boom" of speculative enterprise in irrigation canals. Large sums of money were obtained for irrigation works, but nearly all of these failed, and although they aided in the extension of irrigation, they did not enrich the investors. The 11th census showed that in 1889 there were 3,631,381 acres irrigated on 54,136 farms, with an average irrigation area of 67 acres. During the following decade the irrigated acreage doubled in extent. This was due to the extension and enlargement of the many canals existing in 1889, and to the more complete practice of irrigation on the lands under ditch.

In addition to the statistics obtained at the Eleventh (1889), and Twelfth (1899) Censuses, a special investigation was ordered in 1902 of irrigated farms and extent of irrigation in acres in the principal arid States, and also the total in the semiarid States, namely, North and South Dakota, Nebraska, Kansas, Oklahoma, and Texas. These lie east of the truly arid region but extend in parts into regions of deficient rainfall.

NUMBER OF IRRIGATED FARMS.

States	1902	1899	1889
Arizona	3,867	2,981	1,075
California	29,255	25,611	13,732
Colorado	19,688	17,613	9,659
Idaho	10,077	8,987	4,323
Montana	9,496	8,043	3,706
Nevada	2,260	1,906	1,167
New Mexico	9,314	7,884	3,085
Oregon	5,133	4,636	3,150
Utah	21,618	17,924	9,724
Washington	4,585	3,513	1,046
Wyoming	3,721	3,721	1,917
Semiarid States	6,994	4,970	1,552
Total	126,008	107,789	54,136

ACRES IRRIGATED.

States	1902	1899	1889
Arizona	247,249	185,396	65,821
California	1,708,720	1,445,872	1,004,233
Colorado	1,747,332	1,611,271	890,735
Idaho	713,595	602,568	217,005
Montana	1,140,694	951,154	350,582
Nevada	570,001	504,168	224,403
New Mexico	254,945	203,893	91,745
Oregon	439,981	388,310	177,944
Utah	711,184	629,293	263,473
Washington	154,962	135,470	48,799
Wyoming	773,111	605,878	229,676
Semiarid States	572,751	273,117	66,965
Total	9,034,526	7,536,390	3,631,381

National Irrigation Act.—The latest and most important step in American irrigation is marked by the National Irrigation Act, which was passed by Congress in 1902, and received the countenance of President Roosevelt. The act provides for the construction of irrigating works under the control of the secretary of the interior, the funds being derived from the disposal of public lands in the 13 States and 3 Territories. The public land is withdrawn from entry excepting under the Homestead Act. The holdings when reclaimed are to be restricted to between 40 and 160 acres, the area being limited to the acreage which in the opinion of the Secretary may be reasonably required for the support of a family. The cost of the reclamation works is to be apportioned to the reclaimed lands and is to be refunded in not exceeding 10 annual installments, the charges being determined with a view of returning to the Reclamation Fund the estimated cost of construction. For land in private ownership no right to the use of water shall be sold for tract exceeding 160 acres to any one landowner, and he must be an actual resident on or near the land. The result of the law is to give free land under the terms of the Homestead Law and supply water at cost from permanent systems without charging profit or interest to the settler. The management and operation of the irrigation works will ultimately pass to the owners of the lands to be maintained under such rules as may be acceptable to the Secretary, the title and operation of the reservoirs and similar works remaining in the government. It is believed that during each 10 years for the next third of a century an acreage equal to the total now under irrigation in all the West may be added to the agricultural area of the 16 States and Territories affected; thus rapidly multiplying production, furnishing new homes for millions, and providing the food products needed for shipment from the Pacific coast for use in the lands across the Pacific where new markets are now being opened for the surplus products of this country.

Upon the passage of the Reclamation Law in 1902, examinations and surveys were begun in the arid States and construction started in Arizona and Nevada. In Arizona flood water is to be stored on Salt River by a dam below the mouth of Tonto Creek, furnishing a supply for arid lands in the vicinity of Phœnix. In Nevada the flood water of Truckee River is to be diverted by a canal under construction taking it to Carson River, storage being there provided for the excess water of both streams. This will be used upon the desert area in the vicinity of Carson Lake. Other principal projects favorably reported upon are Colorado River in Arizona and California; Gunnison River in Colorado; Snake River in Idaho; Milk River in Montana; North Platte River in Nebraska; Rio Grande and Pecos rivers in New Mexico; Yellowstone River in North Dakota; Umatilla River in Oregon; Belle Fourche in South Dakota; Bear Lake in Utah; Palouse River in Washington, and Shoshone River in Wyoming.

Surface streams supply over 90 per cent of the irrigated land of the United States. Streams within the arid region of the United States rise high, and at one point or another flow for a time through upper valleys or parks. But after passing through rocky defiles to a fertile lower valley, the typical stream of the arid West loses itself in a shallow sandy channel.

Water-Supply and Regulation.— The water used in irrigation is for the most part taken from the river or creek by natural flow or gravity. The cost of lifting or pumping water is usually too great in proportion to the value of crops raised to permit the general use of pumps. Water will flow rapidly in a ditch having a fall of two feet per mile, and the stream supplying the ditch may be falling at a rate of 12 feet per mile. At the end of the first mile the water in the ditch will be 10 feet above that in the river, and at the end of the tenth mile will be 100 feet higher, and will thus cover land which is less than 100 feet in altitude above the stream at this locality. It is usual to construct some device at the upper end of each ditch or canal by which the amount of water entering from the river can be regulated. Without this, flood-waters would fill the ditch beyond its capacity, and would overflow and wash away the banks. In times of low water, also, the stream may fall to such an extent that it must be raised somewhat and forced into the ditch, and at all times it may be necessary to regulate the flow in order to apportion the water fairly to all concerned. In the case of the simplest ditch, a small dam of brush and stone is built diagonally or into or across the stream-bed as the water becomes low in summer, and this is made tight by means of sod and earth. More permanent dams are sometimes built of timber, or masonry. The head-gate or regulator of the canal placed at the end of the dam consists of a stout framework firmly bedded in the earth or rock with one or more openings, each of which can be closed by a gate sliding vertically. The water enters under the gates, the quantity being controlled by raising or lowering them.

A considerable slope can be used for small ditches, since the volume of water is not sufficiently great to move the large particles of sand and gravel. As a general rule, conduits of this character built in common earth should be so proportioned as to have an average velocity of a little less than three feet per second, or two miles per hour, when carrying their full capacity. It is necessary, therefore, to take into consideration the amount of water to be carried and from this deduce the size and shape of the cross-section of the canal or ditch in order to obtain the desired velocity. If the grade be excessive the seepage or loss of water becomes large. The shape of the cross-section of a canal depends largely upon the character of the surface soil. In light or sandy soil, where the earth is easily eroded, very gentle side slopes are given, while in harder materials the side slopes can be steeper. When the fall of the canal is so great that it is impracticable to allow the water to flow freely down the slope, devices known as drops are introduced. These consist of an arrangement whereby the water can drop to a lower level without injury to the canal. Drops are usually built of planks with a sharp overfall edge, and a low dam or obstruction below the fall in order to maintain the pool. Occasionally they are made in the form of an incline, with a pocket at the bottom to break the force of the falling water. They are expensive to build, and difficult to maintain, because of the rapidity with which the timbers decay and the wearing action of the water, which constantly tends to cut exposed portions.

It is necessary in the construction of nearly every ditch or canal to take water across a depression at some point in its course. This is usually done by means of a flume or long box, usually rectangular and supported above the ground by a frame or trestle of timber or iron. Such flumes are often used across rocky ground where it is impracticable to dig a ditch. This is particularly the case near the head, where the water, after being taken from the river, is often carried through a narrow, steep-walled cañon. Here the foundation for a flume is prepared along the rocky cliffs, supports being devised to suit the inequalities of the ground. A better, though more expensive, type of flume is that having a semicircular section, and built of narrow planks or staves laid side by side and held in place by iron bands run around the flume, joined by nuts and threads by which the bands can be drawn up and the staves brought together. In crossing very deep depressions it is necessary to have a correspondingly high trestle in order to carry the flume across on grade. Such high trestles are expensive and liable to destruction from storms. In their place there have been built inverted siphons, wooden stave-pipe, or aqueducts of other form. The stave-pipes are similar in construction to the semicircular frame of narrow plank, carefully planned to a given dimension, and held in place by circular iron bands or hoops.

Applicotion of Water.— The methods of irrigation practised in various parts of the United States differ with the climatic conditions and soil, and especially with the early habits of training of the irrigators. The methods of conserving and applying water have been improved under the stimulus of modern invention, although there has been little if any scientific or well-considered information available. Water is applied to the irrigated field in three ways — by flooding, by furrows, and by sub-irrigation.

Flooding.— This is done by the check system and by wild flooding. By the latter process the irrigator turns the water from a ditch over a level field and completely submerges it. Perfectly level fields are, however, camparatively rare, and the first step in primitive agriculture by irrigation has been to build a low ridge around two or three sides of a slightly sloping field, so that the water is held in ponds. These low banks are commonly known as levees or checks. In construction they are frequently laid out at right angles, dividing the land into a number of compartments. Water is turned from a ditch into the highest of these compartments, and when the ground is flooded the bank of the lower side is cut or a small sluice-way opened, and the water passes into the next field, and so on until each in turn is watered.

Furrows.— Irrigation in checks has gradually been given up, owing to the expense of leveling and leveeing the ground. With experience the irrigator has become able to apply water to crops which are cultivated in furrows, without resorting to such expensive means. The furrows are plowed in such a direction that the water when turned into them from the lateral ditches will flow freely down them without washing away the soil. When the water has completely filled the furrows, and has reached the lowest points, the little streams are cut off and turned into another set of furrows. The methods of doing this differ. Sometimes the irrigator simply cuts the bank of the distributing ditch with a shovel and then closes the opening after sufficient water has escaped. A more systematic method is commonly employed in California. Water is carried to the furrows in a small box-flume with openings in the side. These openings are closed by little shutters and a number can be opened at once, permitting a certain quantity of water to escape into each furrow. The slope given the furrows determines to a certain extent the amount of water received by the soil. If the fall is very gentle, the water moves slowly and a large portion is absorbed while the furrow is being filled. If steep, the water quickly passes to a lower end and the ground does not absorb so much. When the entire field has been watered the furrows are usually plowed out and a thin layer of the top soil stirred to make an open, porous covering or mulch, preventing excessive evaporation and allowing the air to enter the ground. Without such cultivation a hard crust may be formed. The loosening of this crust breaks the capillary connection with the moisture beneath and thus lessens the loss of water. For irrigating small grain, such as wheat, the ordinary plow furrows are not used. The fields, brought to a uniform surface, are thoroughly cultivated, and after the grain has been sown, small parallel lines are made similar to furrows, but smaller and nearer together. These tiny channels are made either by a peculiar drag or by a roller upon which are projections so arranged as to make small grooves in the soil. These are made in the direction of the desired slope, so that the water can flow down the marks through the grain as it would in furrows through a cornfield. The rapidly growing grain shades the surface and prevents the formation of crust, rendering subsequent cultivation unnecessary. In order to cause the water to spread from the lateral ditches into the furrows through the ground, use is made of the tappoon — a small sheet of metal of such shape as to fit across the ditch. This can be forced into the soft earth, making a small dam and causing the water to back up and overflow the field of grain. Sometimes a canvas dam is used.

Furrow-irrigation is usually employed in watering trees and vines. In some localities, however, basin or pool irrigation is practised. The supply is conducted often in cement-lined ditches and by wooden flumes as near as possible to the trees and vines, and is then turned out into the furrows plowed around or near the trees. The water issuing from small apertures in the side of the wooden box falls into the furrows and is immediately conducted to the vicinity of the trees. Care is usually taken that the water shall not actually touch the tree-trunks, and it is extended far enough about the extremities of the roots to encourage these to spread outward. After the water has traversed the furrows to the lower end of the orchard, the supply is cut off, and the ground is tilled as soon as the surface dries sufficiently.

Sub-Irrigation.— Attempts have been made to conduct the water beneath the surface immediately to the roots of the trees, thus preventing waste by evaporation from the surface of the ground. Few devices have been successful, owing to the fact that the roots of the trees rapidly seek and enter the openings from which the water issues, or, surrounding the pipe by a dense network, cut off the supply. Porous clay tiling has been laid through orchards, and also iron pipes perforated so as to furnish a supply of water along their length. A machine has been invented and successfully used for making cement-pipe in place. Small trenches are dug through the orchard between the trees and the pipe-making machine deposits the material in the trenches, which are filled with earth as soon as the cement is set. Water is thus distributed underground where needed. In orchards where sub-surface irrigation has been unsuccessful because of roots stopping up minute openings beneath the surface, the system has been reconstructed and water has been brought to the surface at or near each tree by means of small hydrants. Vertical pipes are placed at short intervals leading to the level of the ground, and in these are small iron gates or shutters so arranged that the flow can be cut off in the buried pipe. For annual or root crops sub-irrigation has been successfully practised by the use of small iron pipes partly open at the bottom, allowing a small amount of water to escape. These pipes are laid 12 inches or more beneath the surface, and are connected with lines of tile or clay pipes leading from the reservoir or source of supply. As the crops are removed each year, and the ground cultivated, the roots have no opportunity to stop up the pipes. The term sub-irrigation is occasionally applied to conditions occurring in nature where water percolates freely beneath the ground for a considerable distance sufficiently near the surface to supply the need of crops. Where the subsoil transmits water freely, irrigation ditches may sub-irrigate large tracts of country without rendering them marshy. Thus farms may obtain an ample supply of water from ditches half a mile or more away without the necessity of distributing small streams over the surface. In the San Joaquin Valley, California, vineyards in certain localities are thus maintained in good condition, although water has not been visibly applied for many years.

Quantity of Water.— The amount of water required for raising crops varies according to the character of the soil. The plants themselves need a certain minimum supply, but a far larger quantity is required to saturate the surrounding soil to such a degree that the vitalizing processes can continue. Prof. F. H. King of Madison, Wis., has found by direct measurements that from 300 to 500 pounds of water are required for each pound of dry matter produced. When the ground is first irrigated an enormous quantity of water is sometimes required to saturate the subsoil. The quantity of water turned upon the surface during the first year or two has frequently been sufficient to cover the ground to a depth of 10 to 20 feet, and in some cases an amount equal to a depth of 5 feet or more per annum has been thus employed for several years. Gradually, however, the dry soil is filled. The pioneers of irrigation frequently use too much water, often to their disadvantage.

The quantity of water used in irrigation is usually stated in one of two ways: (1) In terms of depth of water on the surface; (2) in quantities of flowing water through the irrigating season. In the humid regions the rainfall is usually from three to four inches per month during the crop season. In the arid region, where the sunlight is more continuous, and the evaporation greater, there should be for the ordinary crops at least enough water during the growing season to cover the ground from four to six inches in depth each month. The second method of stating the quantities necessary for irrigation is of convenience when considering a stream upon which there is no storage. It is estimated that one cubic foot per second, flowing through an irrigating season of 90 days, will irrigate 100 acres. One second-foot will cover an acre nearly two feet deep during 24 hours, and in 90 days it will cover 180 acres one foot deep, or 100 acres to a depth of 1.8 feet, or 21.6 inches. This is equivalent to a depth of water of a little over seven inches per month during the season of 90 days. Successive years of deficient rainfall in southern California from 1897 to 1900 served to prove that, with careful cultivation, crops, orchards, and vineyards can be maintained by using very small quantities of water. In some cases an amount not exceeding six inches in depth was applied during the year, this being conducted directly to the plants, and the ground kept carefully tilled and free from weeds. As estimated by various water companies in southern California, one miner's inch of water will irrigate from five to ten acres, the miner's inch equaling 12,960 gallons in 24 hours, or almost exactly 0.02 second-foot, this being the amount delivered under a 4-inch head, measured from the centre of the opening. Under this assumption one second-foot should irrigate from 250 to 500 acres. If it be assumed that one miner's inch is allowed for ten acres, or one second-foot for 500 acres, this quantity of water flowing from May to October, inclusive, will cover the ground to a depth of a little over seven tenths of a foot. The method of applying water largely governs the amount used. With alfalfa flooding is practised; with small grains the water is run in furrows; while with orchards the water is sometimes applied directly to each tree, or is run in furrows, four or five in each case between two rows of trees.

The annual charges for water by the acre in southern California, where this economy of water is practised, have been as low as $3, and from this rising to $15 or more per acre. For good farming in parts of the arid region outside of southern California, a depth of from 24 to 30 inches of water during the crop season should be sufficient. The usual charge for this quantity is from $1.00 to $2.00 per acre irrigated per annum. The temperature and the wind-movement introduce so many conditions that broad statements of this kind are merely suggestive, and not to be followed as rules.

Where an excessive amount of water is put upon irrigated land, as high as 70 per cent has been known to pass by seepage to the lower grounds. Growing plants evaporate in many cases 300 times their own weight of water each year. If a crop be carelessly cultivated and weeds allowed to grow with plants, the worthless plants waste as much water as is used by those that are valuable. But with careful cultivation the evaporation is lessened and the waste of water is prevented. Thus the quantity of water required is only one half or one third of the amount needed where the farming is carelessly done.

Users' Rights.— The first settlers frequently laid claim to the whole flow of the stream. Soon after the first ditch was built others were constructed a few miles above or below. As long as the stream is of sufficient volume to fill each of the ditches, no difficulties from this arise; but sooner or later the increasing size and number of ditches and canals result in diminishing the flow in the river to such an extent that it becomes low, and water does not reach the ditches farthest downstream.

The result has been that in many parts of the arid region, owing to scarcity of water, lawlessness has prevailed, and every man has endeavored to obtain for his own crops as much as possible of the scanty supply. Usually the irrigators elected a water-master to apportion to each claimant a certain amount of water, or assign certain days or hours upon which water can be used. Often the quantity of the water has been settled only after vexatious lawsuits or neighborhood quarrels. In some parts of the arid region, notably in Wyoming and Colorado and Idaho, the States have undertaken the regulation of disputes, and have created special boards or tribunals to consider the matter and apportion water.

Methods of Obtaining Water.— In the arid region water can be obtained frequently by digging or boring wells at points near stream-channels or along the foot-hills. Out on the broad valleys it may be necessary to go to a depth of from 100 to 300 feet or more before reaching moisture. Where the supply of water from wells is ample, various devices have been employed, such as windmills and gasoline engines, for bringing it to the surface. It is very important to continue the borings through the water-bearing sands or gravel, so as to take advantage of the full thickness of the pervious deposits. Perforated pipe is often driven into the layers of coarse gravel, and adds greatly to the capacity of the well. Artesian or flowing wells may be sunk wherever water held under pressure in pervious material is overlaid by clay. In a well dug through the impervious layer into the gravel the water will rise to a height equal to the line of saturation of the gravel stratum in the surrounding country. Artesian conditions occur in nearly every State, but they do not extend over any considerable portion of the country, excepting on the Great Plains and in California. Wherever they occur the water has especial value on account of the convenience incident to its rising above the surface. In some places, as the James River Valley of South Dakota, the pressure is 100 pounds or more to the square inch, throwing the water to a considerable height and enabling the wells to be used as sources of power. The quantity of water to be had from deep wells is governed by the diameter of the well, the structure and thickness of the water-bearing rocks, and the pressure sustained by the water. With relatively dense rocks a slight head of water will throw only a feeble stream, but from thick layers of open gravel or sand rock large volumes are delivered. It frequently occurs that a 4-

inch pipe will deliver all of the water which can reach this point, and increasing the diameter of the well will not alter the flow.

While most of the water used in irrigation is diverted by gravity from flowing streams, yet, as regards value, it may be said that some of the most important sources of supply are utilized through pumping. In some localities where horses have little value, pumping by horse-power is in vogue. The practicability of irrigation in this way is limited largely by the depth of the water and the number of animals available. The force of flowing water itself is frequently employed to bring water up to the level of the irrigable land, the bucket-wheel having been utilized from the earliest historical times up to the present. The most important source of power for pumping water is wind. Over the broad valleys and plains of the arid region the wind-movement is almost continuous for days and weeks. It is a comparatively simple and inexpensive operation to sink a well into the water and erect a windmill, attaching this to a suitable pump. A windmill once erected on the plains is operated day and night by the wind, bringing to the surface a small but continuous supply of water. This small stream if turned out on the soil would flow a short distance, then disappear into the thirsty ground, so that irrigation directly from a windmill is usually impracticable. To overcome this difficulty it has been found necessary to provide small storage reservoirs or tanks, built of earth, wood, or iron, to hold the water until it has accumulated to a volume sufficient to permit a stream of considerable size to be taken out for irrigation. Such a stream, flowing rapidly over the surface, will penetrate to a distance and cover an area much greater than is possible with the small flow delivered by the pump. One disadvantage connected with the use of windmills is that most of them are constructed to operate only in moderate winds. As the strength of the wind increases, the wheel begins to revolve, increasing in efficiency until the velocity of the wind is about eight or ten miles an hour. At greater speed the mills are usually so constructed that the efficiency decreases rapidly as the wind becomes more powerful. When it approaches a gale, the mill stops completely.

In many places drainage-works are a necessary adjunct of irrigation. On bench-lands or gently sloping hillsides the water which escapes from one man's farm is eagerly caught and used by his neighbor below, and there is none left to stagnate, the surplus from the cultivated lands being often of great value in watering the lower meadows. There are cases, however, where the question of disposing of the water is as important as that of obtaining it. These are on the nearly level lands, where the subsoil has been filled to saturation by the water which has no opportunity to escape, and expensive works are required in order to redeem the lower lands for agricultural purposes.

Duty of Water.— The amount of land which can be irrigated with a given quantity of water, or the relation which these bear to each other, is commonly expressed by the term duty of water. The investigation of the duty of water is one of the most complicated problems of irrigation. There is such a difference in methods of measurement, localities, soils, crops, application of water, and frequency of watering that the statements made by different persons are almost irreconcilable. In general, more water is used, or the duty is less, on the newer land than on that which has been cultivated by irrigation for some years. The rainfall also affects the quantity used, and as this is exceedingly irregular, the amount of water applied each year fluctuates. Seepage likewise complicates matters, for a field may often receive considerable water indirectly and require less by direct application. The duty of water is quoted at from 30 to 500 acres or more to the second-foot. For convenience the unit of 100 acres to the second-foot has been considered as indicating careful irrigating, although in the more southwestern portion of the arid region this would be considered low, and in the northern part high.

Since the value of water per second-foot varies largely with its duty, it will be recognized that it is exceedingly difficult to estimate. However, it is necessary to arrive at certain averages in order to approximate the possible values of river, or of storage basins, in the future development of the country. It has been estimated that a perpetual water-right is worth from $25 to $50 per acre in a grain or grazing country, and as high as from $100 to $500 per acre for fruit-land, rising in southern California for the best citrus lands even to $1,000 or more per acre.

Alkali.— The accumulation of alkali in irrigated lands presents one of the most serious problems encountered in this method of agriculture. The injuries from the presence in excess of earthy salts are usually evident in the corrosive action of the tender bark, especially at the root-crown. Experiments made in California show that apple-trees are severely injured by the presence of 3,000 pounds of common salt per acre, this amount being disseminated through four feet in depth. On the other hand, the olive thrives at Tulare, where the soil contains as high as 5,600 pounds of salt per acre. Alfalfa, when young, is easily killed by alkali, but it has been found to thrive in soil containing as much as 6,000 pounds of common salt, 3,000 pounds of carbonate, and over 1,000 pounds of sulphate, per acre, distributed through six feet in depth. Sugar-beets also have been known to grow well where a large amount of alkali is present. Grapes apparently are least affected by small amounts of alkali, while peaches and lemons are more susceptible to injury because of its presence. The recently introduced salt-bush is notable for its ability to grow in alkaline lands, and sorghum and alfalfa, especially when the latter has reached maturity, are almost equally vigorous.

The most effective way of removing alkali is by underdrainage through tiles laid at a depth of from three to five feet, the drainage-water being allowed to escape into a stream, or into a well from which it can be removed by pumping. Recent authorities on the subject claim that the trouble caused by alkali yields sometimes to careful treatment, and that science has partly solved the problem. It is shown that the tiling of land for alkaline washing costs no more than drain-tiling as practised on eastern farms. In the government demonstration at Salt Lake City, where the percentage of alkali is enormous, the lines of tile are 150 feet apart. The water descending into the soil dissolves large quantities of alkali near the surface and carries it off in solution. Land so tiled, even if badly alkaline, can be returned to profitable cultivation in time if heavily irrigated, and within one year can be used for the production of some crops suited to the climate. Large areas of alkali land in the West may be reclaimed at a cost below the actual increase in the value of the land. It is thought that the time will soon come when drainage will be as common in the irrigated districts as are the tile-drained fields of the Middle West.

States Compared.— In the number of irrigators California stands far ahead of any other State, having about one fourth of the total number in the United States. Colorado, however, exceeds in the number of acres irrigated, although not in the value of irrigated crops. In this respect California leads, having a value double that of Colorado, and over one third that of the total value of irrigated crops in the United States. The greatest percentage of increase in the number of irrigators has been in the State of Washington, and the least in Oregon. This, doubtless, is due to the fact that in irrigation Oregon reached a certain culminating point previous to 1889, while in Washington the construction of ditches had only begun.

Comparison of Crops.— In considering the character and value of the crops produced on irrigated land in the arid States and Territories, hay and forage form the most important item, being over one third of the whole. Cereals — principally wheat, oats, rye, and barley — come far below the forage crops; and next to these in order are vegetables, orchard fruits and small fruits. In California only the orchard fruits surpass the forage crops in value. The large production of hay and forage under irrigation illustrates the fact that in these States irrigation is, to a large extent, an adjunct of stock-raising. The production of cereals under irrigation is relatively small. In California, for example, only 6.0 per cent of the wheat is irrigated, and 8.0 per cent of the barley. The total value of all the cereals produced under irrigation in the United States is far less than that of those produced in almost any one of the humid States of the East; in New York, for example, though it is not considered a farming State, the value of the cereals raised is more than double that of the entire amount produced under irrigation in the whole country. In many localities the irrigation of cereals and staple crops has been brought about by local conditions, such as difficulty of transportation and consequent heavy cost of importation. The irrigated cereals in such localities are raised almost wholly for local consumption, and do not enter the markets of the world.

Economic Bearings.— Irrigation has important economic aspects especially seen in the greater success of the small irrigated holding. The Salvation Army, following the example of the Mormon colonies of 1847 in Utah, and of the Greeley community in California, has located small communities on reclaimed farms. The process of colonization will always be slow from the nature of the case, and the effect on eastern agriculture, far from being sudden and severe as was urged by the opponents of the Irrigation Bill in 1902, will be gradual. It may be very beneficial in forcing eastern farmers to more careful use of their water-supply, and perhaps to the adoption of a modified scheme of irrigation, which has been found to increase crops even in humid districts, and which would at least be a valuable resource in times of drought.

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Irrigation Bill, or Reclamation Act, a Federal measure, dated 17 June 1902, for the reclamation by irrigation of arid and semi-arid lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, Washington and Wyoming. See Irrigation.

Irtish, ir'tish, a river of Asia, which rises in China, in the Altai Mountains, and after expanding into Lake Zaisan, flows through the Russian territory of Semipalatinsk, passes the town of Tobolsk, and finally, after a course of about 1,800 miles, joins the Obi near Samarova.

Irus, nickname of the beggar of Ithaca who served the suitors of Penelope as a messenger. Immortalized in the 18th book of Homer's 'Odyssey,' he becomes the typical beggar of later literature.

Irvine, William, American Revolutionary general: b. near Enniskillen, Ireland, 3 Nov. 1741; d. Philadelphia 29 July 1804. Having graduated at Dublin University, he studied medicine and surgery, and was appointed surgeon on board a ship of war, serving during a part of the war of 1756–63 between Great Britain and France. On the declaration of peace he emigrated to America, and in 1764 settled in Carlisle, Pa. At the opening of the Revolution he took part with the colonies, was a member of the provincial convention assembled 15 July 1774, until he was appointed by Congress, 10 Jan. 1776, colonel of the 6th battalion of the Pennsylvania line. On 12 May 1779 he was promoted to the rank of brigadier-general, and assigned to the command of the 2d brigade of the Pennsylvania line. In the autumn of 1781 he was ordered to Fort Pitt, to take command of the troops on the western frontier, and continued to fulfil the duties of this post, until after the war had closed. He was early in 1785 appointed by the State agent under an «act for directing the mode of distributing the donation lands promised to the troops of the commonwealth.» About this time he suggested to Pennsylvania the purchase from the United States of the tract of land known as «the triangle,» thus giving to the State an outlet upon Lake Erie. He was a member of Congress under the confederation 1787–8, and of the Federal Congress 1793–5. In 1794 he was assigned to the command of the Pennsylvania troops for the purpose of quelling the «whiskey insurrection,» and in all the most important movements in connection with this subject took an active part. He was president of the State society of the Cincinnati at the time of his death.

Irving, ėr'vĭng, **Edward,** Scottish preacher, founder of the religious sect known as Irvingites: b. Annan, Dumfriesshire, 4 Aug. 1792; d. Glasgow December 1834. He was graduated at the University of Edinburgh, and in 1815 became a licentiate of the Church of Scotland and subsequently Dr. Chalmer's assistant. In 1822 he became minister of the Caledonian Asylum chapel in Cross Street, Hatton Garden, London. Here he soon attracted very large congregations by the force and eloquence of his discourses, and the singularity of his appearance and gesticulation. The greatest orators and statesmen of the day crowded with the wealthy and fashionable to hear him. The appearance of the preacher — tall, athletic, and sallow — displaying a profusion of jet-black glossy hair reaching to his shoulders, with a singular obliquity in one of his eyes, and a stern calm solemnity of aspect, enhanced the interest and excitement produced by his discourses. His phraseology was one of the peculiarities which gave him *éclat* with the public, for he expressed his ideas in the language of Milton, Hooker, and Jeremy Taylor. At London he began to publish books in which he broached novel theological views. 'Sermons, Lectures, and Occasional Discourses,' in which his theological peculiarities were first distinctly enunciated, were published in 1828. In the beginning of 1832 his aberrations had become so marked and extraordinary that his hearers, who in 1829 had erected for him a large church in Regent Square, preferred charges against their minister. On 2 May 1832 the London presbytery unanimously found him guilty of error. The consequence was that he became dispossessed of his cure. In 1833 the presbytery of Annan, which had licensed him, deposed him from the ministry, on which occasion his defense of himself was a sublime effort of oratory. He retired to Scotland, broken in health and spirits, and was attacked with consumption. For the religious sect he founded see CATHOLIC APOSTOLIC CHURCH. His life has been admirably written by Mrs. Oliphant.

Irving, SIR **Henry** (originally JOHN HENRY BRODRIBB), English actor: b. near Glastonbury 6 Feb. 1838; d. Bradford, 13 Oct. 1905. He was a clerk in London, but adopted the theatrical profession, his first appearance being at Sunderland in 1856. He appeared first in London at the Princess' Theatre, in 1859; later went to Manchester, where he remained for five or six years, but returned to London in 1866, where his first marked success was as Digby Grant in Albery's 'Two Roses' (in 1870), which was followed by his powerful impersonation of Mathias in 'The Bells.' His next noteworthy parts were Charles I., Eugene Aram, and Richelieu, in the plays so named. In 1874 at the Lyceum Theatre, he sustained the part of Hamlet so successfully as to raise himself to the first place among English actors. His chief Shakespearian parts are Macbeth, Othello, Shylock, and Richard III. In 1878 he leased the Lyceum Theatre for himself, and later put on the stage in excellent style 'Othello,' 'The Merchant of Venice,' 'Much Ado About Nothing,' 'Romeo and Juliet,' 'Twelfth Night,' 'Faust,' 'Macbeth,' etc., playing in them the principal character with Miss Ellen Terry. His appearances in the provinces were equally successful with those in London, and he met with like favor in his repeated visits to the United States. Of his last great roles may be cited Becket in Tennyson's play of that name (1893), King Arthur in a play of that name (1895), Napoleon in 'Madame Sans-Gêne' (1897), the title role in his son's play of 'Peter the Great' (1898), and Robespierre in a play of that name (1899), specially written for him by M. Victorien Sardou, and the title role in 'Dante' (1903). He was knighted in 1895, and in 1898 Cambridge University conferred on him the honorary degree of LL.D.

Irving, Washington, American author: b. New York 3 April 1783; d. Tarrytown, N. Y., 28 Nov. 1859. His father, William Irving, merchant, came to New York from the Orkneys in 1763, having married Sarah Sanders, daughter of Cornish parents, two years before. Washington was the youngest of their 11 children. His school training was far from thorough, and was not directed toward academic culture — though two of his brothers had been sent to Columbia College — a decision of his father that he much regretted in maturer years. He made up for his lack of interest in school subjects by enthusiastic reading in English authors, particularly Chaucer and Spenser. At 16 he entered a law office, and in 1802 began authorship by contributing humorous sketches, over the name of «Jonathan Oldstyle,» to *The Morning Chronicle,* a daily edited by his brother Peter. Developing symptoms of consumption, he sailed in 1804 for France, and spent two years in travel, on the continent and in England, which restored his health. On return he was admitted to the bar, but instead of practice began, in 1807, with his brother William, and James K. Paulding, the issue of 'Salmagundi,' the success of which determined his career, and the immediate character of his writing. At the close of the next year he set about reshaping the burlesque history of New York, which he had begun, with Peter Irving, some time before on a different plan. While in this work he met with the great affliction of his life, the loss of his betrothed, Matilda Hoffman, daughter of a prominent lawyer of the city, in whose office he had finished his legal studies. The completion of the book, 'Dietrich Knickerbocker's History of New York,' published in 1809, was the only solace that he permitted himself in the first months of seclusion and grief. In 1810 he wrote a short life of the poet Campbell, and was received into partnership by his brothers Peter and Ebenezer, who were founding an importing house, and wished to provide

Washington the means, without contribution of time or labor to the business, of preparing himself more fully for his chosen work. In 1813 and 1814 he edited the 'Analectic Magazine,' published in Philadelphia, and contributed biographical articles upon some of the naval commanders in the war then in progress with Great Britain. After the burning of our national capital in 1814, he offered his services to his native State, and was made aide-de-camp to Governor Tompkins, with the rank of colonel. At the close of the war he sailed for England, and was received with distinction by the American artists Allston and Leslie, and by Scott, Campbell, Moore and other literary men. In 1818 the firm of P. and E. Irving and Co. failed, and Washington's pleasant rambles in England and Scotland came to an end. He declined a post in the navy board, at home, and set himself at work in London with his pen. Early in the next year he sent over for publication in New York and Philadelphia, the first number of the 'Sketch Book,' containing 'The Voyage,' 'Roscoe,' 'The Wife,' and 'Rip Van Winkle.' Other numbers followed, the success was great, and in 1820 John Murray brought out an edition of the work in London. Its popularity with British readers was such that Murray became the first publisher of 'Bracebridge Hall' (1822), 'Tales of a Traveller' (1824), and other works. In 1826 Irving went to Madrid, at the instance of his friend, Alexander H. Everett, American minister to Spain, who advised the translation of Naverreté's 'Voyages of Columbus,' then issuing in parts. Irving found the work impracticable to translate, being a collection of sources rather than a consistent narrative, and prepared instead the 'History of the Life and Voyages of Christopher Columbus,' finished in 1828. This first serious product of Irving's powers retained much of the ease and charm of 'The Sketch Book' and 'Tales of a Traveller,' and was eminently adapted to increase his fame. It was not especially successful, though Murray paid 3,000 guineas for the copyright; an abridgment of the work had a better sale. 'The Conquest of Granada' (1829), 'Companions of Columbus' (1831), and 'The Alhambra' (1832) were further fruits of his Spanish studies and travel. In the meantime he had been made secretary of legation (1829), in London, and received the medal of the Royal Society of Literature (1830), and the degree of LL. D. (1831) from Oxford. In 1832 he returned to America, but not to rest. He accompanied an Indian commission to Fort Gibson, on the Arkansas River, and wrote 'Tour on the Prairies,' published as the first volume of 'Crayon Miscellanies,' in 1835. The second volume, 'Abbotsford and Newstead Abbey,' and the third, 'Legends of the Conquest of Spain,' followed in a few months. He now bought the little Van Tassel farm, at Tarrytown, and began to enlarge its Dutch cottage, and improve the grounds. To this home, called "Sunnyside," he soon removed from the city, and eventually brought to it the brothers who had aided him in earlier years. In 1836 he finished 'Astoria,' with the help of his nephew, Pierre M. Irving, from materials furnished by John Jacob Astor. The next year he published 'The Adventures of Captain Bonneville,' properly a continuation of the preceding. He then began a history of the conquest of Mexico, but on learning that W. H. Prescott was at work on the same subject, resigned the task to him. In 1839 he engaged to write for the 'Knickerbocker Magazine,' and furnished monthly articles for about two years. In 1842 he was appointed Minister to Spain, and for the next four years wrote little. On return he arranged with G. P. Putnam for a complete edition of his works, in 15 volumes, to which he added (1849) the 'Life of Goldsmith,' and (1850) 'Mahomet and his Successors.' The way was now open for the 'Life of Washington,' which had long been contemplated. In 1855 appeared 'Wolfert's Roost,' mainly a reprint of the Knickerbocker papers, and two volumes of the 'Life.' The work told on his strength, and the fifth and last volume, finished in March, 1859, left him a broken man. His death was from heart disease, in his 77th year. He was buried by the side of his mother, whose tastes he had inherited, and whose sympathy and nurture had made him what he was. His authorship was the outcome of his personal character, and was little modified by the literatures of the world. With all his graces of expression, he lacked the gift of deep insight, and failed to achieve much vigor of style. The best biography is still the 'Life and Letters' by his nephew, Pierre M. Irving (1863). Consult also Warner, 'Washington Irving' (1881); Laun, 'Washington Irving: Ein Lebens- und Charakterbild' (1870); Richardson, 'American Literature' (1887–8); Wendell, 'A Literary History of America' (1900).

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Ir'vingites. See Catholic Apostolic Church.

Ir'vington, N. J., a town in Essex County, adjoining Newark on the southwest. It is a pleasant residential suburb of that city, and also has a number of manufactories, among which are smelting-works and establishments for making wall-paper, pocket-book frames, tools, brushes, rules, etc. The town was incorporated in 1898, although its settlement dates back almost to 1660. Its governmental affairs are in the hands of a town council. Pop. (1900) 5,255.

Irvington, N. Y., village in Westchester County, on the Hudson River, and the New York C. & H. R. railroad, 23 miles north of New York, and a short distance south of Tarrytown; named in honor of Washington Irving. It is mainly a residential village of recent growth and is noted for its beautiful dwellings and grounds, with their fine situation on the river-bank. These are largely the homes of New York business men and their families. The Guiteau Library and the town-hall are among its most noteworthy buildings. The village is a place of great interest as being the location of "Sunnyside," for many years the home of Washington Irving. The house, half a mile north of the railroad station, "is a many-gabled, vine-clad cottage, covered with stucco, and shadowed by grand trees." It has been rebuilt and enlarged. Pop. (1900) 2,231.

Isaac, ī'zak (Heb. "he will laugh"), Hebrew patriarch, the son of Abraham by Sarah, so called to denote the laughter and gladness occasioned by his birth. He is remarkable for his miraculous escape from death as a burnt-

WASHINGTON IRVING.

offering; and for the fraud perpetrated upon him, at his wife Rebecca's instigation, by his son Jacob, to the injury of Esau. He died at Hebron 180 years old, and was buried in the cave of Machpelah, the resting-place of Sarah and Abraham, and of Rebecca.

Isaac, I., Comne'nus, Byzantine emperor: d. 1061. He was the son of Manuel Comnenus, an eminent general under Basil II., emperor of Constantinople, and was the first of his family to assume the purple. He had distinguished himself as a soldier and commander in the wars against the Arabs in Asia Minor, and had married a captive Bulgarian princess. In 1057 he succeeded to the throne upon the deposition of the aged and incompetent Michael VI. He abdicated in 1059 and spent the remainder of his life in a monastery.

Isaac, II., An'gelus, Byzantine emperor: d. 1204. He became sovereign of the East in 1185, and reigned 10 years. Isaac was a vicious and cowardly prince, and was dethroned, blinded, and imprisoned by his brother Alexius in 1195. Eight years later he was restored to the throne and reigned for six months, when he was again dethroned, and soon after died in prison.

Isaak Church, The, the finest building in Russia, or in northern Europe, begun by the Empress Catherine, and finished by Nicholas I. The foundation alone is said to have cost $1,000,000. It is a magnificent structure, one of the most remarkable sights of the Russian capital. The design is simple and majestic, the whole being surmounted by a gilded dome. The total cost of the structure was $67,500,000.

Isaaks, Jorge, hor'hā ē'säks, Columbian novelist and poet: b. Cali, State of Cauca, Colombia, 1843; d. 1895. He was the son of an English Jew who had married a Spanish woman and was taken to Bogotá in childhood, and ever after made it his home. He published a volume of poems in 1864, and in 1867 his masterpiece, the novel 'Maria,' a story of domestic life in Colombia, told with consummate skill and tender simplicity.

Isabela, ē-sä-bä'lä, Philippines, province of Luzon, on the northern Pacific coast of the island with Cagayán on the north and Principe and Nueva Ecija on the south; length 118 miles; area 5,395 square miles (including dependent islands), the largest province of Luzon. The Sierra Madre mountain range runs parallel to the coast, a short distance inland; the rest of the surface is broken by low hills; the Grande de Cagayán River traverses the entire length of the province; and the main highway from Aparri to Manila parallels this river. Rice, sugarcane, chocolate, coffee, corn and vegetables grow with little cultivation; tobacco is extensively raised and its growth and treatment is the most important industry. Cattle raising is also an important industry. Civil government was established in 1901. Pop. 48,300.

Isabella, (ĭz-a-bel'a) **(I.) of Castile,** queen of Spain, daughter of John II., king of Castile and Leon: b. Madrigal 23 April 1451; d. Medina del Campo 26 Nov. 1504. She married, 19 Oct. 1649, Ferdinand V., king of Aragon (q.v.), surnamed "The Catholic." After the death of her brother, Henry IV., in 1474, she ascended the throne of Castile, to the exclusion of her elder sister, Joanna. After the kingdoms of Aragon and Castile were united, Ferdinand and Isabella assumed the royal titles of Spain. She was always present at the transaction of state affairs, and insisted that her name should be placed beside that of her husband in public ordinances. The conquest of Granada, after which the Moors were entirely expelled from Spain, was in a great degree her work; and the encouragement she gave Columbus assisted him to the discovery of America. In all her undertakings Cardinal Ximenes was her assistant. In 1492 Pope Alexander VI. confirmed to the royal pair the title of "Most Catholic," already conferred on them by Innocent VIII. The zeal for the Roman Catholic religion, which procured them this title, gave rise to the Inquisition, which was instituted in Spain in 1480, at the suggestion of their confessor, Torquemada. See FERDINAND V., XIMENES, and COLUMBUS. Consult Prescott, 'History of the Reign of Ferdinand and Isabella the Catholic.'

Isabella II., ex-queen of Spain, daughter of Ferdinand III.: b. Madrid 10 Oct. 1830; d. Paris, France, 9 April 1904 she succeeded her father in 1833. The early years of her reign were disturbed by a rising in favor of her uncle, Don Carlos, who, if the Salic law had not been set aside, would have ascended the throne instead of her; but this was quelled in 1839. She was declared of age in 1843, and in 1846 was married to her cousin, Don Francisco d'Assisi (q.v.). Her reign was so despotic that a revolution took place in 1868, which drove her from the country. She resigned her claims to the crown in favor of her son Alfonso, who ascended the throne in 1875 as Alfonso XII.

Isabellita. See BUTTERFLY-FISH.

Isaeus, one of the "Ten Attic Orators," though probably a native of Chalcis, made his home in Athens, and there, in the first half of the 4th century B.C., we find him actively engaged in the profession of a speech-writer for clients in the law courts. He seems also to have taught rhetoric, to Demosthenes among others, according to one tradition. We have from him a dozen orations dealing with inheritance cases, two of them in a fragmentary condition. The best edition is that of H. Buermann (Berlin 1883). There is an English translation by W. Jones (London 1779).

Isaiah, one of the great Hebrew prophets. The name Isaiah, more exactly *Yeshā'yā* and *Yeshā'yāhū*, is derived from two Hebrew words and means "Jehovah saves." It refers to the general burden of the prophet's message. The prophet, who was the son of Amoz (q.v.), a man otherwise unknown to us, was born probably at Jerusalem, and this place, the scene of his life work, and in his thought synonymous with his country, engrosses his attention. The year of his birth must have been about 760 B.C., his known activity begins in 739 and continues to 701 B.C., at least. He was married not far from the time of his call in 739, for in 735 a son of his, with a name symbolic of his prophetic message to Judah, *Shear-yashubh*, "a remnant shall turn" (*i. e.*, to Jehovah), was of an age suitable to accompany his father in his walks. Another son, *Maher-shalal-hash-baz*, was born in 734, and his name also is symbolic of predicted events in the national history, namely, the fall of Damascus and Samaria, and means "hastening to booty, speeding to prey."

It is to be remembered that Amos (750 B.C.), and Hosea (q.v.) (735 B.C.), are the only canonical prophets that preceded Isaiah, and these had their work in the northern kingdom, though Micah (q.v.) prophesied in a country district of Judah during the middle and later periods of Isaiah's ministry. It is next to certain that Isaiah was of high rank, if not of the nobility in Judah, and at times might be as bold as he chose in his utterances to the court. We cannot be certain whether the Jewish traditions that he was the nephew of King Amaziah (Megilla, 10b), that he was slain by Manasseh (Jebamoth, 49b), and that he was sawn asunder ('The Ascension of Isaiah,' Ethiopic version: cf. Justin Martyr, 'Dial. c. Trypho,' ch. CXX.), have a basis in fact or not.

The principal crises of the country in Isaiah's time occurred in 735, 734 (during the reign of Ahaz), and in 701 (during Hezekiah's reign). The occasion of the first was the union of Damascus and north Israel against the Assyrian over-lord, Tiglath-pileser III. (745–727) and their attempt to overcome Judah. The occasion of the second crisis was the attempt of Judah and her neighbors to avoid tribute to Assyria and their alliance with Egypt against her. At this time Sennacherib was on the throne of Assyria (705–681). Besides these, there were moderate political disturbances in Judah during the reigns of Shalmanassar IV. (727–722), and Sargon (722–705), for both of these warlike kings in these times were in the west country for conquest and subjugated north Israel, as well as the Philistine territory.

In meeting these crises, Isaiah showed himself the most consummate statesman and the most brilliant theological teacher in Israel in the times before Christ. His hold of truth was strong, his presentation of it was uncompromising, his oratory was superb, and the variety and finish of his discourses and the aptness of his illustrations, as well as the measured flow of his thought, were inimitable. It is of course true that in his teaching he built upon his predecessors, Amos and Hosea, but he put such a stamp of genius upon the ideas he cherished, that his influence has been the greatest of all the Hebrew prophets.

In general it may be said that Isaiah's messages had to do with the safety of the capital in the warlike times in which he lived, with the character of God in his sublime holiness and righteousness, and with the duty of his fellow-citizens to cultivate the righteous life, and, forsaking human political wisdom and alliances with the nations, to depend absolutely upon the Lord God. With him, religion and politics go hand in hand, and theological thinking is the kernel of his most practical and stirring addresses. Incidentally he has given us a view of the circumstances of his time, its social relations and habits, the fashions, the commotions and rumors, in times of peace and war, in seasons of prosperity and distress; in all showing himself the most vivid and powerful preacher of the olden time.

The convictions of Isaiah are due to his faith in God and arise out of the circumstances of the time. Jehovah is the Holy One of Israel, hence he must punish Jerusalem for her injustice to men and her falseness to God, and this he will do through the instrumentality of the most potent political powers of the age; but since Jerusalem is the throne of His glory, and the seat of true religion, however formal the people have made their worship, therefore, a portion of the Judeans will be spared, and the city will prove invincible. Indeed his own beloved capital is destined to become the centre of religious truth for the nations, and is to have a new and perfect ruler, who will reign in wisdom and might, and will bring righteousness and peace to the people.

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Isaiah, Book of. It must be premised that the old prophets of Israel, for the most part, gave themselves to oral utterance, and made little use of the written roll. In the case of some of them, the issue of written discourses was an after-thought, and the latter assumed forms revised to suit the practical needs of the readers, just as the first forms had been adapted to the need of the audience that listened to the preacher's spoken words. This is undoubtedly true of the prophet Isaiah, who appears to have felt that by changes in phraseology he could the better meet the advancing needs of the men for whom he labored. In other words, the prophet's interest was not historical; he did not reproduce his sermons with the thought of preserving them for the world exactly as they were delivered, but he had the practical aim of moving a new circle of people to that faith in God which he had previously inculcated. This example was not lost upon the disciples and admirers of the prophets, and in the book of Isaiah the old messages have received modifications at different times to suit the conditions of successive generations. Indeed Isaiah in the pre-Christian centuries was held in such honor that authors added to his writings other discourses and historical material that were calculated to produce the results aimed at by our prophet, and in much of this material there is not even a kernel of Isaian authorship. It is true that such procedure is not in accord with modern ideas of literary ownership, but there is reason to suppose that in ancient times the name of the author of new material was of little consequence, and his work was often hidden in the product of some distinguished predecessor, the delivery of an exigent message being all important.

The book of Isaiah contains 66 chapters from various sources, being a combination of several collections of oracles, and divides itself naturally into seven grand divisions, viz.: chapters i–xii, xiii–xxvii, xxviii–xxxiii, xxxiv–xxxv, xxxvi–xxxix, xl–lv, lvi–lxvi.

1. Chs. i–xii contain several small sections or series of addresses, mostly by Isaiah himself. From the time of his call to the prophetic office in 739 B.C., he probably made notes of his discourses, and about 734, perhaps, he began to issue combinations of these, first for his disciples, and then doubtless for a larger circle of readers. Chs. vii:1–ix:7, composed of discourses delivered to Ahaz and the people of Judah in 735, 734, is probably the first of these

combinations, and not long afterward this was increased by prefixing to it the inaugural vision, ch. vi, and by affixing ix:8–x:4 (with v:25–30, now misplaced), the prophetic interpretation of north Israel's unhappy history and the application to Judah. Subsequently the prophet appears to have added the woe on Assyria, the instrument of Jehovah's anger against his people (x:5–34), and a prophecy of the righteous king, to whom he had already referred, and of the restoration of Israel (ch. xi).

He, or some disciple of his, prefixed to the book ii:1–iv:1; ch. i; v:1–24, series of discourses that present in most vivid manner the social conditions and the debased life of the age of Jotham and Ahaz, as well as the evil consequences to follow, ere the kingdom of God could be established. Ch. i, called by Ewald "The Great Arraignment," is a general introduction to this part, and was composed after 734, possibly several years afterward, ch. i:1 being an editorial note to introduce all the prophecies of Isaiah. Ch. iv:2–6, ch. xii, are probably post-exilic additions to this division of Isaiah.

2. Chs. xiii–xxvii may be called the book of woes. The genuine Isaiah passages are in substance: xiv:24–27, the removal of the Assyrian yoke, xiv:28–32 woe on the Philistines, both delivered during the domination of Sargon or Sennacherib; xvi:13–14, on Moab, delivered perhaps in 711; xvii:1–11, the fall of Damascus, 735; xvii:12–14, the repulse of Assyria, 701; ch. xviii, the message to Ethiopia concerning the disaster to Assyria, 701; ch. xx, on Egypt, 711; xxi:11, 12, on Edom, and xxi:13–17, on Arabia, of uncertain date, may have been readapted to the exilic situation in 545 B.C.; ch. xxii, against Jerusalem and one of its prominent statesmen, belongs to 702, 701; the substance of ch. xxiii (on Tyre), especially vss. 1–14, was given about 702 B.C. Upon these as a nucleus have been grafted oracles from various epochs and authors; namely xiii:1–xiv:23, the fall of Babylon, composed in Babylonia about 549 B.C.; xv: 1–xvi:12, an old oracle quoted by Isaiah himself, possibly in 711; ch. xix, on Egypt, is a post-exilic oracle, but in vss. 1–15 there may be an Isaiah kernel, from 720, 711, or 702; xxi:1–10, on Babylon, is exilic, dating from about 545 B.C.; chs. xxiv–xxvii form a long post-exilic apocalypse, concerning the judgment on the world and the future blessedness of Israel, and may be assigned with probability to the later Persian period.

3. Chs. xxviii–xxxiii are substantially from Isaiah's hand, and belong chiefly to the time of his later activity. In ch. xxviii, Isaiah's earlier message against Samaria (vss. 1–6, before 722) is reiterated with reasons, in or about 704. In chs. xxix–xxxii we have in several paragraphs a representation of the straits to which Jerusalem was put just before 701 B.C., the futility of reliance on Egypt for help, the weakness of the Judean politicians, the indifference of the women of the capital, the ultimate deliverance of the city, the fall of Assyria, and the coming of the Messianic age (the latter in three passages, xxx:18–26; xxxii:1–8, 15–20; ch. xxxiii is supplementary to this, contains a woe upon some power hostile to Jerusalem, and the prediction of Judah's deliverance. This is probably a post-exilic expansion of Isaiah's utterances in 701 B.C. The sections xxix:16–24; xxx:18–26; ch. xxxii, have been assigned by some writers to exilic or post-exilic times, and they may contain some elements from these periods.

No further prophecies in the book can be assigned with probability to our prophet.

4. Chs. xxxiv–xxxv form a post-exilic prophecy of 450 B.C., or later, and treat of Israel's victory over Edom and of the joyful circumstances of Israel's restoration.

5. Chs. xxxvi–xxxix are historical chapters taken in large measure from 2 Kings. The Isaian passage omits 2 Kings xviii:14–16, and introduces the song of Hezekiah (Isa. xxxviii: 9–20) before 2 Kings xx:12.

6. Chs. xl–lv are a long and developed prophecy, and comprise the great exilic prediction of about 540 B.C. concerning the return of Israel from Babylonia, through the instrumentality of Cyrus. Omitting subdivisions, of which there are many, Skinner and others divide about as follows:

Chs. xl–xlviii, the restoration: (1) xl:1–11, the theme; (2) xl:12–31, the infinity of God; (3) ch. xli, the historical situation, as it has been brought about by God for his servant Israel; (4) xlii:1–xliii:7, the work of Jehovah's ideal servant (xlii:1–4) for Israel and the world, and the contrast with the servant Israel as he is; (5) xliii:8–xliv:5, the witness of Israel's history to the divinity of Jehovah, and the salvation of Israel and the nations through the divine interposition; (6) xliv:6–23, the folly of idolatry; (7) xliv:24–xlv:25, the mission of Cyrus, the anointed of Jehovah, for Israel and for a world-wide religion; (8) chs. xlvi, xlvii, the fall of Babylon; (9) ch. xlviii, the closing argument, and the joyful summons to Israel to depart from Babylon and to declare to the world their redemption by their God.

Chs. xlix–lv, the glorious future of Israel; (1) xlix:1–13, the mission of the servant (vss. 1–6) to the world; (2) xlix:14–l:3, consolation for afflicted Zion; (3) l:4–11, the perfection of the servant through suffering; (4) li:1–lii: 12, the Israelites encouraged to accept the promises; (5) lii:13–liii:12, the servant's sacrificial work and his exaltation; (6) chs. liv, lv, the felicity of Israel and the gracious call to accept the promised deliverance.

7. Chs. lvi–lxvi are probably for the most part of post-exilic origin, as they appear to contain detached messages of condemnation and promise to a people living in Palestine. Here there are details concerning the moral, social, and religious duties of the people, and worship in the new temple appears to have been established. We divide: (1) lvi:1–8, the admission of foreigners and eunuchs to the Israelitish community; (2) lvi:9–lix:21, a series of rebukes to several classes, interspersed with promises for fidelity; (3) chs. lx–lxii, the new Jerusalem; (4) lxiii:1–6, the divine hero in Edom; (5) lxiii:7–lxiv:12, confession of sin; (6) chs. lxv–lxvi, the contrasted futures of true servants of God and apostates.

The principal idea of Isaiah, besides that of judgment, common to the prophets, was the deliverance from the foes of Jerusalem of the remnant of Israel, meditated by a righteous king. The principal ideas of Isa. xl–lv are the deliverance of Israel from exile through Cyrus, and the deliverance of the people from sin and the impartation of spiritual graces through the suffering servant of Jehovah. Hope, therefore, is the keynote of this prophecy and comfort is the opening word. In connection with the theme, the prophet declares, in turn after turn of speech, the reliability of God in bringing to pass his promises, the sublime grandeur of the Holy One, his creative power, the absurdity of idolatry. The writer makes it clear that the absolute and sole sovereign in the earth is Jehovah, the God of Israel. In Isa. lvi–lxvi there is no advance upon these ideas, but many of them are reiterated there.

Bibliography.— Besides the appropriate sections in Encyclopedias, Old Testament Histories, Old Testament Introductions, Old Testament Theologies, works on Old Testament Prophecy and Messianic Prophecy, Dictionaries of the Bible, Histories of Assyria, Babylonia, Persia, Egypt, and Syria, the following selected works may be consulted. For fuller lists the reader is referred to the articles in the Bible Dictionaries, and for the later books, to the lists of current literature in 'The Biblical World.' In the present list, works written in other languages and translated into English, are given in the translation only.

1. *Commentaries.*— Calvin (1850); Vitringa (1714–20, Latin); Lowth (1778); Gesenius (1821, German); Hitzig (1833, German); Ewald (1876–81); Henderson (1840); Umbreit (1846, German); Drechsler (1851–54, German); Alexander (1865); Delitzsch (1892); Reuss (1876, French); Nägelsbach in 'Lange' (1878); Birks (1878); Cheyne (1889); von Orelli (1889); G. A. Smith (1888, 1890); Duhm (1892, German); Skinner (1896, 1898); Guthe and Ryssel in 'Kautzsch' (1896, German); Mitchell (chs. i–xii, 1897); Kittel's 'Knobel-Dillmann' (1898, German); Marti (1900, German); Whitehouse (1905).

2. *Other Works.*— Driver, 'Isaiah, His Life and Times' (1893); Davidson, 'Theology of Isaiah xl–lxvi' ('Expositor,' 1883–84); 'Theology of Isaiah' ('Expository Times' 1894); Guthe, 'Das Zukunftsbild des Jes' (1885); Giesebrecht, 'Beitr. z. Jes. Kritik' (1890); 'Der Knecht Jahves des Deuterojes' (1902); Hackmann, 'Die Zukunftserwartung des Jes' (1893); Cheyne, 'Introduction to Isaiah' (1895), Translation of Isaiah in 'Polychrome Bible' (1898); König, 'The Exiles' Book of Consolation' (1899); Davidson, 'The Servant of the Lord in Isaiah' ('Brit. and For. Evan. Rev.' 1872); Driver and Neubauer, 'The 53d of Isaiah according to Jewish Interpreters' (1876, 1877); Wright, 'Pre-Christian Jewish Interpretation of Isaiah LIII' ('Expositor,' May 1888); Lane, 'Die Ebed-Jahwe Lieder' (1898); Bertholet, 'Zu Jesaya LIII' (1899); Füllkrug, 'Das Gottesknecht des Deuterojes' (1900).

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Ish'maelites, the descendants of Ishmael, the son of Abraham by Hagar. These are to be found among the Arabians, as physical characteristics and language prove beyond a doubt. The Joktanite and Cushite monarchies in southern Arabia give no indication in character and habits of having had Ishmaelites as founders, but the Bedouins who roam over the deserts lying between the Peninsula of Sinai and the Persian Gulf are unquestionably of Ishmaelite origin. They maintain a primitive and partiarchal form of life, and are full of Isthmaelitie traditions.

Ishmailis, ĭsh-mā'lēs, one of the 72 heretical sects of Mohammedanism (q.v.).

Ish'peming, Mich., city in Marquette County; on the Duluth, S. S. & A., the Chicago, M. & St. P., and the Chicago & N. W. R.R.'s; about 14 miles west of Marquette. It was settled about 1856 and received its first charter in 1857. It is situated in the great iron ore region of Michigan, and is the centre of the iron ore mining industry of the State. Gold and marble are found in the vicinity and an excellent building stone. The manufactures are chiefly the machinery used in mining. There are 2 banks with a combined capital of $150,000, 14 church edifices, and 9 large school buildings. Municipal affairs are administered by a mayor and city council of 20 members elected annually. The population is composed mainly of Scandinavians and English. Pop. (1890) 11,197; (1900) 13,255.

Isidorus, Spanish ecclesiastic: b. Carthagena, between 500 and 570; d. 4 April 636. As bishop of Seville (from about 600) he played a leading role in all affairs of church and state, and in his influence upon the thought and literature of the whole Middle Ages he is to be ranked as second only to Boëthius and Cassiodorus Senator. Among his numerous theological, historical, and grammatical writings, the 'Etymologiae' or 'Origines' should be mentioned. His works are chiefly valuable today for their quotations from earlier writers. The best edition is in Migne's 'Patrologia Latina.'

I'singlass, a form of gelatine (q.v.), whitish, firm in texture, and of great purity, prepared mainly from the sounds or air-bladders of different species of fish, especially of the Russian sturgeon and, in this country, of cod, sturgeon, hake, etc. In some cases the skins are also used for this purpose. Besides Russia, from which it had been principally obtained, the United States and Canada, Brazil and the East Indies furnish considerable quantities to commerce, as do also Manila and the West Indies. It is the basis of the Russian glue, preferred to all other kinds for strength. Isinglass receives its different shapes in the following manner: The sounds are taken from the fish while sweet and fresh, slit open, washed from their slimy matter, divested of a very thin membrane which envelops the sound, and then exposed to stiffen a little in the air. In this state they are formed into rolls about the thickness of a finger, and in length according to the intended size of the staple; a thin membrane is generally selected for the centre of the roll, around which the rest are folded alternately, and about half an inch of each extremity of the roll is turned inward. Boiled in milk, it forms a mild nutritious jelly, and is thus sometimes employed medicinally. It is used in making court-plaster, cement, mock pearls, and many other articles, also in clarifying fermented liquors for improving soups, jellies, etc., and as sizing for linens, silk, ganzes, and other fabrics.

I'sis, the principal goddess of the Egyptians, the sister and wife of Osiris, representing the moon, as Osiris did the sun. The Egyptians believed that Isis first taught them agriculture. She is represented in various forms. In one she has the form of a woman, with the horns of a cow, as the cow was sacred to her. She is also known by the attributes of the *lotus* on her head, and the *sistrum* in her hand, a musical instrument which the Egyptians used in the worship of the gods. She is often accompanied by her infant son Horus. In one celebrated Egyptian statue she was shown with her face veiled. She was particularly worshipped in Memphis, but at a later period throughout all Egypt. From Egypt her worship passed over to Greece and Rome.

Is'lam, a term which signifies the Mohammedan religion: complete submission of body and soul to God, His will and His service, as well as faith in all those articles of profession, commands, and ordinances ordained by Mohammed. Every man who makes this profession (*aslama*) is a Moslem, that is, has entirely given himself up to the will of God, and is, on that account, in a state of salvation (*salam*). It is held that Islam was once the universal religion, and that every child born in the true faith would abide in it, without defection, were it not for parental wickedness. As Islam comprehends the practical as well as the doctrinal tenets of the Mohammedan religion — everything which Moslems must believe and practise — it embraces the whole of their civil and religious polity: for the system of Mohammed relates more to this world than the next, and was designed, like the law of Moses, for the secular as well as the spiritual direction of his followers. But, taken in its more common and direct sense, it signifies the profession of the five fundamental doctrines on which, according to a traditional declaration of the prophet, the whole edifice of the faith is built. Those five points are: (1) The acknowledgment of the Divine Unity and of the prophetic mission of Mohammed; (2) Observance of prayer; (3) Giving of alms; (4) Keeping the fast of Ramadan: and (5) The performance, if possible, of the pilgrimage to Mecca. They are also often subdivided and enlarged, in order to arrange them more conveniently into the two classes of belief (*iman*) and practice (*din*). The former relates to (1) God; (2) the angels; (3) the Sacred Book; (4) the prophets; (5) the last day; and (6) the divine decrees: the latter to (1) purification; (2) prayer; (3) alms; (4) fasting; and (5) the pilgrimage. To the first article of this creed the Persians and other adherents of Ali add, "Ali is the vicar of God": and that is the only essential point in which they differ from the Sunnites, or orthodox Mussulmans, who acknowledge the authority of the four first khalifs. The disputes concerning the succession to the khalifate, or supremacy of the prophet, spiritual and civil, which arose immediately after his death, split his followers, as is well known, into two distinct sects, the Sunnites and the Shiites, who have never since ceased to hate each other with a bitter animosity; but they differ more in the degree of veneration paid to Ali than in any other point; and professing the same creed, with the exception of one article, they derive their doctrines from the same sources. In their respective rituals, and their interpretation of particular texts, there are many minor differences; but both agree in superadding a traditional to the written law of Mohammed, and both have sanctioned that departure from the original simplicity of his doctrine, the re-establishment of which was the professed object of the Wahabees. See MOHAMMED.

Island, a body of land entirely surrounded by water. Islands are of very different extent and surface, and some are so large that authors have doubted whether they should be called continents, as Australia; this, however, is a mere matter of definition. The great masses of land forming the Eastern and Western Continents are in reality islands. The following table shows the relative mainland area of the largest islands:

ISLANDS	Area in sq. m.	ISLANDS	Area in sq. m.
New Guinea	303,000	Iceland	40,300
Borneo	284,000	Mindanao	37,000
Madagascar	227,000	Ireland	32,600
Sumatra	162,000	Haiti	28,800
Honshu	86,500	Tasmania	26,200
Great Britain	83,700	Ceylon	24,700
Celebes	76,500	Nova Zembla — (N. Island)	19,300
New Zealand — (S. Island)	58,500	Tierra del Fuego	18,500
Java	49,000	Nova Zembla — (S. Island)	15,700
Cuba	45,000	Formosa	15,000
New Zealand — (N. Island)	44,500	Hainan	14,000
Newfoundland	40,200	Sicily	9,800
Luzon	40,000	Sardinia	9,000

A cluster of several islands is called an archipelago. The principal clusters in the Atlantic are the West Indies, the Azores, the Canaries, the Hebrides, Orkneys, Shetlands, etc. But the great world of islands is in the Pacific, and some modern writers consider them as forming a fifth division of the world, including the Eastern Archipelago, Polynesia, and Australia, to which they have given the name of Oceania. A large island is a continent in miniature, with its chains of mountains, its rivers, lakes, and is often surrounded by a train of islets. The rivers of islands are in general little more than streams or torrents, and the smaller islands are often uninhabitable from want of water; but they serve as haunts and breeding-places of innumerable sea-birds. There are islands in rivers and lakes as well as in the sea. In rivers they are often formed by the division of the stream into various branches, and often by accumulations of earth brought down and deposited around a rocky base. Examples are not wanting of floating islands, which are formed by the roots of plants and trees interlacing with each other, and thus constituting a support for deposits of successive layers of earth. Islands have been grouped into the two distinct classes of continental and pelagic or oceanic islands. Continental islands follow each other in succession along the margin of the continents, and are generally of the same geological structure. Pelagic islands are mostly of volcanic or coral formation. Considerable islands have been known to be suddenly raised up from the sea-bottom by volcanic action, and soon after to have as suddenly disappeared in the ocean. The Pacific contains a great number of low islands having their basis formed of coral reefs, these reefs being produced by the labors of innumerable coral-animals or zoophytes. (See CORAL.) Submarine islands, as they have been sometimes called, are immense banks of sand above which there is no great depth of water.

Isle La Motte, Vt., in the northern part of Lake Champlain, the northern point about 8 miles from Rouse's Point, N. Y., on the Canadian border; the southern point about 15 miles north of Plattsburg, N. Y. It is about 7 miles long and 2 miles wide. The island has large marble quarries; some of the stone for Victoria Bridge, Montreal, for Fort Montgomery on Lake Champlain, for the Brooklyn Bridge, and for many other structures and buildings came from those quarries.

This island was a frequent resort for the Algonquin and Iroquois Indians: at the south end was once an Indian village. It was discovered by Samuel de Champlain in July 1609 and was named after a French officer, Sieur La Mothe. In 1665 a wooden fort called Fort Sainte Anne was built on the south shore. The 'Jesuit Relations' contain numerous references to Fort Sainte Anne, Isle La Motte, and the visits made to this island by the early missionaries. (The chapel of Sainte Anne, erected near the ruins of Fort Sainte Anne, was consecrated 16 July 1893 by Bishop De Goesbriand of the diocese of Burlington, and it is now a place of pilgrimage.)

On 24 Aug. 1690, Capt. John Schuyler and his company stopped at Fort Sainte Anne on their return from an expedition into Canada. The island was included in the grant made in 1733, by M. de Beauharnois, then governor of Canada, to Sieur Pean, major of the town and castle of Quebec, and in the French seignory granted to Sieur Pedon, councillor in the superior council of Quebec in 1752, notwithstanding the cession of sovereignty to the crown of Great Britain by the French in the Treaty of Utrecht in 1713 over the Five Nations of Indians, who claimed Lake Champlain and the circumjacent territory. In 1775 Philip Schuyler remained on this island over night and joined James Montgomery near there en route for Quebec, where Montgomery lost his life. In the spring of 1776, when Gen. Sullivan withdrew his forces from Canada, the sick were sent to Isle aux Noix, Point au Fer, and Isle La Motte. On 8 Aug. 1776, Benedict Arnold, after engaging the Indians in the British service on 6 August, at the Bouquet River, fell back to Isle La Motte, where his fleet remained anchored until 19 August, when he sailed south toward Cumberland Head.

Isle La Motte was settled in 1785 by Ebenezer Hyde, Enoch Hall, and William Blanchard and was organized as a town in 1790. In 1814 Commodore Macdonough stationed his fleet for a time north of this island and subsequently sailed to the bay near Cumberland Head, N. Y., where he afterward fought the battle of Plattsburg. Soon after Macdonough's departure from the island, in September 1814, Capt. Pring (British) erected a battery on the west shore of the island about a mile and a half south from Fort Sainte Anne and made efforts to win over the inhabitants to the British cause, but failed. On 8 Sept. 1814, he was joined by Capt. Downie and three days later they sailed away to attack the Americans at Plattsburg, where they were repulsed. They returned to Canada, removing their munitions of war from the island in their retreat.

The first permanent settlers on the island were from New England. One of those sturdy pioneers was Capt. Caleb Hill, who, at the War of 1812, organized his townsmen into a military company which was known as Company F of the 2d brigade of the 3d division of the Vermont militia. After the departure of Macdonough, Capt. Hill's house was entered one night by a squad of British soldiers, and in his efforts to take them prisoners he was killed. The first ferry established from Isle La Motte to Alburgh, Vt., was by Capt. Hill, and the ferry was maintained by his descendants for three quarters of a century, until the construction of a stone bridge connecting the two islands.

There are on the island two public schools, a Methodist church, town-hall, and a government light-house. The light-house has been in charge of Wilbur F. Hill for nearly 30 years. The island is a favorite summer resort. The strangers who visit the island and vicinity are reminded of the words by which the Indians, in 1609, told Samuel de Champlain about picturesque Lake Champlain, that "It was filled with beautiful islands and with a fine country surrounding it."

Island Number 10, a former island in the Mississippi River, near the northwestern corner of Tennessee, and about 40 miles below Columbus, Ky. Since the Civil War it has been washed away. It was the tenth in a succession of islands lying below Cairo, Ill. Early in 1862, having been fortified by the Confederate. Gen. Polk, it was commanded by Gen. Mackall, who had about 7,000 troops of Beauregard's army. It was bombarded for three weeks by Commodore Foote, commanding seven Federal gunboats, and surrendered 7 April 1862. The evacuation was forced by Pope with a large land force. He, under cover of a vigorous fire from two gunboats, which had run past the island by night, brought his men across the river in transports. The defenders of the batteries fled, and were pursued into the swamps. Over 6,000 prisoners were taken, together with an immense quantity of ammunition and supplies. The Federal forces lost only a few men. Consult the Century Company's 'Battles and Leaders of the Civil War,' Vol. I.

Isle of Man, in the Irish Channel, the largest island in the English seas. The principal towns are Douglas, Castletown, Ramsey, and Peel. Castletown is the ancient capital, but Douglas (pop. 15,719) is the chief town and the seat of government, which is "home rule" under a lieutenant-governor, who, with council and House of Keys of 24 members, makes up the Tynwald Court. The Manx people are a distinct Celtic nationality. Their language and old customs are rapidly disappearing. Area, 220 square miles. Pop. (1900) 55,608.

Isle of Pines (Isla de Pinos, ēs'lä dā pē'nōs), a small island belonging to Cuba, 40 miles southeast of Pinar del Rio. In 1900 the United States gave unofficial expression to the policy of its acquisition as a coaling station. It has an area of about 840 square miles. It is in effect two islands connected by a marsh, the one on the north being somewhat broken by hills, the one on the south low, flat, and sandy. The climate is healthy, the soil fertile and the mineral resources extensive. For administrative purposes the island is a municipal district of the province of Havana. There are large marble quarries here. Cattle raising is the chief occupation of the inhabitants. Pop. (1900) 3,199.

Isle Royale, roi-al (Fr. ēl rwä yäl), an island in Lake Superior, within the state boundary of Michigan. It is 45 miles long, 9 miles wide and has an area of 229 square miles. Valuable deposits are found here.

Isle of Wight, wīt, the second largest island in the English seas, near the Hampshire coast. It is four miles in breadth, but only a mile in width on the west, between Hurst Castle and Cliff End, while it expands to seven miles between Southsea and the Foreland on the east. In shape the island is an elongated rhomboid. Its extreme length, from the Foreland to the Needles, is about 23 miles, and its extreme breadth, Cowes to St. Catharine's Point, is about 13 miles. The late Queen Victoria had a residence here. The area is calculated at 145 square miles. Pop. (1901) 82,000.

Isles of Shoals, a group of eight barren islands in the Atlantic Ocean, near the New Hampshire coast, 10 miles southeast of Portland, Maine, from which a daily steamer plies during the summer months. The three principal islands are Appledore (400 acres); Star (150 acres), and White (55 acres). There is a revolving government light on the last named, 87 feet above the sea. On Star and Appledore islands are several large hotels for summer visitors who find sea air, boating and fishing here. A few fishermen are numbered among the permanent inhabitants.

Is'lip, N. Y., town in Suffolk County, on Long Island; on the Long Island railroad, 44 miles east of New York. The town comprises several small villages and covers an area 20 miles long and 10 miles wide. Here are the Manhattan State Hospital for the Insane, Saint Joseph's Convent (Roman Catholic), and a large fish hatchery, owned by the State. The town is popular as a summer resort and has many fine hotels along the shores of Great South Bay. The Fire Island lighthouse, 166 feet high, is located eight miles from the mainland. Blue Point oysters are shipped from the town in large quantities. The government is vested in a town supervisor and town board, elected every two years. Pop. (1900) 12,545.

Isocrates, ī-sŏk'ra-tēz, Greek orator: b. Athens 436 B.C.; d. there 338 B.C. His principal teachers were Tisias, Gorgias, Prodicus, and Protagoras. On account of his weak voice and natural timidity he was reluctant to speak in public, but gave lessons in the art of eloquence, and made orations for others. He thus made considerable profit, for he received twenty talents ($14,375) for a speech that he wrote for Nicocles, king of Cyprus. He was the first who saw the value of oratory in public life. By basing it on sound moral principles he rescued it from the abuses of the Sophists. He was distinguished for a polished style and a harmonious construction of his sentences. The composition, revision, and repeated polishing of his speeches occupied so much time that he published little. His celebrated panegyric on Athens 'Panathenaicus' employed him 10, or according to others, 15 years. As all his speeches were modeled after the same pattern, their sameness excited weariness, although his subjects were the most important points of morals and politics. His patriotism was sincere, and his desire for the freedom of Greece so intense, that he starved himself to death in his ninety-eighth year from grief at the battle of Chæronea, «fatal to liberty.» In Plutarch's time 60 orations went under his name, not half of which were, however, deemed genuine. Twenty-one now remain, of which the principal are the 'Panegyricus' (an oration in which he exhorts the Greeks to concord, and to war against the Persians) and the 'Panathenaicus' (in which he dilates on the services rendered by Athens to Greece).

I″sodimor'phous Series. See ISOMORPHISM.

Isoetales, ī-sō-ē-tā'lēz. See FERNS AND FERN-ALLIES.

Isola'tion, in evolution (q.v.), the separation or segregation of any set of animals in a particular area, so that incipient varieties or species are prevented from breeding with the parent species of adjoining regions. Through such isolation the swamping or leveling effects of free intercrossing, or mixing with allied varieties or incipient species, are prevented. As a consequence, variations or nascent species become fixed or localized, being prevented from spreading by some geographic or topographic barrier, with the result that there are many thousands of local races, varieties and species; indeed, probably over half of the number of known species are such forms. Not only species, but genera and higher groups are thus isolated. Thus the marsupials of Australia are, with one or two exceptions, confined to that continent, the connection once existing with Asia having been cut off. In one sense natural selection, or the inbreeding of the fittest, is a form of isolation, as also is preferential mating (q.v.) and also those cases when animals breed at slightly different seasons. What Weismann calls Amixia is substantially the prevention of free intercrossing by the geographical isolation of a part of the individuals of a species from their parent stock. Romanes insists that «without isolation, or the prevention of free intercrossing, organic evolution is in no case possible.» and he claims that isolation «has been the exclusive means of modification, or more correctly, the universal condition to it.»

Examples of Isolation.—These are found among cave animals (q.v.) where animals confined to the nether world, living in total darkness, are prevented from breeding with their ancestors of the upper world. The deep-sea fauna is another such assemblage, living in gloom and in water at the freezing point, although at the surface the winter temperature of the sea may be 80–85° F. Other examples of the result of isolation are the assemblage of animals peculiar to certain islands, to basins walled in by mountain chains, valleys, deserts, and Alpine summits. Interesting cases of isolation on islands are the gigantic moa birds of New Zealand; the local species of birds confined to the different islands of the Galapagos archipelago, also the land shells living in the different valleys of Oahu, one of the Hawaiian Islands.

Another form of isolation Romanes calls «physiological selection,» though Seebohm suggests that physiological isolation would be a better term. The first to call attention to the value of isolation was Lamarck, while Wagner has shown the great value of migration and the intervention of geographical barriers in the formation of species.

Isomerism (Greek, "having equal parts"). Chemists formerly assumed that two bodies must be identical in chemical nature, in all respects, provided they consist of the same elements, combined in the same proportions. This view was long ago found to be untenable, and many substances (mostly compounds of carbon or nitrogen) are now known, which exhibit widely different properties, although possessing the same empirical formula. Bodies which possess this peculiarity are said to be "isomeric" with each other, and the property itself is called "isomerism." In its broadest sense, isomerism may be regarded as embracing (1) polymerism, (2) metamerism, (3) isomerism in the narrower sense, and (4) geometrical isomerism.

Bodies are "polymeric" when they have the same percentage composition, but have different molecular weights. Acetic acid, $C_2H_4O_2$, and grape sugar, $C_6H_{12}O_6$, for example, are polymeric with each other, because they consist of the same elements, combined in the same proportions, and yet the molecular weight of grape sugar is three times as great as that of acetic acid. In this particular case there is no specially close relation between the polymeric substances, and the polymerism is therefore said to be "accidental." When a close relation does exist between the bodies compared, the polymerism is said to be "generic." Ordinary acetic aldehyde affords a good example of generic polymerism. Aldehyde has the formula C_2H_4O, but when treated with a mineral acid it becomes transformed into paraldehyde, which has the formula $C_6H_{12}O_3$; and the reverse transformation (of paraldehyde into aldehyde) may be effected by the application of heat.

Compounds are said to be "metameric" when they have the same empirical formula, but differ structurally by containing different radicals, joined by a polyvalent element such as oxygen, nitrogen, or sulphur. Ethyl ether and propyl-methyl ether, for example, both have the empirical formula $C_4H_{10}O$; but ethyl ether contains two ethyl radicals, united by an oxygen atom, and propyl-methyl ether contains a propyl radical and a methyl radical united by oxygen in the same manner. Thus these two metameric bodies have the structural formulæ $\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix} > O$ and $\begin{matrix} C_3H_7 \\ CH_3 \end{matrix} > O$, respectively. Metamerism is manifested, most commonly, by the ethers, esters, and amines.

Isomerism in its narrower sense, or "true isomerism," embraces those cases in which the bodies compared have the same empirical formulæ, but have different structural formulæ, and do not (like metameric bodies) consist of definite carbon radicals united by oxygen, sulphur, or nitrogen. True isomerism may be of two kinds: (1) "nucleus isomerism," and (2) "isomerism of position." The hydrocarbons afford good examples of both kinds of true isomerism. The paraffin known as propane, for example, has the empirical formula C_3H_8, and the structural formula $CH_3—CH_2—CH_3$. Propane may be converted into butane by replacing one of its hydrogen atoms by the methyl radical, CH_3; but the substitution may be made in two essentially different ways, according as the hydrogen that is replaced is attached to the interior carbon atom, or to one of the terminal ones. In the latter case the structural formula of the new substance is $CH_3—CH_2—CH_2—CH_3$, and the substance itself is known as "normal" butane. If the hydrogen that is replaced is attached to the interior carbon atom, a different substance, known as "isobutane" and having different properties from normal butane, is formed; its structural formula being

$$\begin{array}{c} CH_3—CH—CH_3. \\ | \\ CH_3 \end{array}$$

These two substances,— normal butane and isobutane — are said to manifest "nucleus isomerism," since they differ by the mode of arrangement of their fundamental carbon chains. As the number of carbon atoms in a compound increases, the possibilities of nucleus isomerism becomes enormous. Thus the general empirical formula of the saturated fatty hydrocarbons (or paraffins) is C_nH_{2n+2}. We have seen that in the case of butane (for which $n=4$) two nuclear isomers are possible. If the same kind of reasoning is applied to the higher members of the series, regarding each member as derived from the preceding one by the substitution of a methyl radical (CH_3) for a hydrogen atom, we shall find that there are 3 pentanes ($n=5$) possible: 5 hexanes ($n=6$); 9 heptanes ($n=7$); 18 octanes ($n=8$); 35 ennanes ($n=9$); 75 decanes ($n=10$); 159 hendecanes ($n=11$); 355 dodecanes ($n=12$); and no less than 802 tridecanes ($n=13$).

In that kind of true isomerism which is called "isomerism of position," the isomeric bodies contain substituted atoms or radicals, which occupy different positions in the main chain. Thus a paraffin may be converted into an alcohol by substituting a hydroxyl radical (OH) for one of the hydrogen atoms, and the resulting alcohol will have different properties according to the position of the hydrogen atom that was replaced. For example, four butane alcohols are possible. In normal butane, the structural formula of which is given above, the hydroxyl radical may be substituted for one of the terminal hydrogen atoms, in which case an alcohol is obtained which has the structural formula

$$CH_3—CH_2—CH_2—CH_2—OH$$

and is known as "normal primary butyl alcohol." If the hydroxyl is substituted in the place of one of the interior hydrogen atoms, an alcohol is obtained which has the structural formula

$$\begin{array}{l} CH_3—CH—CH_2—CH_3 \\ | \\ OH \end{array}$$

and is known as "secondary butyl alcohol."

Proceeding, now, to the consideration of isobutane, we note that two essentially different substitutions of the hydroxyl radical are here possible. We may replace a hydrogen atom in one of the three CH_3 groups, or we may replace the one in the CH group. In the first case the alcohol has the structural formula

$$\begin{array}{l} CH_3—CH—CH_2—OH \\ | \\ CH_3 \end{array}$$

and is known as "isoprimary butyl alcohol";

and in the second case it has the structural formula

$$\begin{array}{c} OH \\ | \\ CH_3—C—CH_3 \\ | \\ CH_3 \end{array}$$

and is known as "tertiary butyl alcohol." All of these four alcohols have been actually prepared. (For isomerism of position as manifested in the aromatic compounds, and for the nomenclature used in distinguishing the various isomers that those compounds can exhibit, see AROMATIC COMPOUNDS.)

Certain compounds are known which possess not only the same empirical formula, but the same structural formula also, and yet manifest distinctly different properties, either chemically or physically. Fumaric and maleic acids (see FUMARIC ACID) are examples of this. In such cases the provisional hypothesis is made, that the geometrical structures of the molecules of the two substances are related to one another in something like the same manner that the image of an object in a mirror is related to the object itself, and the isomerism is said to be "geometrical." (See STEREO-CHEMISTRY.)

With reference to isomerism in general, consult Hjelt, 'Principles of General Organic Chemistry'; Lothar Meyer, 'Modern Theories of Chemistry.'

Isomorphism, identity of crystalline form. Isomorphous bodies can form homogeneous mixed crystals; and each one is capable of growing in a saturated solution of the other, fresh crystals being gradually amassed around the original body as a nucleus. Carbonates of calcium, known as calcite; of magnesium, iron, manganese and zinc (magnesite, siderite, rhodochrosite, smithsonite) all are of the same class in crystallography (q.v.). The presence of the same chemical elements of composition in substances does by no means imply isomorphism and substances of very varying components may yet be isomorphous. The isomorphous elements in isomorphous salts, as, for instance, the metals, are generally of the same or related groups of elements. Dimorphous substances, that is, those which form crystals of more than one kind, are often connected by a third dimorphous substance, such as carbonate of lime in the case of calcite and aragonite, and form a group known as isodimorphous substances. See CRYSTALLOGRAPHY.

Isopoda, ī-sŏp'ō-da, an extensive and varied group of *Crustacea* (q.v.) usually ranked as a suborder of the *Arthrostraca* or sessile-eyed *Malacostraca*. The body is broad and flattened, and either short or elongated; the carapace is little developed; the thorax long with seven free segments, each bearing a pair of walking limbs; the abdomen more or less shortened and bearing lamellar branchial appendages. The *Isopoda* are classified in seven tribes and more than 30 families, embracing an enormous number of species. They vary greatly in form and mode of life but all are of relatively small size and retiring habits. The vast majority are marine, but a few are inhabitants of fresh water or terrestrial; the latter are familiar to everyone under the names wood-lice and pill-bugs. Most of the marine forms live a free life but conceal themselves in crevices or among sessile animals and plants, others bore into wood, some, as the gribble and its allies, being destructive to piling; many are commensal or parasitic, among the latter being the *Cymothoidæ*, which infest fishes and whales, and the greatly degenerated *Bopyridæ*, which live in the branchial chamber of prawns and similar crustaceans. Consult Packard, 'Zoology' (1887); Richardson, 'Key to Isopods of North America,' in Proceedings United States National Museum, Vols. XXI. and XXIII. (1899, 1901).

Isospondyli, ī-sō-spŏn'dĭ-lī. See ICHTHYOLOGY.

Isothermal. See LINE; THERMODYNAMICS; MATTER.

Ispahan, ĭs-pa-hän', or **Isfahan**, important city and former capital of Persia, 210 miles south of Teheran, in the midst of an extensive plain watered by a broad river. In the time of Chardin the walls were 24 miles in circuit, and contained 162 mosques, 48 colleges, 1,802 caravansaries, and 273 public baths, and the population was then estimated at 600,000. A great part of the city is at present a mass of ruins. Under the caliphs of Bagdad it became the capital of the province of Irak. Being situated in the centre of the empire, and surrounded by the most fertile territories, it soon became a place of great population, wealth and trade. In 1387 it was taken by Tamerlane and the citizens were given up to indiscriminate massacre, and 70,000 are said to have perished. In 1722 it was taken by the Afghans; but in 1727 it was retaken by Nadir Shah, since which it has not been a royal residence. The great palace built by Shah Abbas is said to have been five miles in circuit, a great part of which space, however, was laid out in ten gardens, adorned with summer houses. The square called Maidan Shah was one third of a mile in length, and was formerly encircled by a canal bordered with plane-trees; but all vestiges of both are now obliterated. The streets are narrow, winding, irregular, unpaved, and very dusty. When Ispahan was in its prosperity its suburbs were distinguished for their extent and beauty. The manufactures of the city are still extensive, including trinkets, fire-arms, sword-blades, glass, and earthenware. The textile fabrics range from the most expensive velvet and satin to the coarsest nankeen and calico. The present population is about 75,000.

Is'raelites. See JEWS and JUDAISM.

Israels, Joseph, yō'sĕf ez-rä-äls', Dutch painter: b. Groningen 27 June 1824. He was a pupil at Amsterdam of Kruseman and at Paris of Picot, and established his studio first at Amsterdam and later at The Hague. Having essayed historical painting with no marked success, he turned his attention to genre work. He found his subjects among fisherfolk and the humbler classes, whose existence, particularly in its more serious or tragic phases, he depicts in a style likened to that of Millet. Among his canvases are: 'Awaiting the Fishing Boats'; 'Alone in the World'; 'Nothing More'; 'The Struggle for Existence'; 'On the Dunes.' He published 'Spanien, eine Reiseerzählung' (1900). Consult the study by Liebermann (1901).

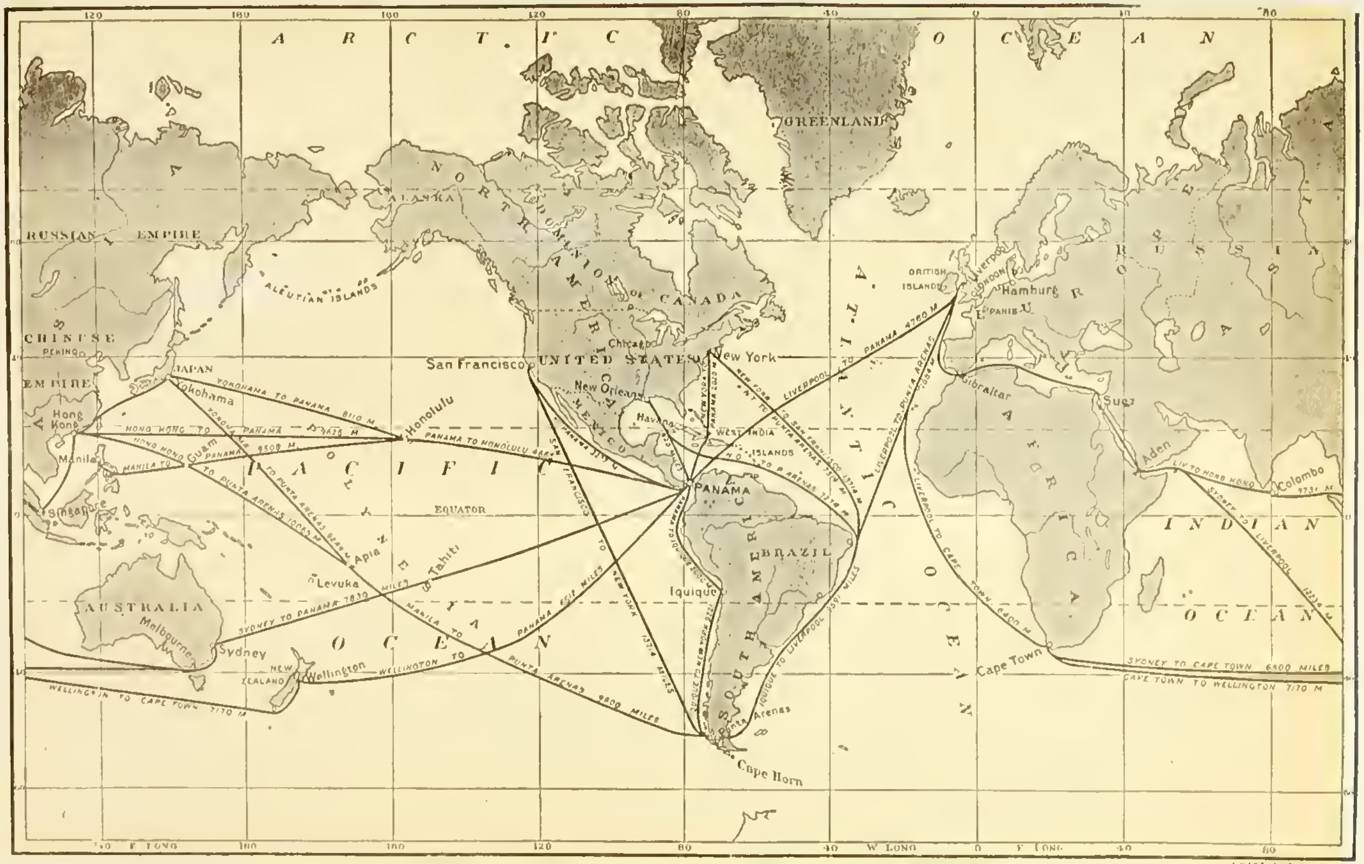
Isthmian Canals, American. The plan of uniting the Atlantic and Pacific Oceans by a great ship canal has been a dream of navigators for several centuries, almost in fact since the days of Columbus, for as early as 1581 the first survey was made to determine the feasibility of connecting the two oceans. In that year, in obedience to instructions, Capt. Antonio Pereira, governor of Costa Rica, organized an expedition and explored a route by way of the San Juan River, the lake, and the rivers emptying into Gulf Nicoya, Costa Rica. In 1620 Diego de Mercado submitted to King Philip of Spain an elaborate report in favor of the construction of a canal over that route which is known as the Nicaragua route. The Panama canal project was conceived later, and other projects were advanced, one of which was the bold conception of James B. Eads, an American engineer, to construct at Tehuantepec a railroad which would be able to carry the largest ships from ocean to ocean. The scheme of connecting the two oceans has possessed a fascination for men of science and an intense interest for men of commerce ever since it was proposed. A number of surveys of the Panama and Nicaragua routes were made during the past half century, but it may be said that not till 1879 was the first positive step taken toward the realization of the project on which so much thought had been expended. In May of that year an International Congress was convened in Paris by M. Ferdinand de Lesseps to discuss the plan of cutting a canal through the Isthmus of Panama. The congress adopted a plan which had been prepared previously by M. de Lesseps, and immediately following that action the Panama Canal Company was formed. The company secured from Lieut. Lucien Napoleon Bonaparte Wyse of the French navy the concession which he had obtained from the United States of Colombia. After the concession had been secured by the company, a commission, known as the De Lesseps Engineering Commission, was sent to Panama to make surveys and prepare estimates of cost. The commission estimated that a canal could be made for 843,000,000 francs. De Lesseps reduced these figures to 600,000,000 francs, or $120,000,000, and announced that a *canal à niveau*, or tide level canal, could be completed for that sum. So confident was he of the accuracy of his calculations that he invited men of prominence to attend the opening of the canal, which he set for 1888.

On 21 Feb. 1881 the first detachment of canal employees arrived at Colon. Surveys were made, and the building of camps, hospitals, and other necessary buildings followed. In 1882 the Panama Canal Company purchased the Panama railway. Interest charges accumulated between 1882 and 1888, while nothing like the progress on the canal which had been anticipated had been made. In the autumn of 1888 further borrowing became impossible, and then came a crash which shook the financial world. On 1 Jan. 1889 the company was forced into liquidation. This event created a ferment throughout France, no less than 800,000 French shareholders having been induced to invest in the stock of the company, largely through the appeals which had been made to their patriotism. A receiver was appointed by the Court of the Seine with unlimited powers. In 1890 the receiver sent a commission of French and other engineers to Panama to report on the actual condition of the work. The report was discouraging. Not more than a fifth of the proposed work had been done; a valuable plant, estimated at $30,000,000, was rusting away and useless; the tide level at Colon was filling in and the harbor was shallowing, owing to the cut.

In 1891 the government of Colombia granted to the Panama Canal Company an extension of 10 years from 1893 in which to finish the contract, provided operations were resumed before February 1893. In November 1892 a member of the French Chamber of Deputies, M. Delahaye, created a profound sensation in Paris by declaring on the floor of the Chamber that the Panama Canal Company had obtained exceptional privileges, which it had used for the purpose of defrauding investors, by the bribery of no fewer than 100 deputies. The demand for an investigation of the charges was of such force and insistence as to be irresistible, and the ministry decided to submit the whole question to a committee. Following this decision, Baron Reinach, a banker accused of being the instrument or agent of much of the corruption of the company, died suddenly, and it was alleged that he had poisoned himself. Amid a popular clamor, such as Paris had not known for many years, the investigation was carried on, and the disclosures before the investigating committee indicated that the operations of the canal company had been slimed with fraud. It was shown that the Panama Company had bribed deputies and journalists on an extensive scale in order to cover up its shortcomings and leave the way open for further imposition.

In February 1893 M. de Lesseps, his son Charles, and some of their colleagues were sentenced to various terms of imprisonment for fraud and bribery. At the time the blow fell M. de Lesseps had passed his 80th year. Bitter as was the feeling of the French toward those who were responsible for their loss of money, much sympathy was manifested toward the man who had been the presiding genius of the great enterprise. That he had been knowingly a party to the great fraud which had wrecked the hopes and fortunes of so many worthy persons in France, the public was loath to credit. The sympathy for him took such form that he was not imprisoned. But the great engineer, who had reaped so much glory through the construction of the Suez canal, was unable to withstand the blow which the Panama exposure gave him. He died in November of the year following. At the end of 1893 the only prominent person left in prison as the result of the Panama prosecutions was M. Baihut, formerly Minister of Public Works.

In 1894 a prominent French engineer proffered a scheme by which he claimed the work could be completed in four years at an additional cost of $110,000,000. A new company was formed, and 300,000 shares were issued. Work on the canal was resumed under French auspices. Early in 1895 a strike occurred among the laborers on the canal, and the methods of the new company were criticised severely by the stockholders. Another scandal such as had attended the operations of the original company was feared, but developments showed that the suspicions were unwarranted. Nevertheless, the confidence of the French public in the ultimate success of the enterprise had been shaken to such extent as to make it manifest that the com-



HOW THE TRADE ROUTES OF THE WORLD WILL BE SHORTENED BY THE PANAMA CANAL

		TO NEW YORK	TO LIVERPOOL	TO NEW ORLEANS
SAN FRANCISCO	via Magellan	13,714	11,084	14,111
	via Panama	*5,299*	*8,038*	*4,698*
YOKOHAMA	via Suez	13,564	11,640	14,929
	via Panama	*9,835*	*12,574*	*9,234*

		TO NEW YORK	TO LIVERPOOL	TO NEW ORLEANS
HONG KONG	via Suez	11,655	9,731	13,020
	via Panama	*11,744*	*14,483*	*11,143*
SYDNEY	via Good Hope	13,658	12 231 (*Suez*)	14,624
	via Panama	*9,852*	*12,591*	*9,251*

pletion of the canal under French auspices was no longer a possibility.

That being the situation, those who were bound up in the enterprise turned toward America for relief. The United States up to that time had concerned itself, as far as the building of a canal was considered, solely with the Nicaragua route. The first survey for a canal at Nicaragua under American auspices was made in 1852 by Col. A. W. Childs. The project as outlined by him has been the basis for all subsequent locations. A second survey was made in 1872 by a party under the charge of Commander E. P. Lull of the United States navy. Eleven years later another survey was made by A. G. Menocal, a civil engineer, also of the United States navy. In 1889 the Maritime Canal Company was organized to construct the Nicaragua canal on the lines of the Menocal project. As there was, for a decade following, considerable enthusiasm over the Nicaragua canal scheme in the United States, the project of the Panama Company enlisting American capital, were anything but promising.

Nevertheless an auxiliary American company was organized. In the investigation of the French company's affairs which was made by the new American company, it was ascertained that of the $156,400,000 expended by the original company only $88,600,000 had been expended legitimately on the excavation and construction, the rest having gone in bribery and corruption. The second French company was started with a capital of 65,000,000 francs, about one half of which was expended cautiously on construction in four years. The second French company had abandoned the original plan of constructing a tidewater canal. Its plans contemplated the construction of a canal with locks.

The history of the isthmian canal project shows that faith in the Nicaragua route as the most practicable suffered a steady decline. This decline was due more than anything else, perhaps, to the uncertainty of the cost of carrying out the project. The first estimate of the Maritime Company was $67,000,000. After doing more or less work on the canal the Maritime Company ceased operations in 1893 for lack of funds. In 1895 Congress appointed the Ludlow Commission to examine and report on the Maritime Company's project. This commission placed the cost of the canal's completion at $133,472,893. The Walker Commission, appointed subsequently, increased the estimate to $140,000,000.

Up to the outbreak of the Spanish-American war the project of constructing an isthmian canal, while acquiesced in by the general public in the United States, had received ardent advocacy only in quarters where a special study of the subject had been made. But at the commencement of that conflict the people of the United States received an impressive object lesson on the need of a canal. That lesson was the historic trip of the battleship Oregon. With the declaration of hostilities American attention was absorbed by the possibility of the Spanish fleet under Admiral Cervera making a sudden attack on some one of the important cities of the Atlantic coast. At that time the Oregon, a newly constructed battleship, was on the Pacific station. It was considered desirable to have the ship added to the strength of the Atlantic fleet. Orders were sent to her commander, Capt. Clark, to bring her around Cape Horn, using all speed possible. The American people watched with anxiety the famous voyage. It furnished an argument for the construction of an isthmian canal more effective than a century of discussion.

But coincident with the making up of the American mind that a canal must be built, there came the conflict of opinion as to the choice of routes. Those who were interested in the Panama enterprise were quick to see the opportunity opened to them. When the commission that was appointed by President McKinley in 1899 to examine the American isthmus at every available point in order to determine the most practicable and feasible route for a ship canal went to Paris to examine the plans of the Panama Company, the company, realizing the improbability of its being able to raise sufficient funds in France to carry the enterprise to a successful conclusion, decided to face competition with the Nicaragua project before the Congress of the United States. At a meeting of the directors it was decided to transfer all of the property of the company, its rights and powers, together with those of the American auxiliary company, to a new American company. That company was organized under the laws of the State of New Jersey, with the title of the Panama Canal Company of America. The capital was fixed at $30,000,000 and the company was authorized to increase the amount if necessary. The arrangement which it made with the French company in taking over its rights, was to pay the shareholders of that company partly in money, but mainly in shares of the American company. The French company retains only an equity in the shape of a lien on a specified percentage of the profits remaining after the payment of all operating expenses and fixed charges and a dividend to the stockholders of the new company. An international commission of French, German, Russian, English, and American engineers, consulted by the French company in drawing up its plans, estimated the cost of completing the Panama canal at $102,000,000, if the two locks were made of a certain width, and $125,000,000 if the locks were wider. The extended concession from the Colombian government runs till 31 Oct. 1910, a bonus of $15,000,000 having been paid to secure the extension.

After the American company was organized and the proposition for a transfer was brought definitely before the French directors, so much opposition was developed to the surrender of an enterprise that had absorbed so much French enthusiasm and entailed such sacrifices on the French people that the directors were unwilling to shoulder the responsibility of carrying out the arrangement, and all resigned. The trustees of the De Lesseps company, in particular, were reluctant to sanction the total transfer of the entire management and control from France to the United States. A new board of directors was chosen, which continued the negotiations with the American company, and the transfer was made. Congress ultimately decided on the Panama canal route as the most feasible and practicable and passed the bill under which President Roosevelt was authorized to acquire the American Panama Canal Company's rights.

The price fixed that the United States government should pay the Panama Canal Company of America for its rights and privileges was $40,000,000. The cost of the completed canal was estimated at $184,233,358. Thus, the passage of the Act of Congress, approved 28 June 1902, "To provide for the construction of a canal connecting the waters of the Atlantic and Pacific Oceans," was the first decisive action taken by the United States Government to secure an isthmian canal. The second important step was taken 17 March 1903, when the Senate ratified the treaty that had been negotiated with Colombia to secure for our country the concession necessary for the canal's construction and management.

The law of 28 June 1902 authorized the President to buy out the New Panama Canal Company, negotiate a treaty with Colombia for a concession, and proceed by means of a commission with the construction of the Panama Canal. If unable to secure a satisfactory title to the property of the Panama Canal Company, or "to obtain by treaty control of the necessary territory from Colombia," the President was empowered to negotiate with Costa Rica and Nicaragua for a concession, and having secured the privileges desired, to construct the canal by the Nicaragua route. The purchase price to be paid the Panama Canal Company was not to exceed $40,000,000 (the valuation which the Isthmian Canal Commission had placed on the company's entire assets, including the Panama Railroad), and before paying over the money to the company the President was required to assure himself of the validity of the title to the property to be transferred and to await the exchange of ratifications of a satisfactory treaty with Colombia.

The first duty of the President was to investigate the title held by the Panama Canal Company and to determine whether it was a good one, free of encumbrance, and transferable to the United States. The attorney-general was promptly instructed to make this investigation, and his elaborate opinion, together with the data upon which his opinion was based, was laid before the President 25 Oct. 1902. The subject entrusted to the attorney-general was one of great importance, and his report is fortunately comprehensive, thorough, and entirely convincing.

Before the attorney-general made his inquiry, the validity and transferability of the Panama Canal Company's title had been investigated by the Isthmian Canal Commission and by the Senate committee on Interoceanic Canals. One of the important duties imposed upon the Canal Commission was to "ascertain what rights, privileges and franchises" were held by the Panama Canal Company, and "the cost of purchasing all of the rights," and of placing the canal under the control of the United States. Accordingly, one of the five committees to which the several departments of the commission's investigation were committed was the Committee on Rights, Privileges, and Franchises. The report of the Isthmian Canal Commission contains a full historical and analytical discussion of the subject of concessions. The relations of the original Panama Canal Company to the New Panama Canal Company were set forth, and the opinion expressed that the New Panama Canal Company was able to sell its concession and property to the United States, provided the representative of the rights of the old company, the "liquidator," gave his approval of the sale, and united with the new company in the offer to sell. Shortly after this report was made the New Panama Canal Company offered to sell out to the United States, and the liquidator gave his consent to the sale. The Commission prepared a supplemental report dealing with this offer, and came to the conclusion that the offer thus made was one that the New Canal Company was competent to make, and that Congress ought to accept.

The chairman and a majority of the Senate committee on Interoceanic Canals disagreed with the conclusions of the commission, but the report of the majority was criticised by the minority members of the committee in an ably written report that supported the conclusions reached by the Canal Commission. The latter was accepted by the Senate.

The treaty granting to the United States the concession and rights necessary for the construction, operation, and control of the Panama Canal was signed by Secretary Hay and the Colombian chargé d'affaires, 22 Jan. 1903, and ratified without change by the United States Senate, 17 March. It is a lengthy treaty, containing 28 articles, but is remarkable for the conciseness and directness with which each provision is stated. The Canal Commission did not consider it necessary for the United States to acquire sovereignty over the territory adjacent to the canal. The desirability of our country's having the sole and undivided ownership and control of the canal when constructed was emphasized, and the recommendation was made that the compensation to be paid by the United States should be definitely fixed either as a single payment or as a predetermined annual payment, or as a combination of these two methods. The treaty authorizes the New Panama Canal Company to sell out to the United States; exempts the Panama Railroad Company from its financial obligation to Colombia, and gives the United States a lease for a period of 100 years, renewable at the option of the United States, of a strip of land 10 kilometres wide across the Isthmus of Panama. The United States not only recognizes the sovereignty of Colombia over this leased strip, but "disavows any intention to impair it in any way whatever, or to increase its territory at the expense of Colombia or of any of the sister republics in Central or South America." The United States secures the right to construct the canal and harbors, to establish free ports at the termini of the canal, to maintain hospitals and drainage and sanitary works along the line of the canal and its dependencies, and to install waterworks and a sewerage system in Colon and Panama, with the authority to "collect equitable water rates during 50 years." Colombia agrees not to cede or lease to any foreign power any territory in the Department of Panama, and the United States guarantees that no country shall be allowed to seize such territory.

It is provided that the canal shall be neutral in perpetuity, in conformity with the treaty of 18 Nov. 1901, between the United States and Great Britain; but the United States secures the right to protect the canal. The new treaty in no wise limits the rights of the United States under the treaty of 1846–8 with New Grenada, by which we guarantee the neutrality of the isthmian transit route and the sovereignty of Colombia.

In the summer of 1903 came the unexpected rejection of the treaty by Colombia, and this put a new phase upon the question. It seemed possible that this act of Colombia might lead to the reopening of final negotiations with Nicaragua and Costa Rica for the construction of a canal by the Nicaragua route. At least, there arose again considerable discussion on the old problem of the two canals. The President was empowered to negotiate with those governments if unable to secure a satisfactory title to the property of the Panama Canal Company, as the Nicaragua route from an engineering standpoint was equally as practicable and feasible as the Panama route. The reports of the International Commission on Panama and of the Nicaragua Canal Commission exhaustively treat the subject of both canals, and a comparison of the two routes may be obtained by referring in this work to the illustration under CANALS, "Comparison of the Panama and Nicaragua Canal Routes." The canals projected on both routes have certain features in common. The greatest problem in both is the maintenance of the summit level and the control of the flood waters of rivers which are subject to extremely heavy freshets. In both cases the most favored plans sought to make the one difficulty cancel the other, the flood waters of the rainy season being stored by the erection of large dams across the course of the rivers, the dams being associated with spill-ways, or waste weirs, by which the impounded waters may be regulated between predetermined maximum and minimum levels.

The total length of the Nicaragua route from sea to sea is 186.5 miles; the total length of the Panama route is 49 miles. But although nearly four times as long as that of Panama, the cost of the Nicaragua route is nothing like proportionate to its greater length, the estimated cost of its construction exceeding by $6,000,000 only, the estimated cost of the Panama Canal. The controlling features at Nicaragua are the existence of a great deep water lake near the Pacific, and its connection with the Atlantic Ocean by the Rio Grande or San Juan, a river of considerable size and discharging in the rainy season an enormous volume of water. The canalization of this river to Lake Nicaragua, a distance of 49.64 miles, and the cutting of a canal from the western shore of the lake to deep water on the Pacific, 17.34 miles, through an elevation of 110 feet, are the labor problems of this route, the remaining 70.51 miles being supplied by the deep waters of Lake Nicaragua.

The successful revolt of Panama from Colombia in November, 1903, as fully described under PANAMA (q. v.), and the immediate recognition of the new republic by the United States and other governments, however, confined the canal question to the Panama route.

The provisional government of Panama at once arranged a new treaty with the United States government for the construction and control of the canal, differing from the treaty with Colombia in that the Canal Zone was enlarged, and greater powers granted to the United States. This, known as the Hay-Varilla Treaty, was signed at Washington 18 Nov. 1903 and ratified in Panama 2 Dec. 1903. By its terms the United States guarantees and will maintain the independence of the Republic of Panama. Panama grants the use in perpetuity of a zone 10 miles wide, and its exclusive control for police, judicial, and other purposes; cedes territory for subsidiary canals and the coast line within the zone; and if police and other matters in the cities of Panama and Colon prove unsatisfactory, the United States government may intervene. The canal is to be neutral and open to the world's commerce. For these grants, the United States was to pay $10,000,000 on the ratification of the treaty and $250,000 yearly beginning nine years after. The sovereignty of Panama over all her territory to be recognized.

Major-General Whitfield Davis was appointed head of the Canal Commission with gubernatorial powers within the zone, his assistants being William Barclay Parsons, N. Y., Wm. H. Burr, N. Y., Benjamin M. Harrod, La., Carl Ewald Crinsky, Cal., and Frank J. Hecker, Mich. The preparatory work of construction was begun on the plan of high-level locks, as favored by Congress in 1902. In this plan the physical difficulties of the Culebra cut through the continental divide near the Pacific, and the floods of the Chagres river, which latter flows down from the northeast, intercepts the line of the canal about its centre, and coincides more or less with the general route of the canal from the point of interception to its Atlantic terminus, had to be overcome. The problem was to be solved by cutting a tide-level canal for the first 16 miles from the Atlantic to Bohio, where a dam was to be thrown across the Chagres river, of sufficient height to form a great lake in the valley of the Chagres, at a maximum elevation of 90 feet above mean sea-level. Allowing for the greatest possible variation due to continued drought or to heavy freshets the level of the lake was to be maintained between the extremes of 82 feet as a minimum, and 90 feet as a maximum level above the sea at mean tide. The surplus waters of the rainy season were to be discharged over a weir 2,000 feet in length, built not far from the Bohio dam, the waste waters being conducted to the Atlantic partly by the Chagres river and partly by artificial channel. At Bohio a double lift lock was to be located with a total maximum lift of 90 feet. The line of the canal would traverse the Bohio lake thus formed for a distance of about 14 miles, or until it reached Obispo, where a set of gates 100 feet wide were to be placed. The purpose of the gates was to retain the waters of Lake Bohio should it at any time be desirable to drain off the waters of that portion of the summit-level lying beyond the gates. Passing through the gates the canal would enter the Culebra section, which consists of a great cut through the continental divide, about eight miles in length, with the Pedro Miguel locks at the Pacific end. A level 1.33 miles in length would lead to the Miraflores locks, by means of which the descent to the tide-level on the Pacific would be made, the distance from the Miraflores locks to the six-fathom line on the Pacific being 8.5 miles.

The average summit-level proposed was to be 85 feet above mean tide. This was to be secured by the Bohio dam, the most important structure of the high-level canal. The dam proposed by the French Panama Company was to have been of clay founded upon a variety of material — hard clay, soft clay, sand, gravel, etc. The Isthmian Canal Commission decided upon a core-wall-and-earth-dam, the core-wall to be carried down everywhere to rock, the latter being reached in places at a depth of 128 feet below sea-level. The cost of the dam was estimated at $6,369,640, and as it would probably take 10 years to build, it would be the controlling feature in the question of time required to construct the high-level canal.

On 19 Dec. 1904, however, the chief engineer of the Isthmian Canal Commission laid his report before the Congressional Committee of Commerce. He was in favor of a return to the original plan of a sea-level canal as the best and cheapest in the end. The cost was estimated at $300,000,000 and the time of construction 20 years.

Early in 1905 the Engineering Committee consisting of Messrs. Burr, Parsons, and Davis also issued a report recommending a sea-level canal, which they estimated could be completed in 10 or 12 years for $230,500,000. As outlined by them the canal is to extend 49 miles from the 36-foot depth mark in Colon harbor on the Atlantic to the similar depth mark in Panama harbor on the Pacific, and with a bottom width of 150 feet, is to be 30 feet in depth. A reference to the "Profile of the Panama Canal" on the map accompanying the article on PANAMA reveals the course of the canal and its natural features. The first section from the Atlantic to Bas Obispo is 29 miles of low, marshy, and unhealthful surface, thick with tropical vegetation; work here is facilitated by the considerable amount of excavation done by the French Company, and a stretch of completed waterway. The second and most difficult section of the canal is in the hill ground from Bas Obispo to Pedro Miguel, 7.91 miles, and is known as the Culebra Cut. It is so well chosen, however, that it affords the lowest crossing in the ridge between the oceans. The third section from Pedro Miguel to the Pacific, nine miles, is similar to the Atlantic side, low and marshy. The chief difficulties to be overcome are keeping the floods of the Chagres river under control and the cut through the rocky height of the Culebra ridge, the isthmian backbone and continental divide that rises 300 feet above sea-level, nine miles from the Pacific.

The intention of building the canal with high-level locks, as planned by Congress in 1902, was recommended to be waived in favor of a sea-level waterway. The general plan to construct the most important dam at Bohio was abandoned for the safer rock foundations at Gamboa where a dam 200 feet high was planned to be built, and a tunnel 10 miles long and 30 feet in diameter bored through the Culebra Ridge at a height of 132 feet to carry the surplus flood waters of the Chagres to the Pacific. Part of the canal would utilize the course of the Bohio Lake and the Obispo river. Although planned as a sea-level waterway, the tidal differences in both oceans necessitates a lock at Miraflores, a short distance from Panama. On the Atlantic side the tidal fluctuation is less than two feet; on the Pacific side 20 feet. The lock, built of concrete upon rock foundations would be 1,000 feet long, of twin construction, with guard gates and intermediate gates of steel. A breakwater at Colon to form an outer terminal harbor on the Atlantic side is also projected, and is to be built from rock quarried from the Culebra cut, the transport of which is facilitated by the Panama railroad built in 1855. The latter is, in the main, parallel to the course of the canal, and was acquired by the United States government as indispensable to the work on the canal.

In consequence of the recommendations a series of radical alterations were made in the United States programme for 1905, but, on March 30, Secretary Taft sent to President Roosevelt a drastic statement concerning the whole scheme, which was acted upon with such promptitude that an executive order was issued on April 3, reorganizing the Canal Commission.

The salaries of the Commissioners were resettled and their duties defined. Theodore Perry Shonts, Ill., was appointed chairman at an annual salary of $30,000; Charles E. Magoon, Neb., to act also as governor of the Canal Zone and as U. S. minister to the Republic of Panama, $17,500; John F. Wallace, Ill., chief engineer, $25,000; Rear-Admiral Mordecai T. Endicott, U. S. N., $7,500; Brig.-Gen. Peter C. Hains, U. S. A., retired, $7,500; Col. Oswald H. Ernst, corps of engineers, U. S. A., $7,500; Benjamin M. Harrod, $7,500. President Roosevelt issued a comprehensive list of instructions concerning the duties of the new commissioners and the administrative work of the canal, simultaneously with their appointment, and organizing at once the Executive Committee proceeded to Panama and assumed charge of the construction preparations with directions conveyed in a contemporaneous catch phrase "to make the dirt fly." The Executive Committee comprised three commissioners in charge of special departments. The chairman, Theo. P. Shonts, presided over the first department, embracing the fiscal affairs of the Commission, and the purchase and delivery of materials. Governor-Gen. Chas. E. Magoon superintended the second department, embracing the government of the Canal Zone and its sanitation, and the Chief Engineer had charge of the third department, embracing the engineering work of the canal. On June 29 it was announced from Washington that the resignation of Mr. Wallace, chief engineer, had been accepted, after a strongly-worded arraignment on public duty from Secretary Taft. He was succeeded by Mr. J. F. Stevens of the Chicago, Rock Island and Pacific Railroad, at the time acting with the Philippine Commission as railroad expert.

Among other recommendations of Secretary Taft was the formation of an advisory board to consider the best design of canal. A board of consulting engineers was appointed upon which were representatives of Germany, England, France, and the Netherlands, nominated by their respective governments at the invitation of President Roosevelt. The members were Gen. George W. Davis, chairman; William Barclay Parsons; W. H. Burr; Gen. Henry L. Abbot; Eugene Tincauzer (Germany); Édouard M. Quellenec (constructing engineer of the Suez Canal Staff); Adolphe Guérard (French); J. W. Welcker (Dutch); Isham Randolph, F. P.

Stearns, Joseph Ripley, W. H. Hunter (Manchester, England). After numerous sittings in Washington the board of consulting engineers divided in vote 17 Nov. 1905 on the plan of canal to be recommended to the President as follows: For a sea-level.— Gen. George W. Davis, chairman; William Barclay Parsons and William H. Burr (America), William Henry Hunter (England), Adolphe Guérard and Edouard M. Quellenec (France), Eugene Tincauzer (Germany) and J. W. Welcker (Netherlands). For a lock-canal — Gen. Henry L. Abbot, Joseph Ripley, Alfred Noble, Isham Randolph, and Fred B. Stevens (America).

Meanwhile, preparatory work proceeded upon the canal cuttings, large bodies of men and much new machinery being employed. But during the summer of 1905 the work of excavation had to be virtually suspended. The mortality had proved alarming, and Governor Magoon diverted most of the labor upon sanitary work, which should have been undertaken at the commencement. Considerable attention was devoted to the draining and oiling of marshes for the destruction of mosquitos propagating malaria and yellow fever, to the sewerage systems of the isthmus, and to a good water supply for the cities of Panama and Colon by the construction of a dam at the headwaters of the Rio Grande, with the result that the mortality from yellow fever was soon completely reduced. The housing, provisioning, and entertainment of the laborers in the zone were also arranged on a generous scale.

The report of the board of consulting engineers was submitted to the consideration of the Senate Committee on Interoceanic Canals, and extended deliberations took place upon the two problems of a high-level lock canal to cost $147,000,000, and not more than eight years to build, and a sea-level waterway to cost about $250,000,000 and from 12 to 15 years to build. Owing to the greater cost of and longer time for constructing a sea-level canal it was considered probable that the lock-canal plan would be recommended for the decision of Congres , a view supported by Secretary Taft, Chairman Shonts, Chief Engineer Stevens, and other members of the Isthmian Canal Commission. On 17 May 1906, the majority report of the Senate Committee on Interoceanic Canals in favor of a sea-level type of canal was submitted by Senator Kittredge. Concerning the division among experts as to the best type of canal, the report says that the following propositions were considered irrefutable: The ideal canal is one at sea-level; its construction would be attended with no more, and probably with less, hazard than one with locks and dams on doubtful foundations; the sea-level canal is safer and more convenient than one with locks; it would take but little longer time to build; it is the simpler and more economical in operation and maintenance.

The dangers to which a lock canal would be exposed in case of earthquake shocks such as had caused the recent disaster in San Francisco were emphasized. The report further asserted that while the cost of the lock canal is uncertainly estimated at about $190,000,000, the ultimate final cost of the sea-level plan as estimated by the majority is $250,000,000, but the cost of transforming the lock plan into a sea-level canal after the former is completed would be at least $200,000,000.

Ships of all classes could pass through the sea-level canal in eight hours, while half that time would be consumed in passing ships through locks alone.

On 15 June 1906, Congress in committee of the whole voted in favor of a high-level lock canal by a majority of 110 to 36, and on 21 June the Senate by a test vote of 36 to 31 also declared for a lock canal. President Roosevelt signed the bill on 29 June 1906.

Isthmian Games, so called because they were celebrated on the Isthmus of Corinth. Here was a famous temple consecrated to Poseidon, near which the Isthmian games were celebrated. On one side of the temple were the statues of the victors in these games, and on the other was a grove of pines. In the temple stood four horses, gilded all over, with the exception of their ivory hoofs; by the side of the horses were two Tritons, the upper parts of which were gilt, and the rest of ivory. Behind the horses was a car, with the statues of Poseidon and Amphitrite, of gold and ivory. Not far from the temple were a considerable theatre, and the stadium, of white stone, in which the games were celebrated. The whole isthmus was sacred to Poseidon, who was thence called *Isthmius*. According to the common opinion the Isthmian games were founded in honor of Palæmon or Melicertes, by Sisyphus, king of Corinth. When there was war between the states of Corinth and Athens a sacred truce was concluded, and the Athenians were solemnly invited to attend the celebration of the games. They were celebrated with the same splendor as the Olympian and other public games, in the first and third years of each Olympiad, probably in autumn; the athletic exercises were the same. The victors were at first adorned with wreaths of pine-leaves, but afterward with wreaths of dry and faded ivy. The pine wreaths were afterward resumed. Victory shed a lustre not only over the individual, but over his family and the community to which he belonged.

Istle, is'tl, or **Tampico**. This structural fibre is produced from several species of small agaves in Mexico, chiefly *Agave heteracantha*, and *A. lechuguilla*. The plants grow wild over a wide area of central and northern Mexico, the centres of the industry being located in the states of Coahuila, Tamaulipas, Nuevo Leon and San Luis Potosi. The fibre is extracted by the peons by hand labor and prepared by rudest methods. The filaments are harsh and stiff, but smooth, and in color a yellowish white, and form an admirable substitute for animal bristles in brush manufacture. Nearly 8,000 tons of the fibre is imported into the United States annually, worth almost half a million dollars. In Mexico the fibre is used for rough cordage and webbing (for saddle girths), and for sacks for the transportation of all kinds of merchandise. A litle fibre finds its way into this country to mix with the cheaper cordage fibres, but it cannot amount to very much in the figures of imports. The fibre is derived from the cogolla, or central spike of unopened leaves, these being separated by hand and each leaf scraped on both sides with a kind of dull edged knife, in order to release the fibre, which lies just under the epidermis. After drying, the fibre is sold at the haciendas, put up in bundles of about 75 pounds, and transported on the backs of pack animals to the neighboring towns, where it is sorted, baled, and sent by rail to the port of Tampico for shipment, hence the commercial name Tampico. For further information see article on Istle Fibre in Mexico, Scientific American Supplement, (1902). See CORDAGE: CORDAGE INDUSTRIES: FIBRE: MEXICO.

CHAS. RICHARDS DODGE.

Itacolumite, ĭ-tạ-kŏl'ū-mīt, also known as flexible sandstone, is a mineral curiosity. It is a light colored, laminated-granular quartzite containing besides quartz grains, mica, talc and chlorite. Usually thin bedded, pieces an inch thick or more have considerable flexibility. This property is attributed to the presence of thin laminæ of mica, talc, etc., and also to the shape of the sand grains which have interlocking angles, due to a secondary growth of the grains by deposition of silica. Itacolumite is found in Brazil, also at several localities in the southern Appalachians.

Itagaki, Taisuke, tī-soo'kä ē-tä-gä'kē, COUNT, Japanese statesman: b. Tosa province, island of Shikoku, 1838. He received a military education, and in the war of the Restoration (1868) was prominent in the imperial army. From 1871 until his resignation in 1873 he was a privy councillor to the emperor. He then became the centre of a movement for constitutional government which in 1877 addressed to the government a memorial asking for a representative assembly and broaching popular rights. Itagaki aimed at a system based on that of Great Britain or the United States, as opposed to the system based on that of Germany, drafted by the Marquis Ito and promulgated in 1890. But he would have been satisfied at first, it is said, with an assembly which quite excluded the popular element. He organized the *Jiyuto*, or Liberals, the first Japanese political party, which rapidly increased in numbers. In 1878 he became minister of public works, in 1880 minister of the interior, and in 1898 the Liberals united with the Progressists, led by Count Okuma, to form the so-called Constitutional party, which had a large majority in the lower house of Parliament. At the Mikado's request Itagaki and Okuma formed a cabinet, with Itagaki as minister of the interior. The cabinet resigned after six months, and the Constitutional party was separated into its original parts.

Italian Architecture. See ARCHITECTURE: ITALY.

Ital'ic Languages, the languages of ancient Italy, before it had become Latinized by the predominance of Rome. These are generally described as Umbrian, Oscan, Etruscan, and Latin. The three first only survive in some fragments and inscriptions. Thus the Eugubine Tables, seven tablets of brass discovered in 1444 near Eugubium, are engraved with a series of sacerdotal inscriptions in ancient Umbrian. Taken together they contain about 450 lines, reading from left to right, some in Roman, others in Etruscan letters. The most important fragment of the Oscan language is that inscribed on a bronze tablet discovered in 1793, and called the Bantine Table, from the neighboring city of Bantia. The Oscan Bantine inscription contains 36 lines, and is much more easy to interpret than the Eugubine Tables. The Oscan language was spoken in the south of Italy. Another important monument of Oscan is the Cippus Abellanus discovered in 1685. The bronze tablet of Agnone discovered in 1848 also contains an Oscan inscription. The Etruscan language is most difficult to all to interpret. The most important remains which are known were discovered in the neighborhood of Perugia in the year 1822. The inscription is engraved on two sides of a block of stone, and consists of forty-five lines. The learned are divided about its interpretation. The most copious and important of the legal fragments which exhibit the Latin language in its earliest form are the Twelve Tables (q.v.).